The Development and Psychometric Evaluation of the Perceived Physical Literacy for Chinese Elderly Questionnaire

by

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Dedication

This dissertation study is dedicated to my loving family and friends.

Thank you for providing me with constant love and encouragement throughout this journey.

Acknowledgement

Frist, I would like to thank the Eckburg Dissertation Fund for funding this study and the members of my dissertation committee for their helpful suggestions and guidance throughout the project. In particular, I would like to express my deepest and sincere gratitude to my chair and mentor, Dr. Barbara King for providing me with tremendous support and unlimited encouragement. Second, I would like to thank all the people who took time out of their busy schedule to help me with the recruitment process, data collection, data analysis, and questionnaire translation. I am grateful to all the Chinese older adults I interviewed, who generously shared their experience and views with me and spent their time filling out the questionnaires. Last but definitely not the least, I would like to thank all my friends, classmates, course professors, and School of Nursing faculties and staffs. I am so fortunate to have these people during my PhD journey.

Abstract

Physical literacy, a relatively novel concept, has been recently introduced in the field of older adults' physical activity (PA). This concept applies a holistic view of PA behavior. A physically literate person is motivationally, physically, strategically, affectively, socially, and knowledgeably prepared to be and stay physically active. However, no instruments to measure older adults' physical literacy existed.

The purpose of this dissertation study is to develop the Perceived Physical Literacy for Chinese Elderly Questionnaire and to establish its reliability and validity. An item pool for the questionnaire was generated from literature and interviews with Chinese older adults. Expert panel reviews and cognitive interviews were applied to establish the content validity of the questionnaire. A convenient sample of 388 Chinese older adults were recruited to assess the questionnaire's concurrent, predictive, and known-group validity as well as the internal consistency and test-retest reliability.

The final solution was a six-subscale 47-item self-report questionnaire. Consistent with the conceptual definition of physical literacy, the six subscales include motivation, physical competence, interaction with environment, sense of self, interaction with others, and knowledge and understanding. The perceived physical literacy scores was moderate positively correlated with the Perceived Competence Scale scores ($r = 0.68$, $p < 0.001$). The perceived physical literacy score independently correlated with participants' leisure-time PA score ($\beta = 0.25$, $p < 0.001$) and PA maintenance score ($\beta = 0.02$, $p < 0.001$). Older adults who reported more leisure-time PA participation (leisure-time PA score ≥ 27) and longer regular PA participation (≥ 5 years) had significantly higher perceived physical literacy scores ($t = -7.19$, $p < 0.001$ and $t = -6.76$, $p < 0.001$, respectively). The item-total correlation coefficients ranged from 0.53 to 0.74,

and the Cronbach's alpha of the questionnaire was 0.88, ranging from 0.82 to 0.91 for each subscale. The test-retest reliability for the questionnaire's six subscales ranged from 0.70 to 0.77.

The developed Perceived Physical Literacy for Chinese Elderly Questionnaire is the first known instrument to measure older adults' perceived physical literacy, which is a reliable and valid tool that can be used for future studies investigating Chinese older adults' physical literacy.

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Chapter 1 Introduction

China is the most populous county in the world and experiencing a dramatic increase in its aging population. Estimations indicate that by 2025 the number of older adults (aged 60 years and older) will exceed 300 million, accounting for one-fifth of the total population (China's Office of National Working Commission on Aging, 2018). As longevity increases, the burden of chronic diseases and healthcare costs are also climbing (Fang et al., 2015). In China, over 60% of older adults suffer from one or more chronic diseases (National Health Commission, 2017). Healthcare expenditures for older adults in China were 0.62% of the gross domestic product in 2011. By 2035, projections indicate this ratio will rise to 11.73% (Hu, 2014). Promoting the health and well-being of older adults has been identified as a critical public health concern and of economic importance for China (Fang et al., 2015).

Physical activity (PA) is an essential health-promoting behavior. Regular PA is associated with multiple health outcomes in older adults, such as reducing the risk of chronic diseases (e.g., cardiovascular diseases, cancer, diabetes), protecting cognition functioning, and preventing mobility decline (Bauman, Merom, Bull, Buchner, & Fiatarone, 2016; Warburton, Nicol, & Bredin, 2006). Evidence has shown that promoting regular PA benefits Chinese older adults' health-related quality of life (Bize, Jonson, & Plotnikoff, 2007; Zhang et al., 2015) and provides significant economic savings for China (Liu et al., 2017; Yu & Schwingel, 2018; Zhang & Chaabban, 2012).

In Chinese culture, PA has a long history of being used to prevent diseases and promote health (F. Li, 2016). Approximately 58% to 97% of Chinese older adults (aged 60 years and older) report participating in some form of PA every week (Fan, 2013; Gu, 2014; F. Li, 2016; Li, 2015). However, evidence has also revealed that only 12.0% to 40.7% of Chinese older adults

meet PA recommendations (90 minutes of moderate or vigorous leisure-time PA per week) (General Administration of Sport of China, 2015; Li, 2012; Zhang M, 2014) and only 10.8% of older adults 70 years and older regularly exercise (performed 30 min of moderate-to-vigorous leisure-time PA three times or more per week) (General Administration of Sport of China, 2015). Thus, promoting the adoption and maintenance of regular PA among Chinese older adults is urgently needed (Li, 2016; Li, Liu, & Harmer, 2016). Unfortunately, although an abundance of literature exists on describing the patterns and correlates of Chinese older adults' PA, a few empirical studies have investigated how to effectively promote regular PA among Chinese older adults. Further, evidence- and theory-based PA programs remain largely limited and we know little about how to facilitate Chinese older adult long-term PA engagement.

Physical literacy, a relatively new concept, has been recently introduced in the field of older adults' PA. Physical literacy is "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (International Physical Literacy Association, 2014, para.1; Whitehead, 2013a, p. 29). Physical literacy encompasses a holistic view of PA behavior - a person needs to be motivationally, physically, strategically, mentally, socially, and knowledgeably prepared to be and stay physically active. Theoretically, physically literate persons are more likely to be physically active over time (Whitehead, 2013a). Physical literacy was initially developed in the field of youth physical education and is already seen a promising strategy for promoting PA in youth. Studies found that physically literate children reported higher PA participation (Choi, Sum, Leung, & Ng, 2018) and were better prepared for overcoming environmental barriers to engaging in PA (Mateus, Santos, Vaz, Gomes, & Leite, 2015). Many organizations, research groups, and governments around the world have adopted physical literacy as a goal of youth

physical education (Edwards, Bryant, Keegan, Morgan, & Jones, 2017; Johnstone, Hughes, Janssen, & Reilly, 2017; McCarthy & Walker, 2017; Tompsett, Burkett, & McKean, 2014).

According to the concept, an individual's physical literacy may fluctuate or decrease over time because of their changing life conditions, such as health status, socioeconomic status, PA experience, lifestyle, and social and physical environments (Loitz, 2013). Therefore, developing physical literacy should be a journey that continues throughout one's lifespan—from cradle to grave. Further, individuals have different focuses on physical literacy development in different stages of life (Whitehead, 2010). Concerning older adults, efforts should sustain and improve their physical literacy level to overcome barriers that come with aging, thus maintaining a physically active lifestyle (Whitehead, 2013b).

Chinese older adults, like many older adults in other countries, face a number of health, environmental, and life challenges for engaging in PA during their aging journey, including reduced physical function, limited social support, and high caregiving demands for family members (Chen, 2010; Mathew et al., 2010). Physical literacy proposes that a physically literate individual has the capability to interact with various challenges to overcome or make adaptations to become and stay physically active (Loitz, 2013). Potentially significant impacts of physical literacy on older adults' adopting and maintaining a lifelong active lifestyle have been highlighted (Almond, 2013; MacDonald, 2015; Whitehead, 2010). Some researchers assert that being physically literate should be an ultimate goal for older adults' PA promotion programs (Almond, 2010; Jones & Stathokostas, 2016).

Increasing physical literacy may be a promising approach for promoting the adoption and maintenance of PA in Chinese older adults. However, we are still in the exploration stage of investigating older adults' physical literacy, as studies conducted on physical literacy in an aging

population are limited. Currently, there is no widely accepted measurement for physical literacy. Therefore, it is difficult to assess and chart the progress of an individual's physical literacy journey. An instrument for measuring physical literacy is still a 'missing piece' in physical literacy research (Longmuir & Tremblay, 2016). Physical literacy should be well operationalized and measured in the context of the targeted population group; otherwise, it would be difficult to apply this concept to practice (Edwards et al., 2018). Jones et al. (2018) proposed a physical literacy-oriented PA promotion model for older adults. The authors posited that reliable and valid instruments are urgently needed to measure the key components of older adults' physical literacy to determine the effectiveness of physical literacy-oriented PA programs. Therefore, this dissertation study aimed to develop a psychometrically sound instrument to measure Chinese older adults' perceived physical literacy. Creating a reliable and valid instrument will contribute to a knowledge gap in understanding and assessing older adults' physical literacy, facilitate older adults' physical literacy research, and may advance research in promoting Chinese older adults' long-term PA participation.

Purpose of the Study

The objective of this study was to develop a valid and reliable questionnaire measuring Chinese older adults' perceived physical literacy. The specific aims of this study were:

1. Develop questionnaire items to measure Chinese older adults' perceived physical literacy based on a review of the literature and item development interviews.
2. Establish the content validity of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire by using an expert panel review and cognitive interviews with Chinese older adults.

3. Establish the reliability (internal consistency and test-retest) and validity (criterion and known-group) of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire.

Theoretical Framework

Questionnaire development and psychometric assessment were based on the combination of the framework of the concept of physical literacy as proposed by Whitehead (2010) and the classical test theory (CTT).

Physical literacy is broadly understood as an individual's disposition and capability for lifelong participation in PA (Whitehead, 2013a). Physical literacy is a holistic, multifaceted construct, including affective, physical, social, cognitive, and knowledge components. According to Whitehead (2010), physically literate individuals demonstrate six attributes for PA engagement: 1. motivation; 2. confidence and physical competence; 3. interaction with the environment, 4. sense of self and self-confidence; 5. self-expression and communication with others; and 6. knowledge and understanding. These six attributes mutually reinforce each other (Whitehead, 2010). In this study, the generation of questionnaire items represents the six attributes of physical literacy. In this study, I used exploratory factor analysis to investigate whether the underlying factors of the developed questionnaire were consistent with the multi-attribute framework of physical literacy.

CTT, also known as the true score model, guided the psychometric assessment of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire. CTT focuses on the measurement instrument as a whole and assumes that although an individual's latent trait is unobservable, it can be estimated by an observed score with some error: measured/observed score (X; estimated true score that obtained by using a measure) = true score (T; unobservable

actual score of the latent construct intending to measure) + measurement error (E; random errors that are irrelevant to true change of the construct intending to measure; Wu, Tam, & Jen, 2016). Reliability and validity are two central concepts of a CTT view of measures (Loevinger, 1957). In CTT, reliability is the ratio of true score variance to the observed score variance and validity determines how well a measure records the true meaning or score of the construct of interest (Crocker & Algina, 1986). In this dissertation study, I utilized a series of qualitative and quantitative analyses to establish the validity (content, criterion, and known-group) and reliability (test-retest and internal consistency) of the Perceived Physical Literacy for Chinese Elderly Questionnaire to ensure the developed questionnaire was a consistent and stable instrument to measure Chinese older adults' physical literacy.

Definitions of Terms

Physical literacy. Based on Whitehead's definition of physical literacy (2010; 2013a), this study used a modified definition of physical literacy, which is the motivation, confidence, physical and social competences, and knowledge and understanding required by older adults that allow them to take responsibility for engagement in a variety of physical activities regularly in a range of environments throughout the aging life course.

The six attributes of physical literacy refer to:

1. Motivation: the positive attitude towards and intrinsic desire to engage in PA;
2. Physical competence: the physical ability to perform a variety of movement tasks;
3. Interaction with the environment: the ability to participate in PA under challenging environmental situations;
4. Sense of self: one's belief in their ability to undertake and maintain regular PA;

5. Interaction with others: the ability to exercise with and build supportive relationships with others;
6. Knowledge and understanding: the knowledge to evaluate, adjust, and enhance PA and the understanding of the value of being physically active.

Perceived physical literacy. Perceived physical literacy is an individual's perception and judgment of his/her physical literacy level.

Physical activity. PA is "any bodily movement produced by skeletal muscles that requires energy expenditure" (World Health Organization, 2010). It is an umbrella term that includes leisure-time PA, transportation, occupational, and household chores related PA, and participating in games, sports, or planned exercise.

Leisure-time physical activity. Leisure-time PA refers to PA performed during discretionary time, such as during leisure and recreation, with the key element being personal choice (Jones et al., 2012; Kandula & Lauderdale, 2005). The General Administration of Sport of China (2015) identifies regular exercisers as persons who participate in moderate-to-vigorous leisure-time PA at least three times per week for at least 30 minutes at a time.

Purposeful physical activity. In this study, purposeful PA is a range of PA that can energize and enrich lives (e.g., walking for exercise, gardening, dancing with friends) (Almond, 2010). Purposeful PA requires one's own choice with the intention of acquiring health, well-being, and social benefits aiming at a better quality of life.

Older adults. The law of the People's Republic of China on Protection of the Rights and Interests of the Elderly identified individuals aged 60 years and over as older adults.

Overview of Methodology

Following the measurement development process suggested by Lynn (1986), I developed and evaluated the Perceived Physical Literacy for Chinese Elderly Questionnaire. Consistent with the three specific aims for the study, the study consists of three stages. Figure 1 illustrates the questionnaire development process.

Stage 1—Questionnaire item generation. In this stage, I generated the questionnaire items by conducting individual item development interviews with 10 Chinese older adults and reviewing relevant literature and existing instruments related to the six attributes of physical literacy. Based on the integrated findings from the literature review and interviews, I constructed the Perceived Physical Literacy for Chinese Elderly Questionnaire (version 1.0), including the questionnaire instruction, item statement, and the response scale and options.

Stage 2—Establishment of content validity. In this stage, I invited seven experts (four university professors and three senior social sports instructors) to review the Perceived Physical Literacy Chinese Elderly questionnaire (version 1.0) developed in Stage 1. I conducted two rounds of expert panel review, and based on experts' ratings for each questionnaire item, I calculated the content validity index (CVI) for each item and the whole questionnaire (Lynn, 1986). I also conducted cognitive interviews with 15 Chinese older adults to assess and enhance the questionnaire's content quality. I refined the Perceived Physical Literacy for Chinese Elderly Questionnaire according to the results of expert panel reviews and cognitive interviews, after which I used the revised questionnaire (version 2.0) for further psychometric testing.

Stage 3—Questionnaire testing and refining. In this stage, I collected the data for questionnaire testing and refining using paper-and-pencil, face-to-face survey interviews with 388 Chinese older adults. Based on the results of the item-level and exploratory factor analyses,

I decided which questionnaire items needed to be retained or removed. Next, I carried out a series of quantitative analyses to explore the reliability (item-total and internal consistency) and validity (criterion and known-group) of the further refined Perceived Physical Literacy for Chinese Elderly Questionnaire (version 3.0). I tested the test-retest reliability of the questionnaire by administrating the survey twice at an interval of two weeks with 17 Chinese older adults.

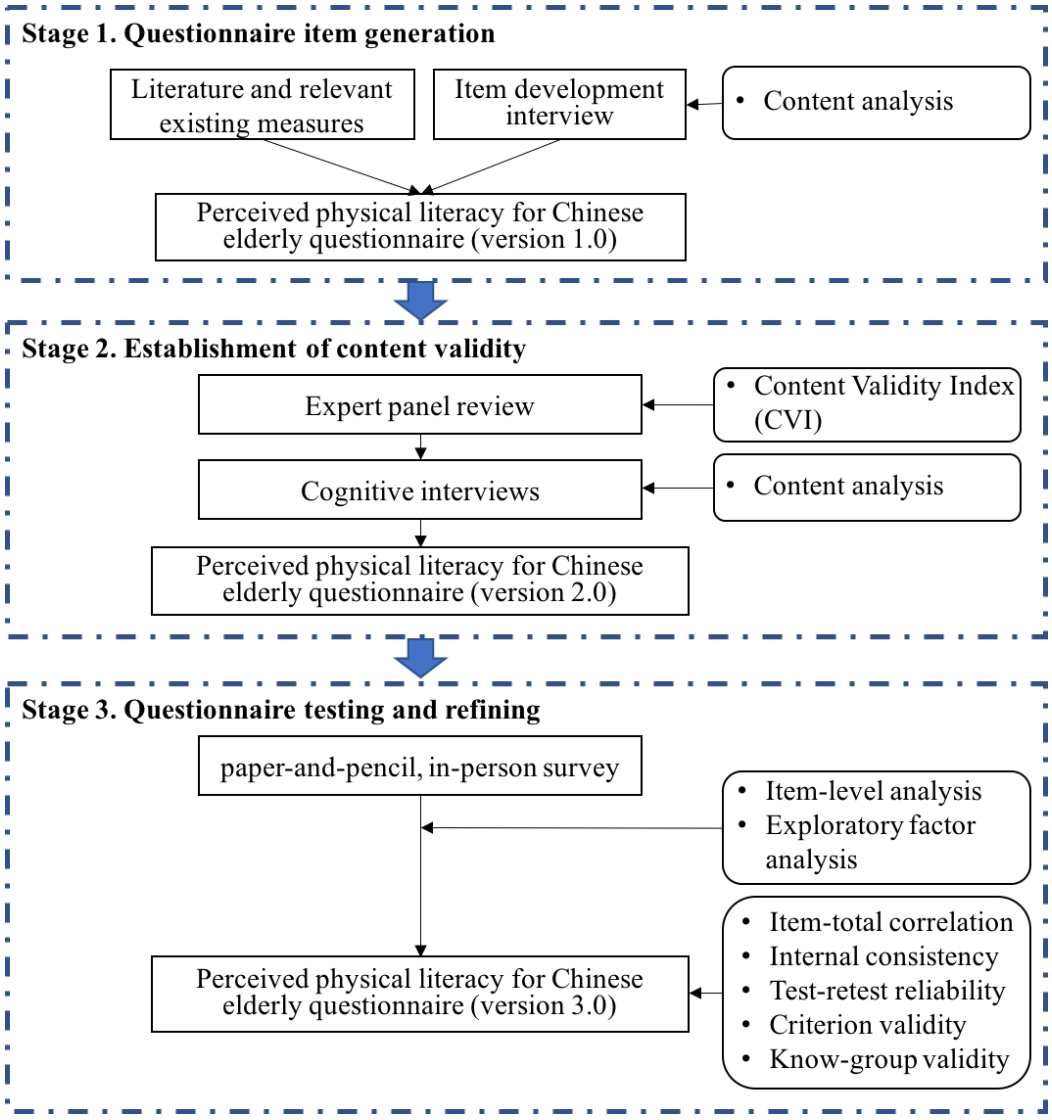

Figure 1. The process of questionnaire development

Chapter 2 Review of Literature

In this chapter, I present a critical review of the literature conducted for my dissertation research project. First, I conducted a review of the physical literacy literature to obtain a thorough understanding of the foundation, definition, and existing measurements for physical literacy. While conducting the review, I focused on how the concept of physical literacy was applied to older adults. As physical activity (PA) is a component of physical literacy, I identified I also needed to conduct an in-depth exploration of Chinese older adults' PA. Therefore, I conducted a second literature review of PA in Chinese older adults. After I conducted the literature reviews, I examined how my findings from a qualitative study on Chinese older adults' perception of PA I conducted before this dissertation study were reflected in the Chinese older adults' PA and physical literacy literature. Finally, based on the review of physical literacy, Chines older adults' PA literature, and my findings on Chinese older adults' perceptions of PA, I modified the conceptual definition of physical literacy to reflect the context of Chinese older adults' PA.

Review of Physical Literacy Literature

There is overwhelming evidence that PA is an important determinant of health. However, low PA is still common in all age groups worldwide, especially in high- and middle-income countries, such as the United States, the United Kingdom, Canada, China, and Brazil (Hallal et al., 2012). To address this issue, a collaborative effort has begun in many countries to develop initiatives to increase PA in individuals and larger populations. Increasing physical literacy has been identified as a means to promote lifelong PA participation (Aspen Institute, 2015). The concept of physical literacy has generated a significant amount of attention in recent years, especially in the field of youth physical education. In 1998, there was only one published

paper about physical literacy, but by 2016, the number had increased to 182 (Edwards et al., 2017). Globally, many educational organizations and researchers have adopted physical literacy as a primary focus for children's and adolescents' physical education (Corbin, 2016; Schools and Physical Activity Task and Finish Group, 2013).

The term 'physical literacy' is not new. As early as 1957, McCloy (1957a, 1957b) used the term in his two articles on physical education. However, the concept did not gain popularity until Whitehead (2001) redefined physical literacy in 2001. In the 1980s, researchers identified that an increasing number of young adults stopped engaging in regular PA after high school and that both youth's and adults' PA participation rates remained low in many developed countries (Craig, Russell, Cameron, & Bauman, 2004; Vertity, Alex, & Dollman, 2015). Recognizing the significant value of PA for health and human well-being, Dr. Whitehead proposed that we need to rethink the value of our bodies and PA from a new perspective and subsequently developed the concept of physical literacy (Whitehead, 1993; 2001).

Philosophical Background of Physical Literacy

To understand the concept of physical literacy, it is important to first understand its philosophical underpinning**s:** monism, embodiment, phenomenology, and existentialism. Physical literacy starts with a belief humans are holistic and embodied beings (Whitehead, 2010). Physical literacy views the human condition through a monist lens (Whitehead, 2001, 2010). Monism rejects the view of dualism. Dualism views humans as made up of two separable parts, the body and mind, where the body is inferior to the mind. In contrast, monism considers the body and mind as a whole (Merleau-Ponty, 1968). Informed by monism, Whitehead (2001) proposed that it was time for us to shift from a 'body-as-machine' view to the 'body-mind-world' as a means to understand movement and PA (Lloyd, 2016).

Often, the human body is perceived as a thing or an object, particularly in the fields of health and PA where we are predominantly interested in physical condition and performance of the body as a tool for us to participate in activities. Whitehead (2001, 2010) argued that the body is not only an object but a lived one; in that we live in, perceive, and experience the world through our bodies. Embodiment is a central notion of the concept of physical literacy. Physical literacy confirms the value of the 'lived body' or 'lived embodiment', and sees the body as the embodied dimension of human existence (Whitehead, 2008). The body "affords us interaction with our environment and provides the foundation for the development of a wide range of human capabilities" (Whitehead, 2010, p. 3). As a monist belief, the lived body/embodiment identifies that all human dimensions/capabilities are intricately woven together (Robinson & Randall, 2017). Humans are embodied beings. All human activities (e.g., thinking, feeling, and moving) are inseparable, interconnected, and embodied interactions with the world (Pot, Whithead, & Durden-Myers, 2018).

The importance of lived body/embodiment is founded in the fundamental views of existentialism and phenomenology. A premise of existentialism is that the existence and development of humans are through their ongoing interactions with everything in the world (Merleau-Ponty, 1968). From an existentialist perspective, physical literacy suggests individuals can gain meaningful experiences by interacting with a variety of environments during PA: "the richer the interactions, the more individuals develop their human potentials" (Whitehead, 2001, p. 129). Interaction experiences help us to learn and capitalize on our embodied potential, such as physical abilities, social abilities, and capacities to overcome environmental challenges (Durden-Myers, Whitehead, & Pot, 2018). Besides, according to phenomenology, every individual perceives interactions with the world based on their own previous interaction

experiences (Gill, 2000; Merleau-Ponty, 1968), and each new perception and interaction changes our knowledge and understanding of the world (Whitehead, 2010). Because we all have different interaction experiences, we perceive, interpret, and understand the world differently, making each of us a unique person. In physical literacy, each person is considered a unique embodied being with different abilities, preferences, goals, and experiences. There is no unified standard of physical literacy for everyone; each person has their own unique physical literacy journey (Pot et al., 2018; Whitehead, 2010). In summary, fundamentally, physical literacy is not a skill but an embodied disposition and capability "to use experience, understanding, and abilities to interact effectively with world" (Whitehead, 2004, p. 4).

The Definition of the Concept of Physical Literacy

This dissertation study adopted the integrated six-attribute definition of physical literacy proposed by Whitehead (2010, 2016). Currently, there is no one universal definition of physical literacy. Although many organizations, research groups, and governments are now promoting the concept of physical literacy, the definitions they have adopted differ. The majority of these definitions evolved from Whitehead's writings. In short, Whitehead (2016) described physical literacy as a disposition and capability that supports lifelong participation in PA. The concept of physical literacy views humans as embodied beings, valuing and signifying everything we do (Whitehead, 2007).

The definition of physical literacy continues to evolve. The most recent definition is, "physical literacy is the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life" (Whitehead, 2016). With this new definition, Whitehead further suggested outcomes of a physical literacy orientation, which include identifying the intrinsic value of PA, overcoming the

need to justify PA as a means to an end, and justifying the notion that PA is for all abilities (Robinson & Randall, 2017).

Moreover, Whitehead (2010, 2013) described the six core attributes of physical literacy. Individuals who are able to make progress on their unique physical literacy journey, demonstrate the following attributes: (1) motivation, (2) confidence and physical competence, (3) interaction with the environment, (4) sense of self and self-confidence, (5) self-expression and communication with others, and (6) knowledge and understanding. The description of each attribute is provided in Table 1 (Robinson & Randall, 2017; Whitehead, 2010).

Table 1.

Description of Physical Literacy Attributes

Attributes	Description
(1) Motivation	▪ A positive attitude towards and a desire to captialize physical potentilal and participate in PA to maximize quality of life.
(2) Confidence and physical competence	▪ The belief in one's own physical abilities to perform a range of PAs.
(3) Interaction with the environment	▪ The ability to read the environment and adapt one's movements as required by the environment.
(4) Sense of self and self-confidence	▪ A positive perception towards one's own abilities or qualities, which is often derived from positive PA-related experiences and comfort with embodiment.
(5) Self-expression and communication with others	▪ The ability to express oneself through non-verbal communicaiton, sense what others are feeling, and offer support.
(6) Knowledge and understanding	▪ The understanding of the benefits of PA on health, and the ability to describe and evaluate one's own movement and make enhancements.

It is important to note that, as a holistic concept, the attributes of physical literacy are all interlinked (as illustrated in Figure 2; Whitehead, 2010). Whitehead (2010) described the reciprocal interrelationships of attributes as the following:

- " Motivation (A) can encourage participation and this involvement can enhance confidence and physical competence (B). The development of confidence and competence can in turn maintain or increase motivation.

- Development of confidence and physical competence (B) can faciliate fluent interaction with a wide rage of environments (C). This effective relationship with the environment, with the new challenges this presents, can in turen enhance confidence and competence.
- The success of developing effective relationships with a range of environments (C) can add to motivation (A). This enhanced motivation can in turn encourage exploration and promote effective interaction with the environment.
- The other three attributes (D, E, F) can help to further the core attributes (A, B, C). For example, an assured sense (D) will feed into motivation and the willingness to accept challenges, while fluent interaction with others (E) adds confidence and the ability to work alongside others in PA settings. Similarly, knowledge and understanding (D) will support the appreciation of developing physical compentence and the perception of different environment." (pp. 14-15)

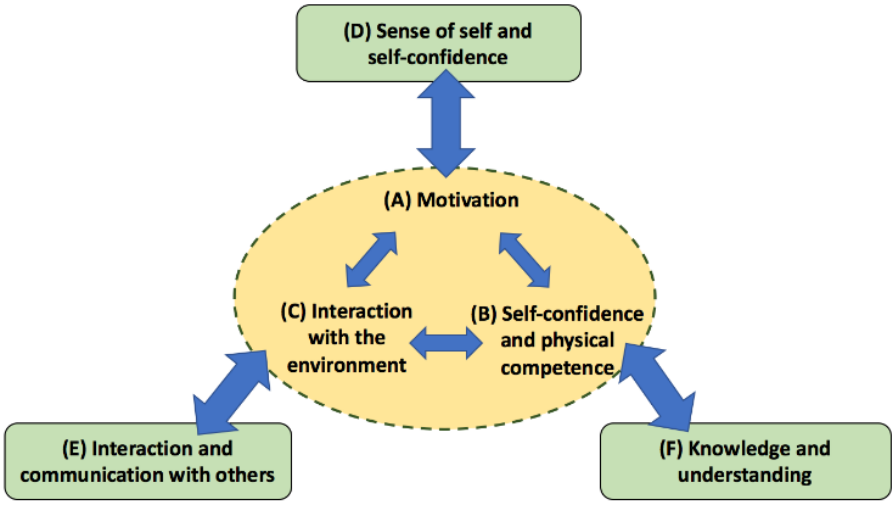

Figure 2. The conceptual framework of physical literacy

Other Definitions of Physical Literacy

The concept of physical literacy has been adopted by many countries and organizations, and they created their own physical literacy definition based on Whitehead's definition of

physical literacy (definitions are summarized in Appendix 1). Although the definitions are worded differently across the counties, similarities are evident. First, most definitions accept that having a lifelong PA is an overarching goal of physical literacy. Second, the concept of physical literacy was originally introduced in the field of youth's physical education. Therefore, mastering fundamental movement/sport skills (e.g., jumping, running, throwing) is a core idea present in the definitions. For example, in New Zealand and the Netherlands, the definitions of physical literacy focus only on developing physical competencies, such as fundamental movement skills or motor skills or sports (Spengler & Cohen, 2015).

Jurbala (2015) presented another perspective of physical literacy — communication should be central to physical literacy and movement should be purposeful, which is based on intention and mediated by emotion. Jurbala (2015) believed that movement is an expression that cannot occur without a prior 'reading' of the world, a gathering of information and an assignment of contextualized meaning. Jurbala proposed a communication-based definition of physical literacy, "the dynamic communication between the embodied self and the physical environment, which continuously integrates perceptive reading of, and appropriate response to physical challenges" (2015, p. 377).

Edwards et al. (2017) conducted a systematic review to summarize the available descriptions of physical literacy in published literature and identified six main constructs of the definition of physical literacy: (1) Affective (confidence, motivation, self-esteem); (2) Cognitive (knowledge and understanding of activities, knowledge and understanding of healthy and active lifestyles, value and taking responsibility for PA); (3) Physical capabilities (movement capacities, motor still competence, fundamental movement skills, purposeful physical pursuits); (4) Progression/developmental pathway (throughout the lifespan, unique journey, long-term

athlete development model), (5) Target audience (children, all can develop physical literacy, importance for adults); and (6) Holistic concept (read/interact with environment, movement with poise and economy). Edwards and colleagues (2017) suggested that it is crucial to consider all six aspects when defining physical literacy.

Related Concepts of Physical Literacy

Physical literacy and physical competence. Physical competence is defined as one's overall perception of personal physical abilities (Bell, 1997), which is tied to pure physicality. In contrast, physical literacy is a holistic concept, as it considers PA to be connected to emotion and cognition and not just to the physical body. Although having strong physical competence is an important characteristic for physically literate persons, Whitehead (2010) stated that physical literacy could not be replaced by physical competence or physical ability. Traditionally, literacy refers to being educated or cultured. In the dictionary, literacy is defined as "the ability to read and write" or "knowledge of a particular subject" (Cambridge Dictionary). More recently, the concept of literacy has expanded to include skills and strategies. The International Adult Literacy Survey (2001) identifies literacy as "an advancing set of skills, knowledge, and strategies that individuals build on throughout their lives in various contexts and through interaction with their peers and with the larger communities in which they participate" (p. 4). Currently, literacy is defined as a cumulative process that can be developed through experience and interaction. Whitehead (2010) argued that literacy is related to PA because it (1) encompasses doing, interpreting, responding, and understanding, (2) has holistic associations, (3) signals an interplay with our surroundings, and (4) has non-exclusive connotations (everyone can achieve this attribute at their own level).

Physical literacy and health literacy. Typically, physical and health literacy are described as separate but related concepts. The Institute of Medicine (2004) defined health literacy as "the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions" (p. 32). Both health literacy and physical literacy are subdomains of literacy (Corbin, 2016). Many of the stated characteristics of physical literacy are associated with health literacy, as a physically literate person has "an understanding of principles of embodied health, with respect to fundamental aspects such as exercise, sleep and nutrition" (Whitehead, 2010, p. 66). For example, Australia has adopted a new curriculum framework that combines health literacy with PA promotion associated with physical literacy (Lynch, 2015).

Physical literacy, physical activity, and physical function. PA refers to "bodily movement produced by skeletal muscles that requires energy expenditure and produces health benefits" (Caspersen, Powell, & Christenson, 1985, p. 127) and physical function is defined as "one's ability to carry out various activities that require physical capability, ranging from self-care (activities of daily living) to more vigorous activities that require increasing degrees of mobility, strength, or endurance" (Cella et al., 2010, p. 1180). Physical literacy has become a key focus of PA. Physical literacy is arguably an antecedent of PA, while also being developed through PA (Edwards et al., 2017). PA has been consistently demonstrated to generate considerable health benefits, such as enhancing an individual's physical function and decreasing functional limitations (McAuley et al., 2012). Meanwhile, people with better physical function are more likely to be physically literate due to a higher level of confidence and physical competence (Whitehead, 2013).

Physical Literacy among Older Adults

Physical literacy is a unique journey that individuals experience throughout their lifespan. This 'never-ending' lifelong journey is also referred to as a 'cradle to grave' concept, with an expectation to encounter success and setbacks along the way (Edwards et al., 2017; Whitehead, 2013a). Whitehead (2010) proposed that an individual passes through six different stages according to age in relation to the development of physical literacy: (1) preschool; (2) early and primary school; (3) secondary-school years; (4) early adulthood years; (5) adult years; and (6) older adult years. Whitehead (2013b) stated that "in older age, physical literacy needs to be sustained within the context of changes in the physical potential of the individual" (p. 55). Some articles specifically highlight the importance of developing physical literacy within adult and older adult populations (Almond, 2013; Jones et al., 2018; MacDonald, 2015; Whitehead, 2010). However, very few studies have examined adults' and older adults' physical literacy.

Brawley, Rejeski, and King (2003) summarized four research challenges in promoting PA for older adults: (1) individualized tailoring of programs; (2) readiness for and value of change; (3) successful maintenance; and (4) population-based activity promotion. Notably, introducing the concept of physical literacy may benefit all of these challenges.

First, gaining a better understanding of an individual's physical literacy journey can facilitate the development of individualized intervention strategies. Physical literacy suggests that everyone has a unique pathway to become physically literate (Taplin, 2013; Whitehead, 2010); there is no universal standard. Taplin (2013) suggested the use of a life-history method to create stories that illustrate one's physical literacy journey. The physical literacy journey stories can help researchers/health educators identify issues that need attention to develop a personally tailored intervention plan.

Second, assessing physical literacy may help us determine an individual's readiness for change. Physically literate persons have the disposition to participate in lifelong PA (Whitehead, 2010) and are affectively, behaviorally, cognitively, and physically prepared to be physically active (Robinson & Randall, 2017). Therefore, researchers and practitioners can measure an individual's physical literacy (having motivation, confidence, competence, knowledge, and understanding the value of PA) to identify if the person is ready for a change.

Third, physical literacy can help older adults maintain their PA when facing challenges that come with aging. Later-life major life events, such as a change in physical status, residence, and relationships, are a significant barrier for PA maintenance (Allender, Hutchinson, & Foster, 2008; Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011). Physically literate individuals have competence and confidence in a wide variety of PA in multiple environments. Developing older adults' physical literacy may increase their capabilities to make adaptations to initiate and continue being physically active (Loitz, 2013).

Last, developing and maintaining physical literacy can be a goal for population-based PA promotion for older adults. The concept of physical literacy has already been applied in population-based PA promotion among children and included in national physical education standards in a growing number of countries, such as Canada, the United States, and the U.K. (Johnstone et al., 2017; McCarthy & Walker, 2017). Using physical literacy as a goal may provide a more detailed structure and articulate direction for PA promotion interventions and policymaking (Dudley et al., 2017). Introducing the concept of physical literacy will assist researchers, practitioners, and policymakers in developing effective population-based PA promotion plans for older adults.

Although promoting physical literacy is a potentially promising strategy for increasing older adults' PA participation, it remains unclear how to facilitate the development of physical literacy among older adults. Jones and Stathokostas (2016) observed that most older adults have a narrow range of exercise choice. Most older adults only chose walking for exercise, and only approximately 31% of men and 24% of women meet the muscle-strengthening exercise guideline (two or more days a week), and 19% and 12% of men and women, respectively, perfomed balance training regularly (Strain, Fitzsimons, Kelly, & Mutrie, 2016). Therefore, Jones and Stathokostas (2016) suggested that we need to promote physical literacy for older adults by improving their physical movement skills. They further indicated that improvement of physical movement skills could increase self-confidence and create an opportunity for older adults to access a greater diversity of PA choices, thereby supporting active aging. However, evidence from systematic reviews shows that although a high level of fundamental movement skills consistently relates to higher levels of PA among children (Logan, Robinson, Wilson, & Lucas, 2012), fundamental movement skills have a low predictive value for PA in adults (Holfelder & Schott, 2014). Further empirical studies are needed to identify the relationships between fundament movement skills, physical literacy, and PA among older adults.

Almond (2010) proposed another perspective, which is promoting older adults' physical literacy by engagement in purposeful PA. Purposeful PA includes a range of PA that can energize and enrich lives (e.g., walking, cycling, and gardening) and enable people to feel they have greater vitality and dynamism. Almond (2010) suggested we should focus on the central role that purposeful PA can play in living life to the fullest, whatever a person's age. It is important for people to learn how to engage in purposeful PA, to make choices and select activates that can enrich their lives and improve their quality of life (Almond, 2010). Further,

people also need to learn how to appreciate, value, and learn from their PA engagement. Older adults must acknowledge that they are responsible for their own life choices and they have the ability and responsibility to make intelligent use of their time and efforts (Almond, 2010). This standpoint is in line with observations among Chinese older adults in a grounded theory study I conducted. I found that doing purposeful PA (e.g., walking to a grocery store instead of driving or taking care of a garden for fun and for exercise) was an important strategy used by Chinese older adults to stay physically active. Therefore, encouraging older adults to engage in purposeful PA may be a promising way to promote physical literacy. Unfortunately, few scientific studies exist to support this hypothesis.

Current PA interventions for older adults have already integrated the notion of physical literacy in their programs. For example, developing a greater understanding of physical literacy was adopted as a PA promotion strategy in the PLAY For Life program for older adults (Kitchen et al., 2018). Andy Kitchen and her colleagues (2018) developed a PA program aimed at promoting older adults' physical literacy movement preparation by enhancing their fundamental movement skills and physical competence. Recently, the Sunnybrook Health Sciences Centre (2018) proposed a study that would apply physical literacy in a PA program for fall prevention. However, these programs only use physical literacy as a tool rather than a goal and a framework to guide their interventions. To date in the field of older adults' PA, no comprehensive physical literacy-oriented intervention exists that applies physical literacy as a complete construct.

The Measurement of Physical Literacy

A variety of formal assessment criteria and tools are currently available for assessing some or all characteristics included in the definition of physical literacy. However, as mentioned previously, physical literacy was originally developed in youth physical education

programs. Therefore, almost all available physical literacy assessments were designed for children, especially for children under 12 years of age, with a focus on assessing children's fundamental movement/motor/sports skills. Whitehead (2010) has acknowledged the importance of physical competence and skills, but she also noted, "this attribute alone can never be the sole constituent of physical literacy" (p. 44). Indeed, comprehensive measurements that cover all aspects of physical literacy are required.

Canada has embraced the concept of physical literacy for many years. A number of institutions have developed a variety of physical literacy assessments. Currently, two comprehensive assessments for evaluating children's physical literacy exist in Canada, the Physical Literacy Assessment for Youth (PLAY) tool (Canada Sport for Life, 2015) and the Canadian Assessment of Physical Literacy (CAPL; Healthy Active Living and Obesity Research Group, 2013).

The PLAY instrument is a comprehensive measure with a focus on skill development for youth and includes five tools: (1) PLAY Fun—a movement assessment tool that measures 18 land-based skills by trained observers; (2) PLAY Self—a self-report of physical literacy, including the participation in environments, various subdomains of physical literacy (self-efficacy, confidence, comprehension, etc.), and relative importance of literacy, numeracy, and physical literacy; (3) PLAY Inventory—a self-reported checklist of participation throughout the past year; (4) PLAY Coach—a surrogate report by the physical education teacher of the child's physical literacy; and (5) PLAY Parent—a parental report of the child's overall physical literacy.

The CAPL is a physical literacy assessment program for youth aged 8–12 years. CAPL assesses the core domains of daily activity behavior, physical competence, knowledge and understanding, and motivation and confidence. Trained observers assess children and ask them

to answer self-report questions. It is interesting to note that the scoring classification of CAPL is based on progress on the journey towards becoming physically literate. In each physical literacy domain, youth are rated using a 4-point classification (beginning, progressing, achieving, and excelling) rating rather than using scores/points. Both PLAY and CAPL include objective assessments and self-report measures, and both were developed through extensive consultations with experts, teachers, and professionals. However, the validity and reliability of the tools have not been fully established (Longmuir et al., 2015; Robinson & Randall, 2017).

Currently, no comprehensive instrument is available for measuring older adults' physical literacy and only one physical literacy measure for adults exists. The Perceived Physical Literacy Instrument (PPLI) developed by Sum et al. (2016) measures physical education teachers' physical literacy. This nine-item measure includes three factors that correspond to three core attributes of physical literacy (motivation, confidence and physical competence, and interaction with others; Whitehead, 2010). The authors used both a review of the literature and focus groups to gather information for item generation. The Cronbach's alpha of the final scale was 0.82 and factor analysis showed the tool had good construct validity. However, the authors conducted both exploratory and confirmatory factor analysis using the same sample data, and therefore further validity testing of the instrument is needed. Although the PPLI is for adults, it still focuses on the fundamental movement of skills for sports rather than general PA. The authors identified the PPLI has the potential to be used to measure perceived physical literacy in other populations. However, the generalizability of this instrument may be limited to physical education teachers or others who may already have rich PA knowledge and experience. Some PPLI items, such as "I am confidence in wild/natural survival" and "I am able to apply PE

knowledge in the long run" (Sum et al., 2016, p. 4), might be difficult for respondents with limited PA experience to answer.

Debate remains around assessing physical literacy. Robinson and Randall (2017) suggested that we must recognize physical literacy as a multidimensional construct, and an effective physical literacy assessment instrument should address the four domains of physical literacy, affective (motivation and confidence), behavioral (lifetime engagement), cognitive (knowledge and understanding) and physical (physical competence). A systematic review conducted by Edwards et al. (2018) summarized current (up to June 2017) measures used to assess physical literacy or physical literacy-related constructs. They found that almost all existing measures were developed only for young children and failed to measure physical literacy in a holistic manner; only two measures (PLAY and CAPL) have attempted to capture all the domains within physical literacy. In current studies, qualitative approaches, such as interview, observation, and reflective diary, were mainly used to measure the cognitive (knowledge and understanding) and/or affective (motivation and confidence) domains of physical literacy. Meanwhile, quantitative approaches, such as objective measures (e.g. pedometer, anthropometric measure, and the agility and movement skills assessment) and questionnaires (e.g., International Physical Activity Questionnaire, Perception of Physical Activity Importance and Children's Ability Questionnaire, and the Nutrition and Physical Activity Self-Assessment of Child Care) were mainly applied to assess the physical domain (physical competence) of physical literacy (Edwards et al., 2018). Although interactions with social and physical environments are central to the philosophical underpinnings of physical literacy, only a few studies (Bélanger et al., 2016; De Rossi, Matthews, MacLean, & Smith, 2012; Millington, 2015) captured the social domain (the social interaction with others during PA)

of the concept by using qualitative approaches (e.g., interview, participant observation, and video recording; Edwards et al., 2018). In addition, it is difficult to determine the reliability and validity of current quantitative measures because most were not originally developed for measuring physical literacy. Edwards et al. (2018) summarized that physical literacy must be measured as a holistic and comprehensive concept with all domains of physical literacy included. Reliable and valid measurements are needed for assessing young adults', adults' and older adults' physical literacy.

The purpose of this dissertation is to develop a questionnaire to measure older adults' perceived physical literacy that includes all six attributes of physical literacy: motivation, physical competence, interaction with environment, self-confidence, interaction with others, and knowledge and understanding. It is worth noting that physical literacy is neither a discovery nor an innovation (Jurbala, 2015). Physical literacy can be seen as an integrated body of embodied human disposition and capabilities of being physically active (Whitehead, 2010). Each attribute in physical literacy is not a new concept. Therefore, for developing physical literacy assessments, we can borrow from existing measures to inform the generation of physical literacy measurement items. For instance, many studies have already explored PA motivation, and several well-developed instruments, such as the Exercise Motivations Inventory scale (Dacey, Baltzell, & Zaichkowsky, 2008), Exercise Motivation Scale (Li, 1999), and Behavioral Regulations in Exercise Questionnaire (Mullan, Markland, & Ingledew, 1997), have been used to measure individuals' motivation towards PA. Morgan, Bryan, and Didffey (2013) implemented a physical literacy-oriented program among children and utilized three subscales of the Intrinsic Motivation Scale (McAuley, Wraith, & Duncan, 1991) to assess the affective domain (motivation and self-confidence) of physical literacy. In this dissertation study, existing self-

reported measurements relevant to the attributes of physical literacy were referenced to begin generating items for the Perceived Physical Literacy for Chinese Elderly Questionnaire.

In summary, physical literacy suggests that we all have the embodied potential of being physically active lifelong. The exploration of older adults' physical literacy is still in its infancy. To understand older adults' physical literacy journey and to evaluate the effectiveness of physical literacy-oriented interventions, a reliable and valid comprehensive physical literacy measurement is needed. If physical literacy is to be applied to older adults' PA, physical literacy should be first explicitly operationalized within the context of older adults' PA. Items created for the Perceived Physical Literacy for Chinese Elderly Questionnaire were generated from a grounded theory study I conducted to understand Chinese older adults' PA. The aim of my grounded theory study was to explore how Chinese older adults' understood PA and actions they took to engage in PA. In addition, based on a review of the literature, my conceptual definition of physical literacy was modified to reflect the context of Chinese older adults' PA to guide the development of the Perceived Physical Literacy of Chinese Elderly Questionnaire.

Review of Chinese older adults' Physical activity

The rapid industrialization and urbanization of China have brought an increase in aging and chronic diseases (e.g., heart disease, hypertension, cancer, and diabetes) among the Chinese population (Li, 2016). By 2017, over 240 million Chinese people were aged 60 years and older. Of older adults, more than 150 million had at least one chronic condition and 41 million had disabilities (Renmin University Elderly Research Center, 2018). This situation has created an urgent need for primary prevention efforts aimed at promoting healthy aging and preventing chronic diseases among the aging Chinese population.

PA has been found to be crucial for preventing many chronic health problems and for promoting mental health and well-being in the later years of life (Chodzko-Zajko et al., 2009; Nelson et al., 2007). Globally, a great amount of research has been conducted to gain a better understanding of and to promote better practices regarding older adults' PA. In China, although the number of studies on PA in older adults has increased in recent years, studies are still limited in both scope and quality compared with many studies among the Western population (Zhu, Chi, & Sun, 2016). Gaps in scientific knowledge and evidence concerning how to get inactive Chinese older adults to initiate PA and to promote active individuals to maintain and increase their physically active lifestyle still exist.

PA Prevalence and Pattern among Chinese Older Adults

Obtaining a definitive description of Chinese older adults' PA prevalence and pattern has been challenging. Prior studies included a wide range of populations and settings, had limitations in study rigor, and used varying definitions and measures of PA.

Overall, past research findings identified that the majority of Chinese older adults preferred easy and low-intensity PA (General Administration of Sports of China, 2015). Further, the most popular exercise sites for older adults are parks, and the most common form of PA was walking and public square dancing (General Administration of Sports of China, 2015; Shen, 2015). The China Kadoorie Biobank study (Du et al., 2013) reported the average PA level was lower for the 60- to 79-year-old cohort, which averaged 13.38 MET-h/day, compared with the younger cohort (aged 30–59 years), which averaged 24.35 MET-h/day. In a national survey conducted by the Chinese Center for Disease Control and Prevention (Zhang, Chen, Wang, Wang, & Jiang, 2014), 71% of older adults (60 years and older) reported no participation in any moderate-to-vigorous leisure-time PA regularly (three times/week, ≥30 mins per time). In

another large-scale national PA survey conducted by the General Administration of Sports of China in 2014 (2015), results identified that 31.3% of older adults participated in moderate-to-vigorous leisure-time PA, but only 14.5% older adults were regular exercisers (who engaged in moderate-to-vigorous PA at least three times/week, ≥30 mins per time). In another large cohort study conducted among oldest-old adults (≥80 years) 61.6% of men and 80.8% of women reported no participation in any leisure-time PA (Shi et al., 2015).

Compared with the low PA participation rates reported in the above large national surveys, data from regional studies showed a higher proportion of Chinese older adults were physically active. For example, in a regional study conducted in Xinjiang (the largest province; located in the northwestern part of China), 47.3% of their respondents (older adults ≥ 60 years) engaged in PA regularly (more than three times a week and ≥30 mins per time), and 39.8% of respondents participated in moderate-to-vigorous PA (Wuma, 2016). This dissertation collected data in Kaifeng, Henan province (located in mid-eastern China and with the highest population among 30 provinces in China). A recent study conducted in Henan province showed that 37.58% of older men and 24.47% of older women were physically active (engaged in moderate-to-vigorous leisure-time PA at least three times/week, ≥30 mins per time) on a regular basis (Shen, 2015).

Factors Associated with Chinese Older Adults' PA

A few descriptive studies have investigated the influential factors that affect Chinese older adults' participation in PA. At an intrapersonal level, the literature reported that Chinese older adults who had higher educational levels, higher income, and younger age were more likely to engage in PA (Chen, 2015; Chen, While, & Hicks, 2015; Gu, 2014; Su, Zhang, Leung, Lam, & Chiu, 2015; Zhu, 2012). Poor health status was the most significant factor preventing older

adults from being physically active (Gao, Fu, Li, & Jia, 2015; Li, Du, Zhang, & Wang, 2013; Zuo, 2013). Chinese older adults with chronic conditions, such as arthritis, cancer, or cardiovascular diseases, perceived lower physical functioning and reported lower levels of PA participation (Zhang & Wang, 2013). Lack of PA experience, knowledge, and skills were the most common intrapersonal barriers experienced by Chinese older adults (Chen, 2015; Guo, 2015; Zhang, 2013). Correspondingly, lack of professional guidance in the community was also a significant barrier for most Chinese older adults to participate in various types of PA (Gu, 2014; A. Li, 2015; Shen, 2015; Zhang, 2014; Zuo, 2013). Chen (2015) reported that only 3.2% of respondents to a survey had received professional guidance about PA and over 50% of the respondents selected their PA by following others, 17% by following trends, and 3.3% based on health needs and professional suggestions (Chen, 2015).

At the interpersonal level, a qualitative study conducted by Li et al. (2013) found social support and encouragement from friends, families, and community were key factors in motivating older adults to initiate and maintain PA. Meanwhile, housework, family duties (e.g., taking care of a grandchild), and lack of leisure time were barriers for older adults, especially older women, to maintain regular PA participation (Fan, 2013; Kang, 2012; Shen, 2015; Tang, 2012; Zhu, 2012). Other studies have identified that Chinese older adults prefer to exercise with others (Chen, 2015; A. Li, 2015; J. Li, 2015; Li, 2012; Yang, 2012). Over 79% of older men and 84% of older women reported that they usually or always participate in PA with their families, friends, and neighbors (Shen, 2015), and approximately 57% of older adults considered middle size (5–10 people) group exercise (e.g., walking, dancing, and Tai chi) as their first PA choice (A. Li, 2015). Participating in group PA provides a means for socializing, which is an essential motivator for some Chinese older adults' PA engagement.

At the community and environment level, researchers have investigated community and built environment influences on Chinese older adults' PA engagement. Many older adults identified lack of public exercise facilities (e.g., walking or running tracks, cycle path, public exercise equipment, and open exercise field) as the most significant community-level barrier to PA engagement (Day, 2016; Fan, 2013; Yangyang Li, 2012; Yi et al., 2016; X. Zhang, 2013; C. Zhu, 2012). Cerin et al. (2013) found those who perceived that neighborhoods had good walkability reported higher levels of leisure-time PA. Another study estimated the impact of air quality on older adults' PA in Beijing (Yu, An, & Andrade, 2017). Findings from this study indicated that an increase in ambient particulate matter (PM2.5) concentration (PM2.5 is an indicator for air pollution higher value means worse pollution) by one standard deviation (56.6 μg/mÑ) was associated with a reduction in weekly total hours of walking by 4.69 hours. In addition, another study examined the relationship between Chinese older adults' perceptions of their social environment and their leisure-time PA (Gao et al., 2015), which found that older adults who perceived their neighborhood as having high social cohesion (participating in frequent social activities) participated in more (at least 150 min/week) leisure-time PA.

Results of a Grounded Theory Study on Chinese Older Adults' Experiences with PA

Although previous studies identified influential factors of Chinese older adults' PA participation, they did not explore *how* those factors influence Chinese older adults' PA initiation and maintenance. To gain an in-depth understanding of Chinese older adults' PA behavior, I conducted a grounded theory study prior to my dissertation study to gain a better understanding of Chinese old adults' perception and experience with PA participation. Findings from my qualitative study identified that Chinese older adults' PA engagement can be divided into three stages: (1) Getting started (Stage 1), (2) Participating in PA (Stage 2), and (3) Making PA as part

of life (Stage 3). Figure 3 depicts a conceptual model illustrating the process of PA engagement in Chinese older adults. I will briefly summarize the findings from this study.

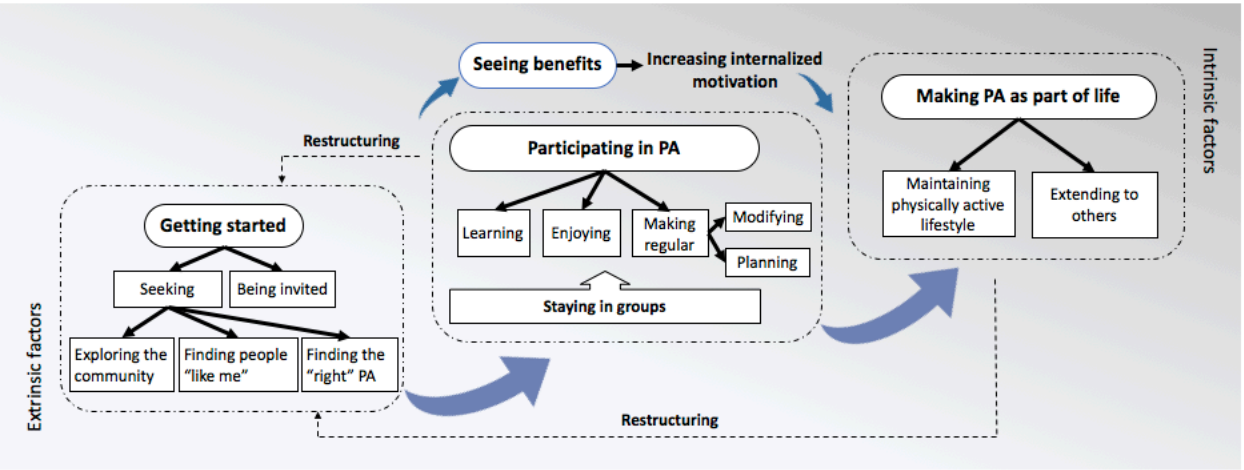

Figure 3. The framework of Chinese older adults' physical activity engagement

In the first stage, Chinese older adults who have an intention to take part in PA are often proactive in seeking opportunities and resources for PA. Persons in this stage engage in three main actions: (1) exploring the community for available resources; (2) looking for people 'like me' (same age, gender, with similar life experiences and shared interests) to exercise with; and 3) choosing the 'right' PA (PAs suitable for their age and health condition and they find enjoyable).

In the second stage, Chinese older adults begin to participate in PA regularly. To stay physically active, older adults (1) learn PA knowledge and skills by seeing and following role models, sharing and communicating with others (peers and families), and seeking information from the media (books, TV, and internet), (2) make their PA more enjoyable by doing PAs they are interested in and by exercising with others, and (3) try to make PA as part of their daily routine by planning (scheduling fixed time, place, and people for PA) and modifying (making adjustments in the amount and type of PA according to environmental situations) schedules. Further, being in groups was an important strategy used by many participants to be physically

active. Being in groups provided participants with learning and social opportunities, which helped to enforce the regularity of their PA. In the process of participating in regular PA, Chinese older adults continued to see the beneficial outcomes of PA, which increased their intrinsic motivation to continue being PA. Seeing benefits increased older adults' understanding, acceptance, and appreciation of the importance of PA.

For some participants, PA was a natural part of their daily life (Stage 3). These individuals integrated PA into their daily life activities. They also seemed to have strong intrinsic motivation for PA and created a supportive PA environment by inviting others (being group leaders, encouraging and convincing others to participate in PA) to join them in PA. People in this stage showed a positive attitude towards themselves and growing old.

PA engagement is a dynamic process. The findings from this study indicated that Chinese older adults may enter a 'restructuring loop' when a life-changing event, such as changing health status, moving to a new community, or getting new family duties, occurs. For older adults with strong intrinsic motivation for PA and rich PA experience and skills (individuals in Stage 3), restructuring was a relatively undemanding process. They had the ability to quickly grasp available opportunities around them, make appropriate modifications to accommodate the new situations, and return to their previous active level of PA.

Findings from this study align with physical literacy, in that physical, mental, social, and environmental components impacted whether Chinese older adults initiated and maintained PA and that consideration of the whole person (lived body) were important components for a physically active lifestyle.

Chinese Older Adults' PA and Physical Literacy

The majority of Chinese older adults participate in PA, but only 15%–35% meet the PA recommendation (moderate-to-vigorous leisure-time PA at least three times/week, and ≥30 mins per time) (General Administration of Sports of China, 2015; Guo, 2016; Shen, 2015). Therefore, the promotion of Chinese older adults' PA is urgently needed. However, we are still in its initial discovery phase of developing effective PA interventions for Chinese older adults. To date, very few PA behavior change theories have been tested in older Chinese populations and limited evidence-based, individualized, and culturally appropriate PA programs have been developed and implemented in China (Li, 2016). To guide future PA interventions and public health policy development, suitable theoretical frameworks and innovative solutions are needed. This dissertation study introduced a relatively new concept—physical literacy—into the field of Chinese older adults' PA. A physically literate person possesses motivation, physical competence, confiendece, knowledge and understanding, and the ability to interact with others and a rang of environments (Whitehead 2010, 2013). Fostering physical literacy may be an important solution to address issues that impede Chinese older adults' participation and maintenance of regular PA.

In our grounded theory study, we observed that extrinsic factors (e.g., improved sleep quality or blood pressure control) initially stimulated Chinese older adults' PA engagement. When older adults began to see the benefits of PA, they started building internalized motivation to continue to participate. Finally, when older adults entered Stage 3, Making PA as Part of Life, they were driven more by intrinsic factors (beliefs and wanting others to experience the benefits). Our findings suggest that facilitating internalization motivation should be a central component for Chinese older adults' PA promotion. Intrinsic motivation is also consistent with physical

literacy. Physically literate individuals are self-motivated and engage in PA mostly for the intrinsic values, such as pleasure, enjoyment, a sense of competence, and positive benefits for quality of life (Chen, 2015; Whitehead, 2010). For individuals to become physically literate, intrinsic motivation has to be stimulated to sustain lifelong PA participation (Chen, 2016).

Low physical competence is a main barrier for Chinese older adults' PA participation (Gao et al., 2015; Li et al., 2013). Many older adults only participated in low-intensity PA, such as light walking and cycling, because of concerns about their age and physical health status (Shen, 2015; Wuma, 2016). Physical competence is a core attribute demonstrated by a physically literate individual (Whitehead, 2010). Physical competence can increase one's self-confidence towards PA and provide access to a greater diversity of PA choices (Roetert & Ortega, 2018). Although physical competence is important, it is more interesting to note that physically literate individuals should also have an appreciation of their own physical potentials to capitalize on their physical competence (Whitehead, 2010). This point of view is valuable in older adults' PA promotion because of the natural decline in function associated with aging. Currently, most PA programs only focus on increasing older adults' physical competence. However, physical literacy believes that everyone, including those with physical and health limitations, has the ability to engage in a range of PA and recommends that it is also important to help older adults learn about their own physical potentials and how to use them. For instance, an older adult with a lower extremity mobility impairment may have the physical competence to participate in water-based PA and upper extremity exercises instead of a walking or dancing program.

A fundamental belief of physical literacy is that individuals develop their human potentials through their experience with interacting in varied environments (Whitehead, 2001,

2010). A physically literate person has the ability to read the environments, use past knowledge and experience to make a strategic decision, and adapt movements as required by the environments (Whitehead, 2010). Many Chinese older adults face a variety of challenging situations (e.g., increased family duties, poor air quality, and lack of PA facilities) that threaten their PA participation (Yi et al., 2016). From the physical literacy perspective, challenging situations or environments can be barriers to PA and opportunities for building one's physical literacy. Physical literacy-oriented PA programs help prepare participants for intrapersonal, interpersonal, and physical environmental challenges by encouraging them to proactively and strategically interact with challenging situations. In addition, the cumulative rewarding experience of effective interaction with environments can enhance one's positive sense of self, which further increases ones' motivation and willingness to overcome barriers and maintain regular PA (Whitehead, 2010). Significant correlation exists between previous PA experience and PA maintenance (Trost, Owen, Bauman, Salliws, & Brown, 2002). However, many Chinese older adults only begin to participate in PA on a regular basis after retirement and few have had PA experiences during their adulthood (Wang & Chu, 2015). Physical literacy suggests that initiatives should provide those 'new exercisers' with a range of PA experiences to improve their capabilities to interact with varied environments and build their self-confidence towards PA.

Previous literature has highlighted the importance of the social aspects of PA. Older adults' social ability, social network, and social support influence their PA engagement (Li et al., 2013; Yi et al., 2016). Many Chinese older adults view PA as a social activity and prefer to exercise in groups (A. Li, 2015; Yang, 2012). Our grounded theory study found that making friends and socializing with others were important motivators for Chinese older adults' PA participation. By exercising with others, Chinese older adults had more opportunities (e.g.,

transportation), information (e.g., advice and guidance), and emotional (e.g., encouragement) social support. In recent years, changes in living arrangements arising from family fragmentation, migration, and immigration of younger people, resulted in an increase of older adults living alone in China. Studies have shown that 'empty nesters' had lower social support, which is associated with a lower level of PA (Chen et al., 2015; Zuo, 2013). This suggests that PA programs for Chinese older adults should include encouragement and support for older adults' social interactions. Social support aligns with the proposition of physical literacy. Physical literacy recognizes that social interaction benefits PA. A physically literate person exhibits good social competence, "fluent interaction with others will add to confidence and the ability to work alongside others in physical activity settings" (Whitehead, 2010, p. 15). Physically literate-oriented programs encourage peer interaction, teamwork, and cooperation (Mandigo, Francis, Lodewyk, & Lopez, 2009) and create opportunities for participants to enhance interpersonal skills and develop supportive relationships with others (PHE Canada, 2011).

Finally, in China, most older adults have never received formal physical education and therefore many lack PA knowledge and skills (Z. Chen, 2015; Guo, 2015; Zhang, 2013). Often, older adults select types of PA simply by following others or trends rather than based on their health needs (Z. Chen, 2015). Knowledge and understanding is an important component of physical literacy (Whitehead, 2010). A physically literate person not only has a clear understanding of the value of PA, but also has the knowledge to evaluate one's own PA performance to make adjustments and improvements (Whitehead, 2010).

The Modified Definition of Physical Literacy

As described above, the majority of current definitions of physical literacy were developed within the context of children's physical education. To guide the development of the Perceived Physical Literacy for Chinese Elderly Questionnaire, I modified the definition of physical literacy within the context of how Chinese older adults' experience and understand PA. Physical literacy in this dissertation study is defined based on the definition and framework proposed by Whitehead (2010, 2013a) and modified according to the findings of the literature review and my previous grounded theory study (described prior).

The definition for physical literacy used for the creation of the Perceived Physical Literacy for Chinese Elderly Questionnaire is as follows: Physical literacy is the motivation, confidence, physical and social competences, knowledge, and understanding required by older adults that allow them to take responsibility for engaging in a variety of purposeful PAs regularly in a range of environments throughout the aging life course.

Compared with the original definition of physical literacy, "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (International Physical Literacy Association, 2014, para.1; Whitehead, 2013a), this dissertation added the statements "…a variety of…" and "…in a range of environments …" into the definition. Modification of Whitehead's definition was based on several factors. First, a longitudinal study found that adults and older adults who regularly participated in three or more types of PA at baseline were almost six times more likely to report being physically active after 22 years as compared with those who only participated in one to two types of regular PA (Borodulin et al., 2012). Our grounded theory study also showed that Chinese older adults in Stage 3, Making PA as Part of Life (physically literate), possessed

various PA skills and engaged in several types of PA regularly. However, the review of the literature showed that walking was the main exercise choice for the majority of Chinese older adults (63.4% to 78.7%; General Administration of Sport of China, 2015; Li, 2015; X. Zhang, 2013). Therefore, it is important to include many types of PA in the definition. Second, because older adults face many challenges (chronic illness, functional decline) in life, "…in a range of environments …" was added into the definition to highlight that to maintain regular long-term PA, older adults need to be able to remain engaged in PA under different challenging personal, interpersonal, and physical environmental situations. In addition, the term "purposeful physical activities" is used instead of "physical activities". PA is a broad concept, which is "any bodily movement produced by skeletal muscles that requires energy expenditure" (World Health Organization, 2010). For older adults' PA promotion, as suggested by Almond (2010), the focus should be on increasing purposeful PA that can energize and enrich lives. Older adults need to learn how to engage in purposeful PA (e.g., choosing to walk to a grocery store instead of taking the bus) and to select activates that can enrich their lives and improve their quality of life (Almond, 2010). Similar to Whitehead's (2010, 2013a) definition of physical literacy, the modified version developed for the Perceived Physical Literacy for Chinese Elderly Questionnaire also includes six attributes.

Motivation. Motivation refers to the positive attitude towards and intrinsic desire to engage in PA. Motivation is a fundamental attribute of physical literacy. A physically literate individual will have a positive attitude towards participating in a variety of PA and will take steps to be involved in PA on a weekly or daily basis (Whitehead, 2010). Motivation is driven by understanding, accepting, and appreciating the physical, psychological, and social benefits of PA. One assumption lies in this meaning: there are two types of motivation—intrinsic/internal

motivation (doing something because it is inherently interesting or enjoyable) and extrinsic/external motivation (doing something because it leads to a separable outcome; Ryan & Deci, 2000). The assumption is that a more physically literate individual has stronger intrinsic/internal motivation. An individual's intrinsic/internal motivation for PA can grow through participating in purposeful PA (Almond, 2010; Whitehead, 2013).

Physical competence. Physical competence refers to the physical ability to perform a variety of movement tasks. It is worth noting that although physical competence is a central attribute displayed by a physically literate person, this attribute alone can never be the sole constituent of physical literacy (Whitehead, 2010). Robinson and Pandall (2017) suggested that an assessment instrument of physical competence should provide a picture of the individual's varying fundamental movement skills. Fundamental movement skills are "those skills that provide us with the ability and opportunity to engage in quality physical activity, sport specific skills and activities of daily living" (Marduye, 2013, p. 1). The development of fundamental movement skills among children and adolescents usually focus on developing basic motor skills, such as running, catching, and swimming (Lubans, Morgan, Cliff, Barnett, & Okely, 2010). However, for older adults, the goal of developing fundamental movement skills should emphasize skills related to the activities of daily living. A physically competent older adult should have the ability and confidence to perform various daily activity tasks that represent either basic or advanced components of physical function (Overdorf, Coker, & Kollia, 2016).

Interaction with the environment. Interaction with the environment refers to the ability to participate in PA under challenging conditions. To maintain regular long-term PA, individuals must have the ability to read, understand, and interact with a wide range of challenging environments. In the original Whitehead (2013) definition, the environment

specifically refers to the physical environment, such as weather condition or the built environment (Sallis, Prochaska, & Taylor, 2000). However, an older adults' PA environment is more complex. Older adults often face many challenging situations, such as a change of health status, lack of social support, and limited community resources. In this dissertation study, environment refers to challenging situations (i.e., personal, interpersonal, and physical environmental situations) that may influence Chinese older adults PA.

Sense of self. Sense of self is described as a positive sense of self that results from one's appreciation of their own abilities. A physically literate older adult has strong self-esteem, self-efficacy, and a positive attitude towards aging as well as confidence for long-term participation in PA and achieving PA goals.

Interaction with others. Relationships with others refer to one's ability to exercise with and build supportive relationships with others. The original definition of this attribute was developed from the point of view of infant's and children's communication skills development, which focuses on the ability to express oneself nonverbally, sense what others are feeling, and respond appropriately (Whitehead, 2010). However, older adults have often developed communication skills and possess the ability to communicate verbally. Therefore, considering the social aspect of PA and shifting the emphasis on enhancing their social skills would be more appropriate. Both interpersonal relationships and social support can significantly influence older adults' PA engagement (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; McMahon et al., 2017). Thus, it is important for older adults to have the capability to estabilish supportive relationships, work well with others, and gain social support from others.

Knowledge and understanding. Knowledge and understanding refers to one's ability to reflect and evaluate one's needs and performance to take steps to make adaptation and/or

improve actions. Two assumptions lie in this meaning: (1) physically literate individuals have a clear sense of their own ability and an understanding about what they can do to make improvements in performance; and (2) they have the knowledge and understanding of health and the benefits of an active lifestyle so they can value and take responsibility for engagement in PA (Edwards et al., 2017; Robinson & Randall, 2017; Whitehead, 2010).

This modified definition of physical literacy serves as the conceptual definition that guided the development of the Perceived Physical Literacy for Chinese Elderly Questionnaire.

Summary

Overall, the literature on physical literacy and Chinese older adults' PA indicates that introducing the physical literacy construct may contribute to PA promotion among Chinese older adults. The goal of physical literacy is lifelong PA participation. Physical literacy posits that all individuals have the potential to develop physical literacy. Further, physical literacy considers the mind and body as a whole and identifies that an individual needs to be physically, cognitively, affectively, and socially prepared to be physically active for life (Robinson & Randall, 2017; Whitehead, 2010). Physical literacy may provide us with a new perspective on how to facilitate the initiation and maintenance of PA in Chinese older adults and guide the development of future PA promotion programs.

However, the exploration of older adults' physical literacy is in its infancy. There is a lack of valid and reliable instruments to measure older adults' physical literacy, as most measures do not relate to adults and older adults and many existing measures fail to capture the holistic and integrated nature of physical literacy. The purpose of this dissertation is to develop and evaluate a measurement of perceived physical literacy for Chinese elderly. Assessing Chinese older adults' physical literacy will help us identify whether Chinese older adults are

more likely to engage in regular PA and whether they are capable of staying motivated and using strategies to maintain PA into later life. The development of a valid and reliable instrument to measure Chinese older adults' perceived physical literacy is valuable for future studies investigating older adults' physical literacy by providing a tool for tracking participants' physical literacy journeys.

The next chapter describes the methodology that I employed to develop the Perceived Physical Literacy for Chinese Elderly Questionnaire and test the psychometric properties of the questionnaire.

Chapter 3 Methodology

This chapter describes the methodological approaches that I used in the dissertation study. With reference to the recommended conventional instrument development procedure (Lynn, 1986), the study utilized three stages as follows: Stage 1—Questionnaire item generation, Stage 2—Establishment of content validity, and Stage 3—Questionnaire testing and refining (Mishel, 1998; Portney & Watkins, 2009; Streiner & Norman, 2003). In Stage 1, I generated the candidate items for the questionnaire through literature reviews, referencing existing instruments on PA, and individual interviews with 10 Chinese older adults. In Stage 2, I enhanced and established the content validity of the questionnaire using the expert panel review and the cognitive interviewing technique. In Stage 3, I conduced a paper-and-pencil, in-person survey to collect data for assessing the psychometric properties of the developed questionnaire. Based on the results of item-level analysis and exploratory factor analysis, I made the decisions regarding which questionnaire items to retain or remove. Finally, I carried out a series of quantitative analysis to determine the reliability (internal consistency and test-retest) and validity (criterion and known-group) of the Perceived Physical Literacy for Chinese Elderly Questionnaire.

Study Design

The purpose of this dissertation study was to develop a culturally specific questionnaire for measuring Chinese older adults' perceived physical literacy and to test its psychometric properties. In this study, I employed the classical test theory (CTT) as the guiding principle for the instrument development (Strenier & Norman, 2008). Overall, this dissertation study is a nonexperimental, prospective, correlational, and descriptive study.

Measurement is a fundamental activity of science, which is the process of translating reality into numbers (DeVellis, 2012). According to Nunnally and Bernstein (1994),

measurement consists of rules for "assigning symbols to objects so as to (1) represent quantities of attributes numerically (scaling) and (2) define whether the objects fall in the same or different categories related to a given attribute (classification)" (p. 3).

The CTT is a theory that was widely used in social and health science for testing and measuring affective and abstract constructs (Polit & Beck, 2011). The CTT focuses on the measurement instrument as a whole and assumes that an individual's latent trait is unobservable but can be estimated by an observed score with some error: measured/observed score (*X*; estimated true score that obtained by using a measure) = true score (*T*; unobservable actual score of the latent construct intending to measure) + measurement error (*E*; random errors that are irrelevant to true change of the construct intending to measure) (Wu, Tam, & Jen, 2016). This theory proposed that the questionnaire items are roughly equivalent indicators of the same underlying construct/concept; the accuracy of a measurement can be improved through the item aggregation (DeVellis, 2012). The CTT is suitable for developing an instrument that measuring complex construct (e.g., physical literacy) with different dimensions — subscales of an instrument that need to be one-dimensional and internally homogenous to reflect the same construct (Polit & Beck, 2011). It is appropriate to adopt the CTT to guide the instrument development of the perceived physical literacy questionnaire, as physical literacy is a complex construct with inherently dimensions. Moreover, according to the CTT, the establishment of reliability and validity of the measurement is important when estimating both measurement error and true score. Therefore, in this dissertation study, I used both qualitative and quantitative methods across the three questionnaire development stages to establish the validity and reliability of the Perceived Physical Literacy for Chinese Elderly Questionnaire.

Protection of Human Subjects

University of Wisconsin-Madison's Human Subjects Institutional Review Board (IRB) granted approval prior to study initiation. This is a minimal risk study. However, one potential risk to participants is a loss of confidentiality. To protect confidentiality, I assigned a unique study identification number to each participant. Only the assigned study identification number was used on all data collection forms, interview recordings, and transcripts and questionnaires. Collected records (audio recordings, field notes, and questionnaires) were linked to individuals only through the unique study identification number. A master key that linked the study identification number to the participants' names and contact information was stored in a separate locked file drawer from other data collection forms. I did not collect any sensitive data from the participants. After completing the data analysis, I deleted all participants' names and contact information and shredded the hard copies.

All study data were collected in Kaifeng, China. During data collection, all digital data (audio recordings, transcripts, and entered questionnaire data) were stored on one password-protected laptop. I used one laptop to temporality store data for this dissertation study. The laptop did not connect to the internet or Bluetooth during the course of the dissertation study and was stored in a locked cabinet in a locked room at my residence. All hard copies of the data (filed notes, transcripts, and questionnaires) were stored in another locked file cabinet in the locked room at my residence. Only I had access to the locked cabinets. After completing data collection, I personally carried back all the hard copies of the anonymous data and the password-protected laptop to the University of Wisconsin-Madison. After I returned to Madison, Wisconsin, I placed all hard copies of the data in a locked file cabinet in a locked office in the

School of Nursing. I deleted all the digital data from the laptop after I uploaded them onto the School of Nursing's secured server.

Interviews (item development and cognitive interviews) were recorded on an encrypted portable digital audio recorder. After completing the interview, the recordings were immediately downloaded from the audio recorder onto my password-protected laptop. After the recordings were downloaded, the recordings on the portal audio recorder were deleted. The audio recorder was always with me during and after each interview until the recordings were downloaded and deleted. I transcribed all audio recordings. No personal identifiable information was present on any transcripts. Participants were asked to refrain from stating their names, family members' names, where they worked, or where they lived during the interview. If any personal information was inadvertently stated by participants, it was not transcribed into the transcripts. Only study identification numbers were used on all the transcripts. The data from the questionnaires were entered into an Excel spreadsheet using the assigned study identification number. The Excel spreadsheet was stored on my password-protected laptop in China and then uploaded onto the School of Nursing's secured server once I returned to Madison, Wisconsin.

Another potential risk for participants was cognitive fatigue. Since older adults may have chronic diseases, the 30- to 60-minute interview could be a burden for some older people. I was sensitive to limiting the interview to 60 minutes and observed participants' expressions and body language during the interviews for signs of fatigue. If participants showed signs of fatigue (e.g., excessive yawning, lack of focus, and slow response times) or reported fatigue, I stopped the interview and either took a five-minute break or rescheduled another meeting to complete the interview. In this dissertation study, only one participant showed fatigue during the cognitive interview process. I rescheduled another meeting time with the participant to complete the

interview. In addition, I informed all participants at the beginning of the interview that they were free to refuse to respond to any questions or withdraw from the study at any time.

Methods of Stage 1—Questionnaire item generation

The Perceived Physical Literacy for Chinese Elderly Questionnaire was designed to measure the degree to which a Chinese older adult has motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in a variety of PA in a range of environments throughout the aging life course (physical literacy). The purpose of Stage 1 was to convert collected information into a pool of questionnaire items. The potential pool of questionnaire items was identified through three approaches: (1) literature reviews; (2) item development interviews with Chinese older adults; (3) referencing existing related measurements (e.g., Intrinsic Motivation Inventory, Physical Function Scale, and Exercise Self-Efficacy Scale). At this stage, it is recommended to generate more items than needed (Bernstein & Nunnally, 1994). According to the CTT, item redundancy is acceptable during item generation because a similar idea expressed in somewhat different ways can better capture the concepts of interest and improve the reliability of the questionnaire (DeVellis, 2012).

Item Generation from Item Development Interviews

The goal of item development interviews was to gain in-depth information about how respondents (Chinese older adults) understand the construct of physical literacy and its attributes and what vocabulary/concepts they use to describe the construct.

Sample. In this dissertation study, I recruited all the participants in Kaifeng, Henan province, China. By 2018, the number of older adults (aged 60 years or older) in Kaifeng was approximately 780,000, which accounted for 15.6% of the total population (Civil Affairs Bureau of Kaifeng, 2019). The inclusion criteria for participants were (1) residents of the People's

Republic of China, (2) 60 years of age or older, (3) able to communicate in Mandarin Chinese, and (3) cognitively competent (the Abbreviated Mental Test (AMT) > 7; Lam, Wong, & Woo, 2010). Purposive sampling was used to recruit 10 participants. A sample size of 10 was appropriate, as qualitative studies for the purpose of item generation typically includes 5–10 subjects (Lynn, 1986; Sandelowski, 1995). Maximum variation sampling involves a purposeful selection of people with a wide range of variation of interest characteristics (Polit & Beck, 2011). I used maximum variation sampling to ensure that individuals with diverse backgrounds were represented in the sample. To ensure sufficient sample diversity, during participant recruitment, I asked potential participants their age range (60s, 70s, or 80s), education level (no school, ≤9 years of school, >9 years of school), and PA level (if met the PA recommendation of moderate-to-vigorous PA at least three times/week, ≥30 mins per time). For those expressing interest but were not selected for development interviews, I asked them if they were willing to participate in other research activities (cognitive interview or questionnaire survey). If they were interested, I asked them to leave their contact information for further contact.

Procedure. I recruited participants from one urban community (Da-xing) and one rural community (Tu-cheng) in Kaifeng, China in March 2018 using the following recruitment strategies: (1) One community committee staff (people that are hired by local governments to assist with managing basic community issues and familiar with the older residents in the community) and one senior community resident helped me to identify potential participants based on their familiarity with community residents. The community committee staff and the senior resident distributed recruitment flyers and asked potential participants if they were interested in learning more about the study. If older adults were interested, they notified me. I then contacted the interested older adults and further explained the study. (2) I posted

recruitment flyers with my contact information in community public areas (e.g., community entertainment room, bulletin boards, local grocery stores, and community yards/parks/squares). (3) I also used snowball sampling. I asked those already recruited participants if they knew other Chinese older adults in their community that might be interested in the study and if they could help introduce the study to other older adults.

The potential participants and I scheduled time and places to meet. The meetings took place in quiet, private locations preferred by the participant (e.g., community center meeting room, community clinic station's meeting room, quite tea store with private compartment, or participant's home). First, I asked older adults to answer the screening questions (age, communication ability, whether they lived in the community settings, if they had major psychiatric conditions, if had a diagnosis of dementia or acute health issues, and if they had difficulty hearing) and to complete the Abbreviated Mental Test–Chinese Version (AMT–C; Chu et al., 1995) to confirm their eligibility for participation (Appendix 2). If AMT–C scores were ≤7 (Lam, Wong, & Woo, 2010), I informed participants they did not meet the study criteria and suggested they see their health care provider for further cognitive examination. Those who met inclusion criteria were asked to provide consent. To enhance confidentiality, I only obtained participants' oral consent instead of written consent. I provided the participant with a written information sheet about the study, and gave them ample time to review the information sheet and ask questions about the study. For those older adults who had a low literacy level and/or vision problem, I read the information sheet to the participants. Then, I provided the participants a copy of the information sheet to keep and assigned a study identification number to those consented participants.

Instrument. I used the AMT–C (Chu et al., 1995) to screen the participants' cognitive eligibility (Hodkinson, 1972) (Appendix 2). The AMT–C consists of 10 items to test an individual's orientation to time and place, attention, calculation, and memory (Chu et al., 1995; Lam, Wong, & Woo, 2010; Woodford & George, 2007). One point is given for each correct answer. A total score ranges from 0 to 10. A higher score indicates better cognitive function. The cut-off point is 7, as a score ≤7 indicates abnormal cognitive functions (Lam, Wong, & Woo, 2010).

I conducted semi-structured interviews to investigate Chinese older adults' perception of physical literacy for item development using an open-ended question interview guide. The interview guide includes questions that cover the six attributes of physical literacy (motivation, physical competence, interaction with environment, sense of self, interaction with others, and knowledge and understanding). I developed the initial interview guide based on the literature review and discussions within the research group and further refined the interview questions according to the first two participants' interviews (see Appendix 3 for the interview guide). Participants' demographic information (e.g., age, gender, and education level) was collected at the end of the interviews.

Data collection. I conducted the interviews in Mandarin or in the local dialect based on participant's choice (the Kaifeng dialect is very similar to the standard Mandarin and people in the region generally have no difficulty understanding Mandarin Chinese). Interviews were all conducted by myself who has prior experience with qualitative interview techniques. The interviews lasted from 37 to 57 minutes and were all audio-recoded. After completing the interviews, participants received a ￥50 gift card (approximately 8 USD) as an appreciation for their time.

Data analysis. I transcribed the audio-recorded interviews for data analysis. Deductive content analysis is appropriate to use when the structure of the analysis is based on a specific structured knowledge (e.g., theory and model) (Elo & Kynagas, 2007). In this study, I chose to use the deductive content analysis to analyze the data, as the conceptual framework for developing the questionnaire was physical literacy (Whitehead, 2010). I analyzed the data following the analysis processes as described by Elo and Kynagas (2007): First, we read the transcripts multiple times for a thorough understanding of the meaning of the data. Second, we used a structured categorization matrix including six predetermined categories (reflects the six attributes of physical literacy) (Table 2) a lens in the analysis of the data. Third, we carefully viewed all the data for content. We highlighted and coded the text corresponding to the categorization matrix and grouped the codes into relevant predetermined categories in the matrix. For example, one participant talked about his attitude towards PA and said, "… I like exercise, very much. I enjoy the process of doing physical activities… it makes my mood better" (P4). I coded the statement as "gaining enjoyment" and "gaining mental benefits" under the motivation category.

I performed the initial coding and text categorization of all the interview transcripts. Another researcher (Shanshan Wang, a nurse researcher with prior content analysis experience) carried out the crosschecking of transcript coding. When the other researcher and I had different opinions on the codes, we discussed the points of divergence in coding together until we achieved consensus. The codes/elements under each category and the collected information from the interviews were later used to facilitate the development of the Perceived Physical Literacy for Chinese Elderly Questionnaire items.

Table 2

Categorization Matrix for Data Analysis

Category	What disposition and capacities does a Chinese older adult need to maintain a long-term regular PA?
Motivation - the positive attitude toward and intrinsic desire to engage in PA	●
Physical competence - the physical ability to perform a variety of movement tasks	●
Interaction with environment - the ability to participate in PA under challenging environmental situations	●
Sense of Self - the self-belief in the ability to undertake and maintain regular PA	●
Interaction with others - the ability to exercise with and build supportive relationships with others	●
Knowledge and understanding - the knowledge to evaluate, adjust, and enhance PA and the understanding of the value of being physically active	●

Item Generation from Literature Review

I conducted a review of the literature to identify the correlates of older adults' PA participation. This review summarized the known influential factors of older adults' PA and identified how these factors align with the six attributes of physical literacy. The aim of this review was to confirm and add additional knowledge to the item development interview findings for item generation.

Since published reviews on older adults' PA correlates already exist, instead of reviewing the original studies, I only reviewed those secondary publications (e.g., literature reviews and systematic reviews) regarding older adults' PA correlates. I searched four electronic databases, including PubMed, CINAHL, PsycINFO, and CNKI (from January 1999 to January 2018), using the searching terms ("physical activity" OR "exercise") AND ("aged," OR "older people" OR "elder" OR "older adults") combined with ("correlates" OR "predictors" OR "determinates") AND "review". As for the CNKI database, the translated Chinese terminology was used for

searching (i.e., 老人, 老年人, 运动, 健身, 锻炼, 综述, 总结). Then, I further screened all the retrieved potentially relevant studies in English and Chinese by reading the titles and abstracts. Studies that only focused on children, adolescents, and adults (<65 years old) were excluded along with discussion papers, editorials, letters, commentaries, and conference proceedings. Appendix 4 provides an overview of the searching process.

The data extracted from the included reviews were authors, publication year, age range of covered population, outcomes, and main findings. The correlates identified from each review were integrated and then classified based on the six attributes of physical literacy.

Item Generation from Referencing Existing Measures

I conducted a second literature review to identify existing self-reported instruments that are relevant to the attribute(s) of physical literacy and have been used in adults and/or older adults. Specifically, instruments that measured adults' and/or older adults' perceived (1) intrinsic motivation towards PA, (2) physical competence, (3) capability to continue PA participation under challenging environments/situations, (4) self-confidence towards PA, (5) PA-related social ability, or (6) PA-related knowledge and understanding.

To identify relevant measures, I searched PubMed, CINAHL, PsycINFO, and CNKI for quantitative, peer-reviewed studies published in English or Chinese within the last five years (between January 2013 and January 2018). The search terms (English or translated Chinese terms) included ("physical activity" OR "exercise") AND ("adults" OR "aged" OR "older people" or "elder", or "older adults") AND ("questionnaire" OR "scale") combined with ("intrinsic motivation" OR "internal motivation")/ ("physical competence" OR "physical function" OR "physical ability")/("barriers" OR "environment")/ ("self-confidence" OR "self-efficacy" OR "self-esteem")/("social ability" OR "social support" OR "social interaction")/

("knowledge" OR "understanding"). After removal of duplicated studies, additional studies were excluded if they (1) only targeted children and/or adolescents (⩽18 years), (2) focused on other issues rather than PA, or (3) did not use self-reported instruments to measure the concepts of interest. Next, the included studies were scanned to identify which measurement(s) were used. If the measurement was potentially relevant to the attribute(s) of physical literacy, the full copy of the measurement and the original publication that described the measurement were searched and retrieved for review. The data extracted from the measurement included the name of the measurement, target population to whom the measurement was originally developed, the aim of the measurement, and the structure of the measurement. Then, I carefully read the items in these existing measurements or the subscale(s) of existing measurements. Those items/elements that were potentially related to physical literacy attribute(s) but had not yet been identified from the item development interview and literature review were extracted to supplement the Perceived Physical Literacy for Chinese Elderly Questionnaire item pool.

Constructing the Questionnaire

Based on the findings in Stage 1, I began to construct the questionnaire. Typically, an instrument consists of item statements, response format (including rating scales and response options), and statement of instructions for completion.

Item statement. The major principles of item statement are: (1) maintenance of clarity, (2) preference for short statements, (3) avoidance of double negatives, (4) avoidance of double-barreled statements, and (5) all items worded in a uniform manner (DeVellis, 2003; Streiner & Norman, 2008). According the principles, first, I tried to write the item statements as clear as possible and to use older adults' own language and words in designing the statements, which to ensure that the vocabulary used in the questionnaire was easily understandable and to ensure

respondents can interpret the meaning of each statement accurately. Second, in order to reducing the complexity of the questionnaire items, I tried to use simple and short sentences (Foddy, 1993) and not put two or more ideas in a single item (e.g., How much do you value the physical and mental health benefits that physical activity brings to you?). Further, I avoided the double-worded negative statements and the statements containing universals (e.g., all, always, none, never) to increase the clarity of statements. Moreover, it is also recommended that the wording and formatting of items should be designed to match the questionnaire administration mode (Martin et al., 2007). Given the low education and literacy level among Chinese older adults, I decided to deliver the questionnaire using the face-to-face, pencil-and-paper, interviewer-administrated mode (Bowling, 2005). In present study, I designed the questionnaire in the style that matched the selected mode. I aimed to keep the language of the questionnaire less formal and worded the items the way people normally ask questions.

Response format. The rating scale and instrument format were considered simultaneously with generation of items so that the two were compatible. The most common rating scale is the Likert scale, which asks respondents to provide a rating indicating how strongly they feel positively or negatively on an issue (Likert, 1932). The response category of a Likert scale ranges from 2 to 19 points (Matell & Jacoby, 1971). Research has identified that as the number of response categories increases, both reliability and validity improve. The optimum number of response categories is between four and seven (Lozano, García-Cueto, & Muñiz, 2008). Another study suggests five or three-point response formats are more likely to be perceived by respondents as relatively quick and easy to use (Preston & Colman, 2000). Therefore, the developed Perceived Physical Literacy for Chinese Elderly Questionnaire used a Likert scale with a five-response category. The 5-point Likert scale is an ordinal scale level,

ranging from “1 = not at all” to “5 = extremely”. In addition, in this study, respondents were allowed to choose “I don’t know” if they had no experience, perception, and/or knowledge concerning the item in the question. Moreover, instead or using agree/disagree response options, I used the construct-specific response option in this study. The construct-specific response options require the response options be tailored to the particular construct of each item (Saris, Krosnick, & Shaeffer, 2005). For example, questions are asked as, “How important is physical activity in your daily life? Is it not at all important, a little important, somewhat important, very important, or extremely important?” rather than “How much do you agree with the statement that physical activity regularly is important in my daily life. Not at all agree, a little agree, somewhat agree, very agree, or extremely agree?” Saris et al.’s study (2010) indicated that questions with construct-specific response options avoid acquiescence, minimize cognitive burden, and increase the reliability and validity of self-report.

Statement of instruction for completion. The instruction for completion is an important component of a measurement (Tourangeau & Rasinski, 2000) that explains to respondents the purpose of the measurement and how questioning is performed. The term ‘physical activity’ was repeatedly used in the developed Perceived Physical Literacy for Chinese Elderly Questionnaire. PA is an umbrella concept and individuals may have different interpretations for this term. To keep in line with the perspective of physical literacy for this questionnaire, PA refers to purposeful activity. Purposeful PA is a range of activities that can energize and enrich lives (e.g., walking, gardening, and dancing with friends for exercise and for fun) and is performed with one’s own choice and intention of acquiring health, well-being, and social benefits to better quality of life (Almond, 2010; Whitehead 2013). To ensure all respondents had consistent and correct understanding of the term ‘physical activity’ in the questionnaire, I carefully explained

the term in the instruction for completion. The following was included in the instructions, "By physical activity, in this survey, we refer to the physical activities that you do by your own choice with an aim to keep fit, stay healthy, or have fun. For example, doing Tai chi, taking a stroll, brisk walking, biking, dancing, doing radio calisthenics, swimming, stretching, lifting dumbbells, and so on. Those activities that you have to do, such as household chores, farming chores, or activities required in your jobs, are not considered as physical activity at here". Further, I explained what constitutes "doing physical activity regularly" in the instruction, which is doing PA at least three times a week for half an hour or more each time.

At the end of Stage 1, a preliminary questionnaire for measuring Chinese older adults' perceived physical literacy was developed—the Perceived Physical Literacy for Chinese Elderly Questionnaire (version 1.0). The preliminary questionnaire was developed in Chinese and then translated into English by myself and back-translated into Chinese by an independent translator (Yi Sun, high school English teacher with a master's degree in English) who is fluent in both Chinese and English and had no knowledge of the instrument. Both the Chinese and English version were used for further instrument improvement.

Methods of Stage 2—Establishment of Content Validity

Content validity can be defined as the degree to which the selected items reflect variables of the construct in the measure (Chung, Wong, & Griffiths, 2007; Lynn, 1986). In Stage 2, content validity of the Perceived Physical Literacy for Chinese Elderly Questionnaire was assessed and further established using two approaches—calculating a content validity index (CVI) based on expert panel review and conducting cognitive interviews with Chinese older adults.

Expert Panel Review

Seven experts on Chinese older adults' PA and measurement development were approached and invited to evaluate the content of the developed questionnaire. Three experts were university/college professors with more than five years of research experience studying Chinese older adults' PA. Another three experts were senior social sports instructors (trained and certified volunteer PA instructors, consults to community residents, and communicators and organizers of community PA services**;** Tan, 2015) with more than 10 years of experience working with older adults in the community. One expert had experience developing PA-related self-report measurements.

Procedure. I invited the experts to comment on the adequacy of the items in capturing the referred physical literacy definition. With the provided definition of physical literacy, I asked experts to rate each item for relevance against the concept being measured and evaluate the clarity of each item (DeVellis, 2003). I also encouraged experts to provide comments and suggestions for the confusing and inappropriate items. Specifically, I provided experts a content validity rating form (Appendix 5) and asked them to assess each item's relevance using a 4-point ordinal scale (1 = not relevant; 2 = somewhat relevant; 3 = quite relevant; 4 = highly relevant) and clarity by choosing "clear (C)" or "not clear (NC)". I asked experts to provide written comments for problematic items receiving a rating of 2 or below and "not clear" items. At the end of the rating form, open-ended questions asked experts to comment on the overall comprehensiveness of the questionnaire and provide recommendations.

I conducted two rounds of expert panel review. The first round (with all seven experts) was conducted before the cognitive interview with Chinese older adults. After I revised the developed questionnaire according to the results from the first round expert panel review and the

cognitive interviews, I conducted the second round of expert review using the revised questionnaire (with five experts; two of three social sports instructors did not participate in the second-round review).

Data analysis. The item-content validity index (I-CVI) for each item and the scale average-content validity index (S-CVI/Ave) for the whole questionnaire were computed. The I-CVI is the proportion of experts who rated an item as 3 (quite relevant) or 4 (highly relevant), whereas the S-CVI/Ave is the average score of the I-CVI for all items (Lynn, 1986). The S-CVI/Ave of 0.80 was the minimum acceptable value for the content validity of the questionnaire (Lynn, 1986). Items that reach or exceed a predetermined I-CVI criterion (I-CVI = 1.00 with 3 to 5 experts and a minimum I-CVI of 0.78 for 6 to 10 experts; Lynn, 1986) on either attribution assessed were automatically retained in the measurement. Items that failed to reach the predetermined criteria were reviewed by the research team and considered for inclusion/revision or exclusion from the questionnaire.

Cognitive Interview

Cognitive interview is a qualitative method that incorporates a client-centered approach to questionnaire development (Subar et al., 1995; Willis, 2004). The main purpose of cognitive interview is to investigate if respondents understand/interpret the questionnaire items correctly and can provide accurate answers. In this study, I employed the cognitive interviewing technique to detect problems with the developed questionnaire items, identify the potential sources of response errors, and gain a richer understanding of the type of data that has been collected (Willis, 2004), which aimed to enhance the content validity of the developed questionnaire.

Sample. In this study, 15 Chinese older adults participated in the cognitive interviews. Inclusion criteria consisted of (1) residents of the People's Republic of China, (2) 60 years of age or older, (3) ability to communicate in Mandarin Chinese; and (3) cognitively competent (AMT > 7; Lam, Wong, & Woo, 2010). A sample size of 15 is appropriate for cognitive interviewing as recommended by Willis (2004)—5 for a single round and 15 across multiple rounds. Purposeful sampling by age, gender, education, and physically active status was employed to ensure that a range of information and perspectives was captured.

Procedure. The recruitment and consent procedures were the same as used for the item development interviews' in Stage 1. I recruited the participants in May 2018 in Kaifeng, China. I conduced all the cognitive interviews, and each interview lasted approximately 45–60 minutes. After the interview, participants received a ￥50 gift card (approximately 8 USD) as an appreciation for their time.

Data collection. I audio-recorded all the cognitive interviews. The cognitive interviews were semi-structured; I conducted the cognitive interviews using an open-ended question interview guide. During the cognitive interviews, I employed both thinking-aloud and probing techniques (Buers et al., 2014; Priede & Farrall, 2011). I asked participants to express their thoughts aloud about the item while answering the question. Besides, I used follow-up questions (probes) to obtain additional information about their understanding and interpretation of the items (Willis, 2015). For example, when participants were hesitating or having trouble describing what they were thinking about related to an item, I used the probes "You looked puzzled. Are any words or phrases confusing to you? Is there any other way to ask the question to make it clearer and easier to answer?". Thinking-aloud and probing techniques helped me understand if there were words in items that were hard for Chinese older adults to interpret, if

items were awkwardly worded, or if Chinese older adults were having difficulty retrieving information to answer the question. Both pre-scripted and spontaneous probes were used during the interview (concurrent) and directly after the interview (retrospective; Willis, 2004). Appendix 6 contains the interview guide with the probing questions. I developed the probing questions according to Beatty and Willis (2007)and Buers et al. (2014). Following each interview, I took the field notes to capture both participants' main areas of feedback and my reflections.

Data analysis. I transcribed the audio-recorded interviews verbatim for data analysis. I used directed content analysis to analyze the data because I already had a pre-determined coding scheme. Data analysis followed the structured approach outlined by Hsieh and Shannon (2005). First, based on the framework of the Question Appraisal System (QAS; Willis, 2015), a predetermined coding scheme was developed (Table 3) and the operational definition for each code was determined. The QAS included eight coding categories, each containing several subcategories, for a total of 27 possible codes related to 27 major sources of errors in survey questions. For example, for the item "How likely are you to stop doing physical activity regularly?" participants may have difficulty answering this question as the item is already assuming that the older adult already engages in PA regularly. Therefore, the item could be coded as "inappropriate assumptions". In this study, because the developed questionnaire did not contain open-ended questions and questions requiring participants to calculate numbers, two codes in the QAS, "open-ended question" (in the response category) and "computation" (in the knowledge/memory category), were excluded. Therefore, the predetermined coding scheme used in this study included seven categories and 25 subcategories.

Using the predetermined coding scheme, I coded the data first, after which the results of my coding were reviewed by another researcher (Yan Liu, a nurse researcher with prior content analysis experience).

I conducted one initial round of interviews with five participants and five subsequent rounds of interviews (two participants for each round) until data saturation (no more new problems occurred) was reached. Data analysis occurred after the first round of interviews, and I revised/modified the problematic items based on analysis results. Then, I used the original questionnaire items and the revised questionnaire items for the next round of cognitive interviews. During the following round, I asked participants to comment on whether the revised/modified questionnaire items were better than the original ones and if the items needed further modification.

Table 3

Pre-determinate Coding Scheme for Cognitive Interviews

Categories	Sub-categories (codes)	Categories	Sub-categories (codes)
Reading (interviewer)	• What to read • Missing information • How to read	**Knowledge/ Memory**	• Knowledge • Attitude • Recall
Instruction	• Conflicting or inaccurate instructions • Complicated instructions	**Sensitivity/ Bias**	• Sensitive content • Sensitive wording • Socially acceptable
Assumptions	• Inappropriate assumptions • Assumes constant behavior • Double-barreled	**Response categories**	• Mismatch • Technical term(s)-R • Vague • Overlapping • Missing • Illogical order
Clarity	• Wording • Technical term(s)-S • Vague • Reference periods	**Other problems**	• Other problems

Based on results of the expert panel reviews and cognitive interviews with Chinese older adults, I modified the Perceived Physical Literacy for Chinese Elderly Questionnaire (version 1.0) to improve the content validity of the measurement. The final decision to accept or reject the expert advices and Chinese older adults' feedback was the responsibility of the questionnaire developer (myself). I maintained a log of decisions about accepting or rejecting reviewer suggestions, including justifications and decisions corresponding to those decisions. To protect against researcher bias and ensure that appropriate item revisions occurred, I met weekly via Skype with my mentor (Dr. Barbara King) to discuss decisions and revisions.

At the end of Stage 2, a modified Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0) was prepared for further testing and refinement. Version 2.0 of the questionnaire was translated from Chinese into English by a bilingual independent translator not affiliated with the study (Weishun Lu, a doctoral student in English at the University of Wisconsin-Madison), and then back-translated into Chinese by another bilingual independent translator (Yi Sun, a high school English teacher with a master's degree in English; Douglas and Craig, 1983; Berry, 1980). I worked closely with both translators to ensure the English and Chinese versions of questionnaire were equivalent.

Methods of Stage 3—Questionnaire Testing and Refinement

The purpose of Stage 3 was to establish the psychometric properties of the developed questionnaire. In Stage 3, a paper-and-pencil, in-person survey was conducted. Based on the results of item-level analysis and exploratory factor analysis, decisions were made regarding which questionnaire items to retain or remove. Next, a series of quantitative analyses were carried out to explore the reliability (item-total, internal consistency, and test-retest) and validity

(criterion and known-group) of the newly developed Perceived Physical Literacy for Chinese Elderly Questionnaire.

Study design. This study used a cross-sectional design except for a test-retest procedure in a subsample of participants.

Sample. Inclusion criteria for participants were consistent with the item development interview and cognitive interview: (1) residents of the People's Republic of China, (2) 60 years of age or older, and (3) able to communicate in Mandarin Chinese. Chinese older adults were excluded from the study for the following reasons: (1) a diagnosis of a major psychiatric condition, (2) a diagnosis of cognitive impairment, or (3) significant hearing impairment despite using prescription hearing aids.

The sample size of the cross-section survey was determined by two main statistical analysis methods, correlation analysis and exploratory factor analyses (EFA; Pilot & Beck, 2011). For the correlation analysis, Strickland (2000) suggested that data be obtained from a minimum of 200 subjects from the target population and analyzed at the item level to achieve credible findings. For EFA, a minimal sample of 300 is recommended in the literature (Comrey, 1988; Nunnally & Bernstein, 1994; Tabachnick & Fidell, 2007; Tinsley & Tinsley, 1987), and Heckler (1996) suggested a sample size of at least five times the number of items. The developed Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0) consists of 72 items; therefore, the estimated sample size is 360 Chinese older adults.

Recruitment. I recruited the participants from one local health examination center and three communities in Kaifeng between July 2018 and August 2018. The Kaifeng Health Examination Center serves approximately 20,000 clients a year, of which over 40% are over 60 years of age. During the participant recruitment period, one trained data collector (Tengbo

Yang) and I spent two days (Monday and Tuesday 9 am–5 pm) every week at the center to recruit participants and collect data. Two center staff at the registration station (all customers need to return their health examination form to the registration station after they complete all examinations) helped to approach individuals who were aged 60 years and older and able to communicate in Chinese. Center staff informed older adults about the opportunity to participate in the study and handed out the study recruitment flyers. If older adults were interested, I was notified and met with older adults to discuss the details of the study, ask screening questions (Appendix 8) to confirm their eligibility, and obtain oral consent. Next, I invited the consented older adults to complete a paper-and-pencil, in-person survey interview in a quiet, private conference room in the health examination center.

Da-xing and Jin-an are two urban communities, Tu-cheng is a rural community. I recruited participants from the three communities using the following approaches:
(1) Recruitment flyers were posted in community public areas (e.g., community entertainment room, bulletin boards, local grocery stores, and community yards/parks/squares). Recruitment flyers contained a brief description of the study and my contact information. If older adults were interested, they were instructed to contact me for more information. (2) One community committee staff or one senior community resident in each community helped me to identify potential participants based on their familiarity with the community residents. Community members helped send out recruitment flyers and asked potential older adults if they were interested in learning more about the study. If the older adult was interested, I was notified, and I contacted the older adult to explain the study further and obtain oral consent from the older adults by phone if they met the inclusion criteria. After participants were enrolled, I scheduled a time and place to meet with them to complete the survey interview. (3) I set up a survey table at

several community locations (community center, senior activity room, community park, and community square). A data collector and I stayed at the survey table during a fixed time period on certain days of the week. While at the survey table, I handed out recruitment flyers and answered questions about the study. If older adults were interested and initially met inclusion criteria, I conducted screening questions to confirm their eligibility and obtained oral consent. Participants could choose to complete the survey interviews on site with a data collector or schedule another time and place to finish the interview. (4) Snowball sampling technique was also used. Participants who volunteered to complete the survey interview were asked if they knew of other Chinese older adults in the community that might be interested in the study and if they could help introduce the study to them. Interested referred participants were provided information (flyers) that contained my contact information.

I obtained oral consent from all participants before they entered the study. The consenting process was identical to that used for item development interviews and cognitive interviews. All consented participants were assigned a study identification number.

Instruments. Participants were invited to complete four instruments: (1) Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0), (2) the Physical Activity Scale for the Elderly (PASE), (3) the Perceived Competence Scale (PCS), and (4) a personal demographic information sheet (Appendix 11).

Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0). This self-report questionnaire was developed in Stages 1 and 2 to measure Chinese older adults' perceived physical literacy level. The questionnaire has six subscales and contains 72 items: (1) Motivation subscale (15 items); (2) Physical competence subscale (12 items); (3) Interaction with environment subscale (20 items); (4) Sense of self subscale (10 items), (5) Interaction with

others subscale (8 items); and (6) Knowledge and understanding subscale (7 items). Participants were asked to rate items on a 5-point ordinal scale ranging from "Not at all" (1) to "Extremely" (5). High scores for the subscales indicate stronger motivation towards PA, perceived physical competence, perceived ability to interact with the environment, sense of self, perceived ability to interact with others, and better knowledge and understanding of PA.

Physical Activity Scale for the Elderly (PASE). Chinese older adults' PA behavior was measured by the PASE (Washburn, Smith, Jette, & Janney, 1993). This 12-item self-report questionnaire assesses the level of older adults' PA (leisure-time, household, and occupational) over the past seven days. A high PASE score indicates a higher level of PA; the possible total score of the PASE ranges from 0 to 500 or more. The PASE is a valid tool for measuring older adults' PA. The PASE score significantly correlates with PA level as measured by portable accelerometer ($r = 0.49$, $p < 0.05$; Ficker, 1999). The Chinese version, PASE–C, has been tested with Hong Kong Chinese older adults and has demonstrated good test-retest reliability (intra-class correlation coefficient = 0.81; Ngai et al., 2012).

The PASE–C includes three subscales: leisure-time PA, household-related PA, and occupational-related PA. In this study, I only used the leisure-time PA subscale of PASE–C to assess Chinese older adults' PA behavior for testing the criteria and known-group validity of the developed perceived physical literacy questionnaire, which is because physical literacy is about a person's disposition and capability for purposeful PA; household-related PA and occupational-related PA are usually not purposeful PA.

Besides, because the PASE–C only measures older adults' PA behavior in the past week, I added two additional questions to the questionnaire to determine if the older adult self-identifies as a regular exerciser and how long the older adult maintained regular PA

participation. The two additional questions were (1) "Are you a regular exerciser? That is, at most weeks, you do at least three times physical activity, and each time last about half an hour or more." If the older adult responded "Yes" to the first question, a following question was asked "How long have you been doing physical activity regularly? Less than one year, one to five years, five to ten years, ten to fifteen years, or over fifteen years?" I assigned a score to each response option (0 for "not regular exerciser", 1 for "less than one year", 2 for "one to five years", 3 for "five to ten years", 4 for "ten to fifteen years", 5 for "over fifteen years"). A higher score indicates longer PA maintenance.

Perceived Competence Scale (PCS). The PCS (Williams & Deci, 1996) is a four-item measure designed to assess individuals' perceived competence in their ability to participate in PA on a regular basis. Respondents were asked to indicate the extent to which each statement is true for them. The PCS uses a 7-point Likert-type scale, ranging from 1 (Not at all true) to 7 (Very true). Scores from all four items are summed to form a total score. The total score of the PCS ranges from 0 to 28, with a higher score indicating better perceived competence. The PCS is a valid and reliable measure of one factor of perceived competence for regular PA (Carroll et al., 2014; Williams & Deci, 1996). The Cronbach's alpha of the PCS among older adults was 0.91 (Sloberg, Halvari, & Ommundsen, 2013). In this study, I translated the PCS from English into Chinese, and then a bilingual independent translator (Weishun Lu) back-translated it into English to ensure the content of the English and Chinese PCS versions were equivalent (Berry, 1980; Douglas & Craig, 1983). The Cronbach's alpha for the Chinese version PCS in this study was 0.88.

Personal information sheet. We collected participants' personal information at the end of each interview, including year of birth, gender, education level, marital status, living area (rural

or urban), accommodation (alone, live with spouse, live with children/relatives), ambulatory status (independent in walking, use of ambulation assistive device such as a cane, rollator/frame or wheelchair), perceived health status (very poor, poor, fair, good, very good), and co-morbidities.

Data collection. A trained data collector (Tengbo Yang, a master's student at Henan University, China) and I collected all data. I trained the data collector and asked him to follow a standard procedure during data collection. First, I introduced the project to the data collector to ensure he had a good understanding about the study aims, methods, the questionnaire, and the data collection procedure. Second, prior to data collection, the data collector and myself role-played the procedure twice to increase his familiarity of the survey. Finally, I observed three survey interviews conducted by the data collector to ensure that standard interview procedures were followed.

All the surveys were conducted using pencil-and-paper, in-person interviews at quiet places (e.g., meeting rooms in the health examination center/community centers/senior activity room, quiet corner in the parks/square/gardens, or participant's home). The data collector or I read the survey questions to participants and checked-off responses provided. We used show cards (visualized Likert scales; see Appendix 11) to facilitate participants' answers to questions (Gillham, 2008). Each interview lasted approximately 20–40 minutes. We only used the study identification number on questionnaires. After each survey interview, we placed the completed questionnaires were placed in a sealed envelope and kept in a locked carrier. At the end of the survey, every participant received a ￥20 (approximately 3 USD) gift (3 pounds mung beans) as an appreciation for completing the interview.

Test-retest. At the end of the original survey interview (Time 1), we asked participants if they would also be interested in participating in the test-retest reliability study. If so, we asked participants to provide a contact telephone number. The last four digits of their telephone number were written on the completed original questionnaire and used as the identification numbers to link the test-retest data. After two weeks (Time 2), I contacted participants to schedule a retest interview meeting. Only the developed Perceived Physical Literacy for Chinese Elderly Questionnaire was used for the retest. Participants who completed the retest survey interview were given an additional ¥ 20 (approximately 3 USD) gift to compensate them for their time and effort.

Data analysis. SPSS version 24 was used for descriptive statistics, correlations, and multiple linear regression. Mplus version 7 was used for the EFA.

Missing data. All surveys were conducted by face-to-face interviews; therefore, 100% of questionnaires were completed, no missing data was found. However, the questionnaires allowed participants to select "I don't know" responses if they had no experience, perception, and/or knowledge needed to answer the question(s). In this study, the response option "I don't know" was treated as non-random missing data.

Descriptive statistics. Descriptive statistics were carried out to perform data cleaning and describe the demographic characteristics of the participants. Descriptive statistics included frequency, percentage, mean, and standard deviation.

Item analysis. A series of item-level analysis were conducted for item reduction. (1) The percentage of missing data. If item(s) with more than 10% of missing data ("I don't know"), the item (s) were considered to be deleted (WHOQOL Group, 1998). The high percentage of missing data indicates that the item(s) may be not applicable to many participants. (2) The

frequency of endorsement. By examining the endorsement rates (the proportion of respondents who gave each alternative response to an item), the items with ceiling or floor effect and skewed pattern could be identified (Streiner & Norman, 2008). An item with a percentage of more than 40% selecting "extremely" suggested a possible ceiling effect, whereas a percentage of more than 40% selecting "not at all" suggested a floor effect (Donna, Lamping, Fitzpatrick, Tiazi, & Thompson, 2001). For detecting skewed items, when an item has the endorsement rate less than 10% in any two adjacent response options (i.e., "very" and "extremely", "not at all" and "little"), it is regarded as skewed (WHOQOL Group, 1998) and should be considered to be deleted. (3) Item-total and inter-item correlations. Within each subscale, if the correlation value between an item and its subscale was above 0.70, this item was considered as over-redundant; if the correlation value between two items was greater than 0.75, these items were considered over-redundant items (Ferketich, 1991; Portney & Watkins 2009). The deletion of items was decided based on the overall performance of the item on the above item-level analysis, the re-evaluation of content of those items, and the group discussion.

Exploratory factor analysis (EFA). The factor analysis is the most appropriate method to explore the underlying factor structure (i.e., common factor) from a pool of measured items (Costello & Osborne, 2005; Fabrigar et al., 1999; Floyd & Widaman, 1995). In this study, I first preceded the factor analysis by a principal component analysis (PCA); the scree plot and the eigenvalues > 1 were evaluated to determine the potential appropriate numbers of factors. Then, I performed the EFA to explore the underlying dimensional structure of the developed questionnaire and for further item reduction. The EFA estimates the pattern of relations between the common factors and each of the measured item's factor loadings, which to reveal the structure of correlations among measured items (Fabrigar et al., 1999). Besides, the EFA can

differentiate the common factor from unique factors, thus presenting the common factors in the solution (Fabrigar et al., 1999). In present study, given that the items are polytomous and factors (attributes) in physical literacy were expected to be correlated (Whitehead, 2015), factors were extracted based on the unweighted least squares (ULSMV) estimation method and oblique (Promax) rotation (Maydeu-Olivares & D'Zurilla, 1996; Muthén, Muthén, & Asparouhov, 2015). The missing data was handled by likewise deletion. Once the potential appropriate number of factors was obtained, we conducted the EFAs, and then compared the factor loading tables to determine the best factor model based on the criteria: in the factor model (1) the factor loadings for the majority of items should be greater than 0.32, (2) fewer items were cross-loaded more than one factor, (3) each emerged individual factor should contain at least three items, and (4) the meaning of emerged factors should be interpretable (Costello & Osborne, 2005). In addition to these four criteria, I made initial decisions about the number of factors based on the preconceived conceptual beliefs about the number of underlying dimensions. Based on the preconceived physical literacy conceptual framework for the study, six factors were expected to be extracted from the questionnaire of Perceive Physical Literacy for Chinese Elderly. Next, I re-performed the EFA several rounds using the determined factor number. After deleting the items that failed to meet the statistical criteria — (1) item's factor loading > 0.32, (2) item only loaded on one factor, the best and the "cleanest" factor model was reached. The model fit was considered good if the model's comparative fit index (CFI) ≥ 0.95, the Tucker-Lewis index (TLI) ≥ 0.95, the standardized root mean square residual (SRMR) ≤ 0.08, and the root mean square error of approximation (RMSEA) ≤ 0.06 (Hu & Bentler, 1999). Methodologists recommended that using EFA first and then confirmatory factor analysis (CFA) to examine the structural validity of the instrument especially when evaluation a new instrument (Worthington & Whittaker, 2006), and

the "factor structure from an EFA should be confirmed with CFA on a different data set" (Green et al., 2016, p. 18). In this dissertation study, because of the limitation of the sample size, I only conducted the EFA. In further study, the factor structure of the questionnaire need to be further tested by the CFA using another sample.

Criterion validity and known-group validity. (1) Criterion validity refers to the extent to which results on one measure are associated with results from a separate measure, the latter being taken to be the criterion variable (Streiner, Norman, & Cairney, 2015). If the proposed measure forecasts a future criterion value, the validity is called predictive validity (Coste et al., 1995). If the proposed measure corresponds to a criterion measured simultaneously, the validity is called concurrent validity (Coste et al., 1995). In this study, I used the leisure-time PA subscale of the PASE and the years of PA maintenance to assess the predictive validity of the perceived physical literacy questionnaire. Theoretically, individuals with a higher level of physical literacy should have a higher volume of PA participation and a longer PA maintenance period (Edwards et al., 2017; Whitehead, 2010). I performed the multiple linear regression analysis to determine the predictive ability of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire for Chinese older adults' leisure-time PA score and their PA maintenance score, after controlling for covariates (i.e., age, sex, education level, marital status, living area, ambulatory status, perceived heath status, and number of co-morbidities). The significant relationships between the perceived physical literacy score and leisure-time PA score and PA maintenance score indicate the developed questionnaire had good predictive ability for Chinese older adults' PA behavior. The concurrent validity of the questionnaire was evaluated using the PCS. The PCS measures an individual's overall self-competence for regular PA participation (Williams & Deci, 1996), which is similar to the notion of physical literacy. A high

correlation ($r > 0.9$) between the PCS and the perceived physical literacy questionnaire would indicate the over equivalence of the two instruments (Portney & Watkins, 2009). A high correlation indicates both instruments are too similar and indistinguishable in the participants' responding pattern. A moderate correlation ($r > 0.3 < 0.7$) would indicate that the perceived physical literacy questionnaire was a related but different tool from the PCS. (2) Known-group validity was evaluated to generate evidence of contrast validity (Kline, 2013). First, the sample was divided into high and low physically active groups based on a median split of the leisure-time PA score (group 1: leisure-time PA score < 27; group 2: leisure-time PA score ⩾ 27). A 2-sided t test was used to test the group differences on both the scale and subscale level. The sample was divided into short-term and long-term PA groups based on a median spilt of the years of regular PA participation (group: 1 year of regular PA < 5 years; group 2: years of regular PA ⩾ 5 years). The 2-sided t test was used to test the group differences. A significant t score ($p < 0.05$) indicates a good known-group/contrast validity of the developed questionnaire.

Reliability. Reliability refers to the consistency of assessment scores (DeVellis, 2003). Reliability was tested by the following strategies: (1) Item-total correlation. The item-total correlation was calculated again using the refined Perceived Physical Literacy for Chinese Elderly Questionnaire to assess if the items in the same subscale are measuring the same thing (internal consistency reliability). A moderate correlation ($r > 0.3 < 0.7$) between item and subscale is considered good (Ferketich, 1991; Portney & Watkins 2009). (2) Cronbach's alpha. Cronbach's alpha was also calculated to determine the internal consistency of the questionnaire and its six subscales. High Cronbach's alpha indicates that the instrument has high internal consistency. Nunnally and Bernstein (1994) suggested that for newly developed instruments, a Cronbach's alpha with 0.70 or higher is acceptable. However, if the Cronbach's alpha is too

high (over 0.95), it may suggest that items are redundant (Shevlin, Miles, Davies, & Walker, 2000). (3) Test-rest reliability. Test-retest reliability is the correlation between the same subjects' scores on the same set of items at two points in time. It exhibits the extent to which the same results are obtained on repeated administration of the instrument. Experts have different opinions about the time interval between test and retest; usually a two-week interval is suggested (Knapp, 1985). In the current study, the two-week test-retest reliability was determined using a subsample of 17 participants and assessed using the intraclass correlation coefficient (ICC). It is recommended that the ICC value should be larger than 0.50 (Duruoz et al., 1996).

Based on the results of a series quantitative testing, the developed perceived physical literacy questionnaire was further refined to establish the validity and reliability of the measurement. Subsequently, the Perceived Physical Literacy for Chinese Elderly Questionnaire (Version 3.0) was generated.

Summary

This chapter presented the methods of questionnaire development and validation for the Perceived Physical Literacy for Chinese Elderly Questionnaire. In general, this dissertation study required three standard stages in sequence, including questionnaire item generation, the establishment of validity, and questionnaire testing and refining. First, I conducted individual interviews with Chinese older adults, a literature review, and referenced the existing relevant measurements for item generation. Next, expert panel reviews and cognitive interviewing techniques were performed to establish the content validity of the questionnaire. Then, I tested the developed Perceived Physical Literacy for Chinese Elderly Questionnaire among Chinese older adults through cross-sectional, pencil-and-paper, in-person survey interviews. Using the collected data, a series of item-level analysis and EFA were applied to assess and refine the

questionnaire. Last, I evaluated the psychometric properties of the questionnaire by testing the criterion validity (i.e., predictive and concurrent), known-group validity, internal consistency reliability, and test-retest ability. The results of the three study stages are described in the next chapter.

Chapter 4 Results

This chapter presents results of the three stages of the study, item generation, content validity, and psychometric analysis. Based on the findings from each stage, I generated, refined, and tested the Perceived Physical Literacy for Chinese Elderly Questionnaire. Figure 4 illustrates the dissertation's research deductive process. Because we conducted the item development interviews and cognitive interviews in Chinses and direct translated the Chinese materials, some quotes presented in this Chapter may contain grammatically incorrect sentences.

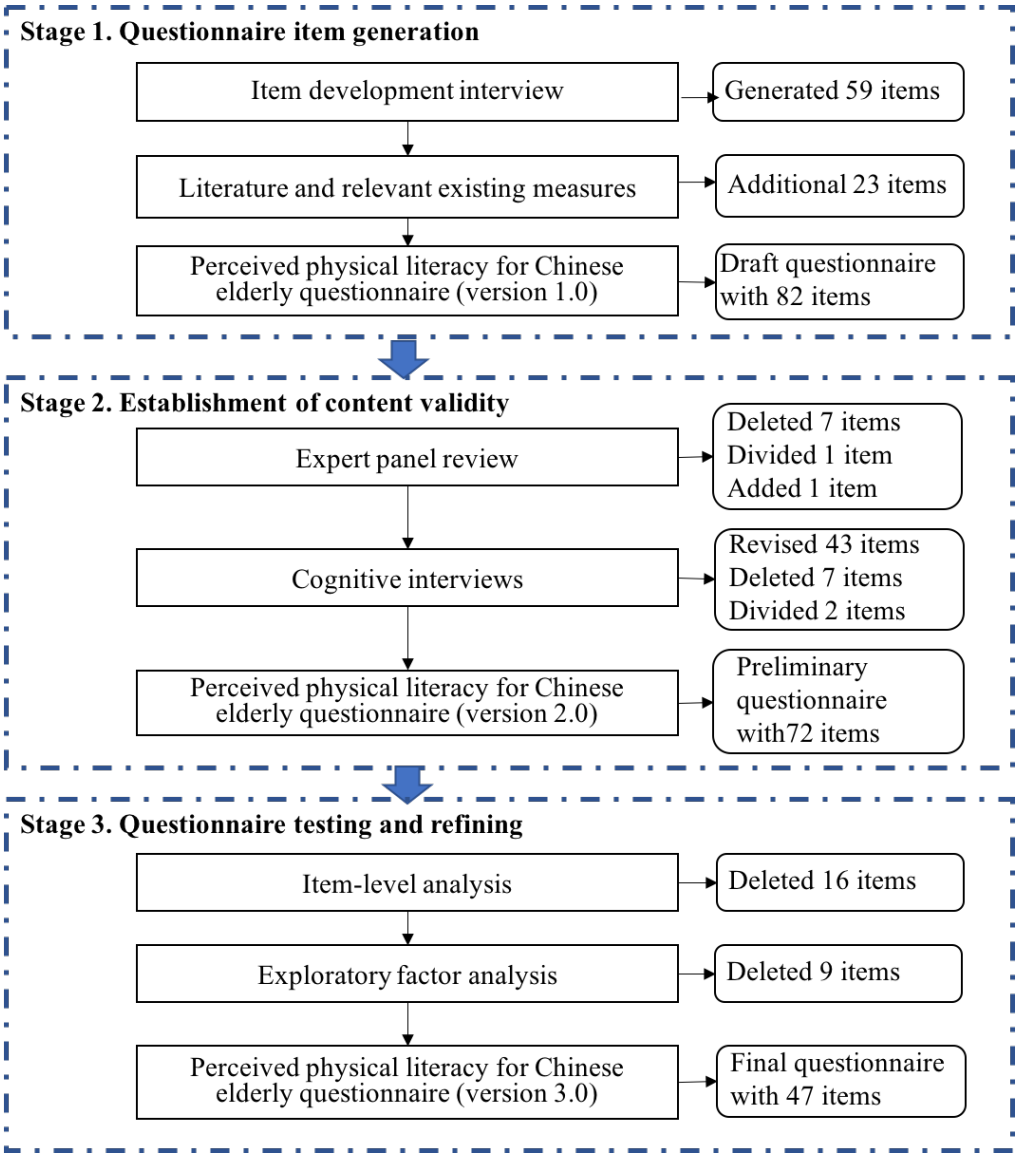

Figure 4. Item generation and deduction process

Results of Stage 1—Questionnaire Item Generation

Item Generation Resulted from the Item Development Interviews

For item development interviews, I approached ten Chinese older adults. Table 4. presents the demographic characteristics of the item development interview sample (*N*=10). The sample's age ranged from 62 to 84 years old (*M*=72.80, *SD*=6.30). Six participants were female. The majority of participants were married and living with a spouse (*n*=6). Two participants were illiterate whereas the majority (*n*=8) had attended formal education. Six older adults self-identified as regular exercisers (participating in PA at least three times a week, 30 munities per time).

Table 4.

Demographic Information of Item Development Interview Participants (N = 10)

ID	Age	Sex	Marital status	Education	Living area	Living with others	Retirement (years)	Health status	Regular PA
RI1	69	F	Married	Primary	U	S	14	Fair	Yes
RI2	75	F	Married	Illiterate	U	S	9	Good	Yes
RI3	62	F	Widowed	Tertiary	U	Alone	Not retired	Good	Not
RI4	77	M	Married	Secondary	U	S	22	Fair	Yes
RI5	71	F	Married	Primary	R/U	S	NW	Poor	Not
RI6	72	M	Married	Primary	U	S	7	Fair	Not
RI7	66	M	Widowed	Secondary	U	Alone	6	Good	Yes
RI8	84	F	Widowed	Secondary	U	Other	25	Poor	Yes
RI9	78	M	Married	Illiterate	R	S and C	NW	Excellent	Yes
RI10	74	F	Widowed	Primary	R	C	NW	Fair	Not

Note. F=female; M=male; U=urban; R=rural; S=spouse; C=children; NW=never worked.

Based on the physical literacy framework (6 attributes) I identified a total of 18 subcategories and 59 key elements/codes from the interview data to conceptualize Chinese older adults' perceived physical literacy. Table 5 demonstrates the subcategories and their respective key elements.

Table 5.

The Subcategories and Elements Emerged from the Item Development Interviews with Chinese Older Adults

Categories	Subcategories	Key elements/codes	Frequency (%)
Motivation- the positive attitude toward and intrinsic desire to engage in PA	Value	Overall value	10 (100%)
		Health value	10 (100%)
		Mental value	8 (80%)
		Social value	6 (60%)
	Importance	Important for me	6 (60%)
		Important for older adults	3 (30%)
		Effort	3 (30%)
	Affect	Enjoyment	3 (30%)
		Satisfaction	4 (40%)
		Joy	7 (70%)
		Interest	10 (100%)
		Want	10 (100%)
	Habit	Part of daily life	3 (20%)
		Restlessness	2 (20%)
Physical competence - the physical ability to perform a variety of movement tasks	Ability of basic physical movements	Physically fit	3 (30%)
		Walking	6 (60%)
		Climbing	3 (30%)
		Squatting/kneeling	1 (10%)
		Carrying	1 (10%)
	Ability of PA	Low intensity PA	3 (30%)
		Moderate intensity PA	4 (40%)
		High intensity PA	2 (20%)
		Aerobic/endurance PA	1 (10%)
Interaction with environment- the ability to participate in PA under challenging environmental situations	Intrapersonal situations	Stress	2 (20%)
		Joint problem	2 (20%)
		Pain	1 (10%)
		Lack of time	6 (60%)
		Chronic health conditions	4 (40%)
	Interpersonal situations	No companion	3 (30%)
		Provide care to others	5 (50%)
	Physical environment situations	Lack of PA program	2 (20%)
		Lack of public exercise equipment	1 (10%)
		Lack of PA space	2 (20%)
		Weather	2 (20%)
		Temperature	3 (30%)
		Air quality	1 (10%)
		Neighborhood walkability	1 (10%)
Sense of Self - the self-belief in the	Sense of ability to undertake	As well as others	7 (70%)
		As much as others	2 (20%)

ability to undertake and maintain regular PA	Sense of ability to maintain	Short-term maintenance	3 (30%)
		Long-term maintenance	5 (50%)
		Maintaining with aging	1 (10%)
	Sense of ability to achieve	Overcome barriers	2 (20%)
		Achieve goals	1 (10%)
		Achieve more	2 (20%)
	General sense of self	Positive sense of self	2 (20%)
Interaction with others - the ability to exercise with and build supportive relationships with others	Relationship with others	Work well with others	4 (40%)
		Get along with others	5 (50%)
	Relationship with group	Join in a group	2 (20%)
		Fill in a group	3 (30%)
	Supportive relationship	Gain support	3 (30%)
		Provide support	2 (20%)
		Lead others	1 (10%)
Knowledge and understanding - the knowledge to evaluate, adjust, and enhance PA and the understanding of the value of being physically active	Knowing self	Suitable PA for me	5 (50%)
		Suitable amount for me	4 (40%)
		Suitable adjustment	4 (40%)
		Improvement	1 (10%)
	Knowing physical activity	PA for well-being	6 (60%)
		Knowledge of PA	3 (30%)

Note. PA=physical activity.

Motivation

For motivation, the most common way participants expressed their attitudes and intrinsic desire towards PA was by describing their perceived values of PA, perceived importance of PA, and the affective outcomes gained from PA participation. The perceived values of PA include the "overall value" *("... doing physical activity is good...*", PR6), "health value" ("*well, it helps me to control my blood pressure*", RI4), "the mental value" ("*after doing exercise, I felt my mind is much clear*", RI1), and "social value" ("*I can't just stay at home; I need to go out and contact with others*", RI7). Six of the ten participants described the importance of PA reporting that PA was important for older adults and they desired to spend time and effort to participate in PA. One participant said, "*physical activity is very important, especially for older people, for people like me... every time I do exercise, I do my best; make sure every move I made was done well*" (RI2). All participants described experiencing a positive affect from participating in PA. Words

commonly used included "enjoyment" (RI1, RI4, RI7), "satisfaction" (RI2, RI4, RI8, RI9), and "joy" (RI1, RI2, RI3 RI5, RI7, RI8, R9). In addition, participants describing "wanting" to engage in PA, rather than having to. Three participants (RI2, RI4, RI9) believed that doing PA was a crucial component of their daily life. One male participant explained that PA was a part of his daily routine and skipping made him feel restless, "*I have kept doing exercise for over 20 years; (doing PA) has become a habit… if one day I didn't do it, I felt anxious*" (RI4).

Physical competence

Chinese older adults described their perceived physical competence in two primary ways: having the ability to perform basic physical movements and having the ability to carry out different types of PA. Seven participants (excluding RI1, RI7, RI9) used their basic physical ability including walking, climbing, squatting, and carrying ability to evaluate their physical competence. For example, one older adult considered her physical ability was declining in recent years and stated *"…it was easy for me to climb to the third floor before, but now it is getting harder… I have to rest for a while on the second floor…*" (RI5). Three older adults (RI2, RI8, RI10) used the term "physically fit" to summarize their physical competence. According to participants, the better physically fit they were the more physically competent they felt, "*compared to others in my age, I am pretty physically fit; I can do most of the movements that I want to do*" (RI2). Six of ten participants (RI1, RI2, RI3, RI7, RI8, RI9) talked about their physical competence by describing how capable they were in performing different intensity PA loads (low, moderate, high intensity, and general aerobic PA). One physically active participant expressed his improvement in physical competence by saying *"…when I started to exercise, I was only able to do something like briskly walking and biking; now I can do more… I play basketball, I'm a senior basketball team member*" (RI7).

Interaction with environment

Participants identified a range intrapersonal, interpersonal, and physical environmental challenges that impacted their PA participation. At the intrapersonal level, Chinese older adults identified several personal issues that could interrupt their ability to engage in PA. The personal issues included "stress" (RI3, RI5), "joint problems" (RI4, RI8), "pain" (RI10), "lack of time" (RI1, RI2, RI3, RI5, RI7, RI10), and "chronic health conditions" (RI4, RI5, RI8, RI10). Among intrapersonal issues, "lack of time" was the most common barrier reported by older adults', *"... always have something that I must to do…I don't have the time to exercise*" (RI10). At the interpersonal level, three participants (RI1, RI3, RI7) said "no companion" was a significantly challenging situation for them. One female participant who engaged in social dancing said "*if my husband [her dance partner] don't go to dance, I won't…*" (RI1). Another interpersonal challenging situation was "providing care to others". Five of ten participants (RI1, RI3, RI5, RI7, RI10) stated they either did or did not have strategies to address caregiving duties that impacted their ability to participate in PA. One woman explained, "*my granddaughter is only seven months old; can't do without people, and her parents are busy, so I have to be with her almost all day long*" (RI5). Moreover, the interviews showed that all ten participants preferred outdoor PA in their community. Therefore, older adults' ability to address environmental challenges in their community is curial for their PA maintenance. According to participants, at the physical environmental level, issues that hindering their PA participation were "lack of PA programs" (RI6, RI9), "lack of public exercise equipment" (RI2), "lack of PA space" (RI3, RI10), "bad weather" (RI1, RI3), "uncomfortable temperature" (RI4, RI8, RI10), "bad air quality" (RI7), and "limited neighborhood walkability" (RI6). One participant described, "*the playground in our*

village was demolished last year… we had to stop to play badminton, find something else we can do… walking is good, but not as good as playing badminton" (RI9).

Sense of self

In response to questions about the sense of self, participants described their ability to engage in PA, maintain PA, and progress in their ability. Seven of ten participants categorized their ability as able or unable to perform PA well (RI2, RI3, RI4, RI5, RI7, RI8, RI9) or their ability to perform a certain amount of PA (RI2, RI8). When they summarized their perceived feeling of themselves, they reached conclusions by comparing their ability with others in their same age group, one participant explained, "*the people who dance with me are all my peers… I can do all the dance moves they can do; they can dance for half an hour and I can dance that long*" (RI2). Seven older adults reported their ability and confidence with maintaining PA based on time, either short-term (RI3, RI5, RI6) and(or) a long-term (RI1, RI2, RI4, RI7, RI9). One participant with over 40-years of exercise experience said, "*as long as I'm alive, I can move, I'm confident to keep exercising…"* (RI9). It is interesting to note that, one woman expressed her concern about aging; getting older influenced her confidence in being physically active. She said "*I think I can do this [maintain PA]… but I'm getting older; I don't know how long I can keep doing this*." (RI10). Two older adults (RI1, RI8) also talked about their overall positive feeling towards themselves; one 84-years older participant said, "*overall, I think I'm good… this year, I will be 85 years old; many people at my age are already in bed… I'm satisfied [about herself]*" (RI8).

Interaction with others

Nine of ten participants (except for RI6) preferred having someone to exercise with. Eight participants (except for RI6, RI10) were part of a PA group. Eight older adults described

their social ability by how well they were able to work (RI1, RI2, RI7, RI9) and get along (RI2, RI3, RI5, RI7, RI9) with people they were exercising with. For example, "*when I walk with my neighbor [an 86- years older lady], I walk slower to accommodate her speed… she likes to walk with me*" (RI1); "*I never lack people to exercise with me … even if with someone first meets, I can get along with them"* (RI2). For those who liked group PA, the ability to quickly join a group was important. One participant who stopped doing group calisthenics after she moved to a new community explained, "*I'm not an outgoing person, hard for me to join in a new group… at here, no one I'm familiar with, no one introduce me [to the group*]" (RI5). Additionally, five older adults described the importance of establishing supportive relationships. Three older adults (RI2, RI4, R9) described asking for help when they needed it. One woman narrated her experience of how she learned *Ba-duan-jin* (a traditional Chinese exercise), *"I saw her playing (Ba-duan-jin) very well, so I walked over and greeted her, saying that 'you played so well' and asking if I could play it with her; she said yes and she was happy to help me correct my poses"* (RI4). Two participants (RI7, RI9) also reported that they often provide support to others. One (RI9) mentioned how he became a leader and brought others to play badminton in their village.

Knowing and understanding

In order to maintain effective PA, five older adults (RI2, RI4, RI7, RI8, RI9) believed that it was important to know themselves first, including knowing what types and amounts of PA were suitable for them and how to adapt PA based on their own body's ability. One participant explained, "*I know exercising must reach a certain amount to have effect… I'm pretty fit, if I just walk slowly for 10 or 20 minutes, that's not enough, at most it can only help with digestion."* (RI7), and another participant summarized, *"everyone's situation is different, like me, I have a heart problem, so I need to know what I can do, what I can't do, how much I can do… for*

example, when do gymnastics, others do the jumping movements, I only tiptoe" (RI4). There was one participant who believed that older adults should know how to progress their activity to achieve better outcomes, *"... many people, they just do the same exercise all the time; that's not right, not enough. Once your body adapts to this amount, the effect is compromised... we need to keep improving*" (RI9). A few older adults (RI2, RI5, RI7) talked about the importance of knowing the benefits of PA for well-being. One participant explained, "*PA is good for us, for our well-being…you need to know why exercise is good, so you have the motivation to exercise"* (RI7). Finally, three older adults (RI2, RI5, RI6) stated that because they lacked PA knowledge, rather than making their own PA decisions, they blindly followed others. One participant reported that *"I don't know much about PA… I just follow others. They say doing that kind of exercise is good, I do that kind of exercise"* (RI5).

In summary, according to the perception of Chinese older adults, 18 subcategories and 59 key elements emerged as influential in shaping the perceived physical literacy of Chinese older adults. The item development interview was used to generate the item pool for the Perceived Physical Literacy for Chinese Elderly Questionnaire. Next, in order to supplement the findings above and to identify additional key elements to expand the item pool, I conducted two bodies of review - the literature review of known correlates of older adults' participation in physical activity and a review of existing self-report measures that were relevant to the six attributes of physical literacy.

Item Generation Results from the Literature Review and Existing Measures

The searching processes of literature review and existing measures are shown in Appendix 4. Six previous literature reviews have been published regarding the correlates of adults'/older adults' PA behavior (Eyler et al., 2002; Hu et al., 2018; Koeneman, Verheijden,

Chinapaw, & Hopman-Rock, 2011; Plonczynski, 2003; Trost, Owen, Bauman, Allis, & Brown, 2002; Van Cauwenberg et al., 2011;). These reviews summarized the personal and physical environmental factors related to older adults' PA behavior (four reviews included both adults and older adults). I extracted a total of 65 correlates from these reviews. Forty-five correlated to some extent with the six attributes of physical literacy (the summary of the correlates is shown in Appendix 10 in alphabetical order). The remaining 20 were excluded as they were related to demographics (e.g. age, gender, personality), behavioral (e.g. smoking, alcohol, stages of exercise), and PA program (e.g. group cohesion) and not directly aligned with the construct of physical literacy.

Searching relevant existing self-report instruments resulted in a total of 22 instruments (see Appendix 11). Among them (some of the instruments relate to more than one attribute of physical literacy), five instruments relate to the "Motivation" attribute (measuring the individual's motivation and attitude towards PA)_(Markland & Ingledew, 1997; McAuley, Duncan, & Tammen, 1989; Molanorouzi, Khoo, & Morris, 2014; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997; Taylor, Lawton, & Conner, 2013); eight instruments relate to the "Physical competence" attribute (assessing individual's perceived physical ability or function or difficulties) (Bergner, Bobbitt, Carter, & Gilson, 1981; Cress, Buchner, Questad, Esselman, & Schwartz, 1996; Jones, Rutldge, Jones, Matallana, & Rooks, 2008; Rejeski et al., 1998; Ryckman, Robbins, Thornton, & Cantrell, 1982; Spertus et al., 1995; Taylor, Lawton, & Conner, 2013; Ware, 2000); five instruments related to the "Interaction with environment" attributes (a range of challenging situations to one's PA participation) (Hong, Panuthai, Srisuphan, & Wannarit, 2009; Kehn, Ho, & Groah, 2007; McAuley, 1992; Vasudevan, Rimmerm & Kviz, 2015; Taylor, Lawton, & Conner, 2013); four instruments related to the "Sense of self" attribute

(measuring PA-related belief and feelings about the self) (Kroll, Kehn, Ho, & Groah, 2007; McAuley, Duncan, & Tammen, 1989; Rosenberg, 1965; Taylor, Lawton, & Conner, 2013); three instruments related to the "Interaction with others" attribute (assessing perceived support from others) (Pierce, Sarason, & Sarason, 1991; Sallis, Grossman, Pinski, Patterson, & Nader, 1987; Taylor, Lawton, & Conner, 2013); and three instruments related to the "Knowledge and understanding" attribute (evaluating one's PA knowledge) (Crandall & Steebergen, 2015; Hui, Hui, & Xie, 2014; Taylor, Lawton, & Conner, 2013).

Motivation

The literature reviews identified that positive attitudes, intention towards PA, enjoyment of PA, and the perceived value of PA outcomes are positively correlated with PA participation (Eyler et al., 2002; Koeneman et al., 2011; Plonczynski, 2003; Trost et al., 2002; Van Cauwenberg et al., 2011). These findings are confirmed in item development interviews. Most of the available PA motivation measurements were organically designed to investigate the types of motivation (extrinsic or intrinsic), namely, why an individual engages in PA, rather than the strength of one's positive attitude and intrinsic desire for PA participation. Therefore, based on that measured intrinsic motivation and general attitude toward PA. By cross-comparing the extracted items, I added three key elements into the "Motivation" category. (1) Effort to do well: The Intrinsic Motivation Inventory tool (McAuley, Duncan, & Tammen, 1989) uses effort as an indicator to measure how important PA is for the respondent. I assumed that if an individual tried hard to do well at PA, this person is then motivated and willing to be physically active. (2) Happiness and (3) Pleasure. Happiness and Pleasure were consistently described during the item development interviews as illustrated by participants use of words such as, "enjoyment", "satisfaction", "joy", and "interesting". Happiness and Pleasure seem to be related to a persons'

intrinsic motivation for PA participation. Additionally, existing motivation measurements also used the words “happiness” and “pleasure” in their items (Molanorouzi, Khoo, & Morris, 2014; Ryan et al., 1997). The meaning of “happiness”, “pleasure” and “joy” is very similar but slightly different in small ways, therefore, I decided to include these items in the item pool for further testing.

Physical competence

Individuals’ physical competence/fitness is significantly associated to their PA participation (Eyler et al., 2002; Koeneman et al., 2011; Plonczynski, 2003; Trost et al., 2002; Van Cauwenberg et al., 2011). Similar to findings from interviews with Chinese older adults, existing measurements on physical competence and fitness measure an individual’s perceived difficulty in performing basic physical movements and/or if the person has the physical ability to carry out low, moderate or high intensity activities or tasks (Bergner et al., 1981; Cress et la., 1996; Jones et al., 2008; Rejeski et al., 1998; Ryckman et al,1982; Spertus et al., 1995; Taylor, Lawton, & Conner, 2013; Ware, 2000). Informed by these measurements, I added four elements into the category of “Physical competency” of physical literacy. (1) Overall ability and (2) Grip: both of these elements are borrowed from the Perceived Physical Ability subscale of the Physical Self-Efficacy Scale (Ryckman et al., 1982). Overall ability refers to ones’ general perception of physical ability, and Grip refers to the muscular power and force that can be generated by hand. Grip strength is a well-established and strong predictor of older adults’ physical function (Sasaki, Kasagi, Yamada, & Fujita, 2007). Having good grip strength may allow older adults to perform PA that requires hand function, such as dumbbell lifting, cycling, or using a Tai-chi sword. (3) Muscle-strengthening PA and (4) Balance PA: both muscle-strengthening PA and balance training is recommended for older adults (WHO, 2010). Three of eight available measures

include the ability/difficulty of performing muscle-strengthening/balance PA as the indicators of an individual's physical competence (Cress et la., 1996; Jones et al., 2008; Spertus et al.,1995).

Interaction with environment

Based on the review of the literature and existing measurements, thirteen elements were added to the "Interaction with environment" category. At the intrapersonal level, eight additional elements, (1) "low mood", (2) "function limitation", (3)"lazy", (4)"tired", (5)"balance problem", (6)"not health", (7)"injury history", and (8)"no regular routine", were identified. (Eyler et al., 2002; Hong et al., 2009; Kehn et al., 2007; McAuley, 1992; Vasudevan et al., 2015; Taylor et al., 2013 Trost et al., 2002; Van Cauwenberg et al., 2011). At the interpersonal level, three of five existing measurements mentioned (9) "lack of encouragement" as a PA barrier of the social environment (Hong et al., 2009; McAuley, 1992; Taylor et al., 2013 Vasudevan et al., 2015). At the physical environmental level, (10) "lack of transportation", (11) "heavy traffic", and (12) "poor neighborhood safety" were identified as significant negative factors on older adults' PA participation (Eyler et al., 2002; Trost et al., 2002; Van Cauwenberg et al., 2011). The Barriers-specific Self-Efficacy Scale (McAuley, 1992) also identify that (13) "not convenient" can have a negative effect on individuals' PA maintenance.

Sense of self

Four previous literature reviews reveal that having high self-efficacy (belief of personal ability) and self-esteem (positive sense of self) are significantly positively related to adults' and older adults' PA engagement (Eyler et al., 2002; Plonczynski, 2003; Trost et al., 2002; Van Cauwenberg et al., 2011). Results from the item development interviews also mirror this, in that older adults who described high self-efficacy (confidence) in performing PA were more likely to described how they stayed motivated to continue to engage in PA. In consistent with the findings

from the item development interviews, currently available measurements measure sense of self by assessing the one's perceived confidence to undertake, maintain, and achieve PA. One additional element "control over PA" was added to the "Sense of self" category based on the review of the literature review (Trost et al., 2002). Control over PA refers to one's general belief of how easy or difficult the behavior may be; and the sense of control over PA is influenced by ones' PA competence, opportunities, and resources (Choi, Lee, Lee, Kan, & Choi, 2017). Thus, I assumed that individuals with strong perceived control over PA have a better sense of self (the self-belief in the ability to undertake and maintain regular PA).

Interaction with others

Social support, including social support from families and peers, is the only social factor that emerged from the literature reviews (Eyler et al., 2002; Hu et al., 2018; Koeneman et al., 2011; Plonczynski, 2003; Trost et al., 2002; Van Cauwenberg et al., 2011). However, according to the definition of physical literacy (Whitehead, 2010), the measure of "Interaction with others" should focus on assessing one's own interpersonal ability to exercise well with and build supportive relationships with others. Rather than evaluating whether an individual needs support from others to engage in or maintain PA. Therefore, no additional items were added into the "Interaction with others" category.

Knowledge and understanding

The literature reviews confirmed that having good knowledge about health, fitness, and PA is a significant determinate of PA behavior (Eyler et al., 2002; Hu et al., 2018; Trost et al., 2002; Van Cauwenberg et al., 2011). However, I only identified one well-developed instrument that measured PA knowledge among adults with Type 2 diabetes (Hui, hui, & Xie, 2014). Another two instruments contain one to three questions that assessed if respondents have

knowledge of the health benefits of PA and knowledge of recommended levels of PA (Crandall & Steebergen, 2015; Taylor et al., 2013). Informed by these measurements, I added "PA recommendation" into the "Knowledge and understanding" category.

In summary, from the review of the literature and existing related measures, I identified an additional 23 key elements that relevant to older adults' physical literacy. So far, a total of eighty-two key elements were identified from item development interviews, literature review, and existing relevant self-report measurements. The summary of the key elements, sources of key elements, and the initial draft of item statements are presented in Appendix 12.

Following the literature review, I started to draft the questionnaire. I wrote the item statements based on principles as described in the methodology chapter (Chapter 3), which included clarity, simplification, avoidance of double negatives, and avoidance of double-barreled statements (DeVellis, 2003; Foddy, 1993; Polit & Beck, 2010; Mishel, 1998; Streiner & Norman, 2008). In addition, I attended to the pattern, style, and tone of all items to ensure consistency across the questionnaire.

At the end of Stage 1, the development of initial version of Perceived Physical Literacy for Chinese Elderly Questionnaire (Version 1.0) was complete. Version 1.0 consists of 82 items and included 6 subscales: "Motivation" (17 items), "Physical competence" (13 items), "Interaction with environment" (27 items), "Sense of self" (10 items), "Interaction with others" (7 items), and "Knowledge and understanding" (8 items).

Results of Stage 2—Establishment of Content Validity

Results from Expert Panel Review

Between April 2019 to May 2019, I invited seven experts to rate the relevance and the clarity of the candidate items. The Table 6 shows the discipline and research background of the

invited experts. According to Lynn (1986), when using an expert panel of seven members, the criterion level for Item-Content Validity Index (I-CVI, the proportion of content that experts gave an item a relevance rating of 3 or 4 point) should be greater than 0.78. Therefore, for this study at least six of the seven experts needed to rate 3 or 4 points on each item in order to achieve the criterion.

Overall, the Average-Content Validity Index (S-SVI/Ave) of the Perceived Physical Literacy for Chinese Elderly Questionnaire was 0.91(>0.8). A total of 66 items (80.5%) achieved a satisfactory I-CVI score (>0.78). The panel of experts also provided narrative comments for 31 out of the 82 items (37.8%). Tabulated details of experts' all the comments on are present in Appendix 13. I carefully read the comments provided by the seven experts. After discussion with my PhD advisor, I made decisions to delete seven items, revise six items, split one item into two items, and add one new item into the questionnaire.

Among the 82 items, the experts rated 14 items (17.1%) with a low I-CVI score (0.43-0.78). For these suboptimal I-CVI items, the decision in response to the comments of experts is presented in Table 7.

Table 6.

Background of the Expert Panel (N=7)

ID	Disciplines	Expert introduction
EP1	Nursing	Assistant professor of a local university; over seven-years researcher experience on community-dwelling older adults' PA and leisure time activity.
EP2	Physical education	Assistant professor of a local college; over five-years researcher and teaching experience on older adults' PA.
EP3	Social sports instructor	Certified senior social sports instructor; over twelve-years working experience of supporting older adults' PA participation.
EP4	Public health	Associate professor of a local university; over twelve-years researcher experience on community-dwelling older adults' health promotion, including PA promotion.

EP5	Physical education	Assistant professor of a local university; over seven-years researcher experience on adults' sports and PA; have previous experience of developing PA-related self-report measurement.
EP6	Social sports instructor	Certified senior social sports instructor; over ten-years working experience of supporting older adults' PA participation.
EP7	Social sports instructor	Certified senior social sports instructor; over fifteen-years working experience of supporting older adults' PA participation.

Note. PA =physical activity.

Table 7.

Results of the items with low I-CVI (<0.78)

Item	Original item statement	I-CVI	Experts comments	Decision/Item revision
M1	How much do you value the benefits brought by physical activity?	0.57	This is a conclusive question, which can be covered by question M2, M3, and M4	▪ Deleted. Accepted expert's suggestion.
M7	How much effort did you put in physical activity?	0.71	Not clear. Suggested to use "time and effort"	▪ Kept and revised: according to the interview results, older adults talked about the time and effort they put in PA; - How much time and effort did you put in physical activity?
P2	How confident are you about your physical ability?	0.71	A conclusive question, which is not at the same level with other questions; the meaning of the item is same to P1	▪ Deleted. Accepted expert's suggestion.
E1	How confident are you about keeping up some amount of physical activity when your mood is low?	0.71	Low mood can be a motivation for PA participation	▪ Kept. For further testing. Low mood was seen as a significant barrier for PA participation in literature.
E2	How confident are you about keeping up some amount of physical activity when you experience great stress?	0.71	Stress can be a motivation for PA participation	▪ Kept. For further testing. Stress was seen as a significant barrier for PA participation in literature.
E7	How confident are you about keeping up some amount of physical activity when you feel tired?	0.43	Similar to E6. For older adults, if they feel tired, they need better rest rather than doing PA	▪ Deleted. Accepted expert's suggestion.
E10	How confident are you about keeping up some amount of physical activity when you are not healthy?	0.43	Not appropriate. If people get sick(acute), they need rest	▪ Deleted. Accepted expert's suggestion.
E13	How confident are you about keeping up some amount of physical activity when you don't have a regular routine?	/	Not clear. (2 experts did not rate this item because of the unclear question)	▪ Kept and revised. How confident are you about keeping up some amount of physical activity when some issues interrupt your regular routine?
E23	How confident are you about keeping up some amount of physical activity when you don't have transportation?	0.71	This situation is uncommon; older adults usually workout in their communities	▪ Kept. For further testing. Lack of transportation was seen as a significant barrier for PA participation in literature.

E24	How confident are you about keeping up some amount of physical activity if the traffic is heavy in your community?	0.71	This situation is uncommon	▪ Kept. For further testing. Heavy traffic was seen as a significant barrier for PA participation in literature.
S9	How positive do you feel about yourself in general?	0.71	Not relevant to PA	▪ Kept. According to physical literacy, physically literate individuals have an overall positive attitude towards themselves
S10	How easy for you to perform physical activity regularly?	0.71	A conclusive question, which is not at the same level with the rest of questions; redundant question, the meaning of this question can be summarized by previous questions	▪ Deleted. accepted expert's suggestion.
K6	Howe clear are you about the health benefits of regular physical activity?	0.71	This question can be covered by K5	▪ Deleted. Accepted expert's suggestion.
K7	How much do you know about physical activity?	0.57	The question is not clear. A conclusive question, which is not at the same level with other questions	▪ Deleted. Accepted experts' suggestion.

Note. PA= physical activity; M=motivation; P=physical competence; E=interaction with environment; S=sense of self; O=interaction with others; K=knowledge and understanding; I-CVI = Item-Content Validity Index

For items M1, P2, S10, K6, and K7, experts commented that these items are conclusive questions. For example, the meaning of item M1 ("How much do you value the benefits brought by physical activity?") can be covered by the item M2 ("health value"), M3("mental value"), and M4 ("social value"). One expert (EP5) suggested that this type of question should be avoided because the meaning of these items are not at the same level as others items in the subscale(s). I decided to delete these five items based on the experts' suggestion and the criteria that (1) all the items in one scale need to be measured on one level and (2) the meaning of items should not overlap (Putten, Paulus, Evers, Hutubessy, & Hiligsmann, 2016).

I also made the decision to delete item E7 ("How confident are you about keeping up some amount of physical activity when you feel tired?") and item E10 ("How confident are you about keeping up some amount of physical activity when you are not healthy?"). Over half of the experts believed these two items were not appropriate. One expert commented that "*when older adults are sick, they needed more rest rather than performing PA" and "it is not safe and effective to do PA when tired*" (EP6).

For items E1and E2, some experts commented that "low mood" and "stress" can either be a motivation or barrier for older adults' PA participation. However, there is strong evidence from the literature review that mood disturbance and stress are significantly negatively associated with low PA participation (Eyler et al., 2002; Koeneman et al., 2011; Plonczynski, 2003; Trost et al., Van Cauwenberg et al., 2011). Therefore, I decided to retain these two items for further testing with Chinese older adults using cognitive interviewing. For items E23 and E24, some experts noted that "heavy traffic" and "lack of transportation" were uncommon challenging situations for Chinese older adults in China. Therefore, older adults may not think that these are barriers. Again, I decided to retain these two items for further testing since existing evidence shows that

heavy traffic and lack of transportation has a significant negative influence on older adults' PA participation (Eyler et al., 2002; Van Cauwenberg et al., 2011; Trost et al., 2002).

Experts also identified that item M7 ("How much effort did you put in physical activity?") and item M13 ("How confident are you about keeping up some amount of physical activity when you don't have a regular routine?") lacked clarity. The reviewers suggested in M7 to replace the word "effort" with "time and effort (in Chinese, people used to say the words "time" and "effort" together to refer to the meaning of "great effort"). Further, the reviewers suggested "don't have regular routine" for item M13 required more clarity. I accepted the experts' suggestions and revised the items accordingly.

For item S9 ("How positive do you feel about yourself in general?"), two expects rated it irrelevant or somewhat relevant because they considered this item had little relevance to PA. However, according to physical literacy, physically literate individuals have an overall positive attitude and feeling towards themselves (Whitehead, 2010). Therefore, I decided to retain this item in the questionnaire.

In addition, although the I-CVI for item O5 "(What is your ability to get the physical activity-related help that you need from other people, such as information or guidance?) was 0.87, one expert (EP5) commented that this item contained two thoughts "information" and "guidance" and suggested to divide the item into two questions. I accepted this suggestion and divided the items into: item O5 "What is your ability to get the physical activity - related information that you need from other people?" and item O8 "How confident are you to get the physical activity guidance that you need from other people?". One expert (EP3) suggested to add an additional question regarding PA safety in the "Knowledge and understanding" domain, *"many older adults I worked with were once injured in PA. Older adults need to know how to*

protect themselves during PA, one question needs to be added to ask if they know how to prevent injury during exercise." I accepted this suggestion and added an additional item K9 "How clear are you about how to prevent injury during physical activity?".

In summary, the generated 82 candidate items were examined through an expert panel review. Overall, I deleted seven items, divided one item, and added one item to the questionnaire based on comments provided by seven experts. Additionally, I revised six items to increase clarity. The revised Perceived Physical Literacy for Chinese Elderly Questionnaire (version 1.1) now totaled 77 items. The revised questionnaire was then used in cognitive interviews with Chinese older adults.

Results from Cognitive Interviews

Fifteen Chinese older adults (9 female, 6 male), ages range from 63 to 82 years old (M=71.40, SD=5.89) completed cognitive interviews. The majority of participants were married and living with a spouse (n=10). Four out of 15 participants were illiterate and 8 had secondary or higher education. Among participants, nine self-identified as regular exercisers (participating in PA at least three times a week, 30 minutes per time) (see Table 8).

Table 8.

Demographic Information of Cognitive Interview Participants (N=15)

ID	Age	Sex	Marital status	Education	Living area	Living with others	Retirement (years)	Health status	Regular PA
RC1	69	F	Widowed	Secondary	U	Alone/C	13	Fair	Yes
RC2	78	F	Marred	Illiterate	U	S	20	Good	No
RC3	73	M	Married	Primary	U	S	10	Excellent	Yes
RC4	65	F	Married	Primary	R	S	10	Good	Yes
RC5	70	M	Married	Secondary	U	S	10	Fair	No
RC6	77	F	Married	Illiterate	R	S and C	NW	Poor	No
RC7	73	M	Widowed	Secondary	U	Alone	13	Fair	Yes
RC8	63	M	Married	Secondary	U	S	1	Good	No
RC9	65	F	Divorced	Tertiary	U	Alone	Not retired	Good	Yes
RC10	82	F	Married	Illiterate	U	S	NW	Fair	No
RC11	69	M	Single	Primary	R	Alone	8	Good	Yes
RC12	69	F	Married	Secondary	U	S	12	Poor	Yes

RC13	71	M	Married	Secondary	U	S	6	Fair	Yes
RC14	81	F	Widowed	Illiterate	R	C	NW	Fair	No
RC15	66	F	Married	Secondary	R	S and C	9	Fair	Yes

Note. F=female; M=male; U=urban; R=rural; S=spouse; C=children; NW=never worked.

A variety of problems were identified from the cognitive interviews indicating a need for further revision of the questionnaire. By using the pre-determined coding scheme that was developed based on the Questionnaire Appraisal System (Willis & Lesser, 1999; Willis, 2015), I identified a total of 50 problems from the developed questionnaire, including: Wording (n=15), Technical terms (n=7), Vague (n=10), Inappropriate assumption (n=5), Attitude (n=9), Mismatch (n=1), other problems (not previously identified) (n=2), and Complicated instructions (n=1). Based on the findings from the cognitive interviews, I eliminated 7 items and revised 43 items from the questionnaire. The summary of the cognitive interview results is shown in Appendix 14. The following Table 9 demonstrates examples of revised and deleted items.

Table 9.

Examples of Problems Identified from Cognitive Interviews (N=15)

Item	Statements	Codes	Quotes and comments	Decision/Amendment
M7	How much time and effort did you put in physical activity? Not at all effortful, A little effortful, Somewhat effortful, Very effortful, or Extremely effortful?	▪ Mismatch	▪ "You asked 'how much', so the options should be how much 'amount' not 'effortful'" (RC9) ▪ The rest of interviewees agreed with the comment.	▪ Revised. ▪ How much time and effort did you put in physical activity? Not at all, A little amount, Somewhat amount, Very amount, or Extremely amount?
M13	How much pleasure do you derive from participating in physical activity? Not at all pleasurable, A little pleasurable, Somewhat pleasurable, Very pleasurable, or Extremely pleasurable?	▪ Other Problem -Redundancy	▪ "I think this question is same to this one (M11)" (RC1) ▪ The rest of interviewees agreed with this comment.	▪ Deleted.
P11	How confident are you about your ability to do the aerobic PA, such as walking, radio calisthenics, cycling, or jogging? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Technical terms ▪ Wording	▪ "What is aerobic PA? I have never been to school… Is playing badminton (an aerobic exercise)?" (RC2) ▪ 5 of 15 did not know the term "aerobic exercise".	▪ Revised. Used substituted plain language. Reworded the question. ▪ What is your ability to do the physical activities that are not high-intensity but require endurance, such as walking, radio calisthenics, cycling, or jogging?
P12	How confident are you about your ability to do the resistance activities, such as dumbbell lifting, squat, or wall push-up? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Attitude ▪ Technical terms ▪ Wording	▪ "What does resistance activity include?" (RC1) ▪ "…I can guess but I'm not sure, I don't do these activities very often… so I would say my ability is not good." (RC1) ▪ 10 of 15 did not know the term "resistance activity". ▪ 6 of 15 said that they did not do this kind of PA.	▪ Revised. Resistance training is recommended for older adults. Used substituted plain language. Reworded the question. ▪ What is your ability to do the physical activities that rely mainly on your muscle strength and power, such as dumbbell lifting, squat, or wall push-up?
E1	How confident are you to perform physical activity regularly when your mood is low? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Inappropriate assumption	▪ "This is not a problem …I think I would do more physical activity if I have bad mood to make my mood better.. so … (bad mood) is more like a motivation for me." (RC8)	▪ Deleted. For the targeted Chinese older adults, low mood may not a challenging situation for them.

			▪ 12 of 15 did not feel low mood is a barrier for their PA participation.	
E5	How confident are you about keeping up some amount of physical activity when you have physical function limitation, such as having difficulties with mobility? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Other Problem-Redundancy	▪ "for me, this is the same question with the joint problem question… I am thinking about my join problem when I answer this question" (RC3) ▪ The rest 10 interviewees agreed that E3 and E5 can be combined.	▪ Deleted. Combined E3 and E5 ▪ How confident are you about keeping up some amount of physical activity when you have physical function limitation, such as having joint problem that affects your mobility?
E12	How confident are you to perform physical activity if you have past injury history during physical activity? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? ?	▪ Attitude	▪ "I never get injured during physical activity… I don't know." (RC10) ▪ All interviewees did not have injury history during physical activity.	▪ Deleted. For the targeted Chinese older adults, injury history is not a common challenging situation for them.
E15	How confident are you about keeping up some amount of physical activity when you need to provide care to others, such as your grandchild, your spouse, or family member? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Double-barreled	▪ "Well, that depends on who I look after. Looking after grandchild is different from looking after older or sick people… the mood is different. If I needed to look after a sick person, I don't have the mood to do exercise." (RC9) ▪ 11 of 15 agreed with that taking care of children is different from taking care of dependent family members.	▪ Revised. Divided into two questions. ▪ How confident are you about keeping up some amount of physical activity when you have childcare duty? ▪ How confident are you about keeping up some amount of physical activity when you need to take care of someone member who lacks the ability to maintain independent living, such as sick family members?
E16	How confident are you about keeping up some amount of physical activity when no one encourage you to do physical activity? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Inappropriate assumption	▪ "I don't need anyone to encourage me.. so it doesn't matter have someone encourage me." (RC1) "My husband always told me to do, but I still don't do." (RC15) ▪ 12 of 15 felt no encouragement is not a challenging situation for them.	▪ Deleted. For the targeted Chinese older adults, no encouragement may not a challenging situation for them.
E21	How confident are you about keeping up some amount of physical activity when the temperature is too hot or too cold? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Double-barreled	▪ "Too hot is problem but too cold is not…" (RC7) ▪ 8 of 15 noted that this item includes two questions.	▪ Revised. Divided the question into two. ▪ How confident are you about keeping up some amount of physical activity when the temperature is too hot?

				▪ How confident are you about keeping up some amount of physical activity when the temperature is too cold?
E23	How confident are you about keeping up some amount of physical activity when you don't have transportation? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Inappropriate assumptions	▪ "I don't go far to do physical activity; I don't need the transportation" (RC 2) ▪ "My legs are my transportation… I don't know how to answer this question." (RC10) ▪ All interviewees found this question is not relevant to their PA.	▪ Deleted. For the targeted Chinese older adults, heavy traffic may not a challenging situation for them.
E24	How confident are you about keeping up some amount of physical activity if the traffic is heavy in your community? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Inappropriate assumptions	▪ "I don't do exercise on the street, so it is not matter whether the community traffic is heavy or not" (RC13) ▪ All interviewees found this question is not relevant to their PA.	▪ Deleted. For the targeted Chinese older adults, heavy traffic may not a challenging situation for them.
E26	How confident are you to perform physical activity if your community is not safe, such as no streetlights, unattended dogs, or feeling unsafe? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Inappropriate assumptions	▪ "I don't know, our community is quite safe…" (RC1) ▪ 13 of 15 found this question is difficult to answer because they did not have such experience before.	▪ Deleted. For the targeted Chinese older adults, community safety may not a challenging situation for them.
S3	How confident are you to keep doing physical activity regularly for a short period of time? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Vague	▪ "…about 1 year" (RC6) "short-term, about 3 months…" (RC7) ▪ Interviewees had different opinions about "long-term", from one month to 1 year.	▪ Revised. Made the question more specific. ▪ How confident are you to keep doing physical activity regularly for the next 3 months?
S4	How confident are you to keep doing physical activity regularly for a long period of time? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	▪ Vague	▪ "it means always … at least 10 years…" (RC3) "I'm thinking about 5 years or more" (RC11) ▪ Interviewees had different opinions about "long-term", from 3 years to over 10 years.	▪ Revised. Made the question more specific. ▪ How confident are you to keep doing physical activity regularly for the next 3 years? and How confident are you to keep doing physical activity regularly for the next 10 years?

Note. PA= physical activity; M=motivation; P=physical competence; E=interaction with environment; S=sense of self; O=interaction with others; K=knowledge and understanding.

The most common problem of the developed items was Wording (n=15). Chinese older adults pointed out that the wording of some questions was awkward and lengthy, which were not consistent with how people normally speak. For example, items P3 to P13, the original wording for these items were "*how confident are you about your ability to…? 您对自己… 的能力有多少信心?*". One participant commented that since these questions were not asking about the perceived ability, the questions can be asked more directly; he said, *"the wording of the question is awkward… how about - What is your ability to …? 您...的能力如何?"* (RC5). The rest of the interview participants all agreed that the revised item statement was better. When comments about problems with wording occurred during the interviews, I asked participants how they would word the question. Based on responses, I revised the items accordingly by using the language provided by participants.

Seven items contain terms/words that were difficult for some participants to understand. For example, item P11 asks one's perceived ability of performing aerobic PA. Five out of fifteen participants did not know the definition of "aerobic PA". One illiterate participant reported, *"what is aerobic activity? … I have never been to school… is playing badminton [an aerobic PA]?*" (RC2). For items with "Technical terms" problem, I modified the original items to avoid using terms/words that older adults may not be familiar with. Instead, I substituted plain language to replace those terms and provided some examples to explain the questions. By using these strategies, I revised item P11 to "what is your ability to do the physical activities that are not high-intensity but require endurance, such as walking, radio calisthenics, cycling, or jogging?".

Another common issue that emerged from the interviews was "Vague" (n=10), that is, the question is unclear and has multiple ways to be interpreted (Willis & Lesser, 1999; Willis, 2015).

For example, for item P1 "How physically fit do you think you are?", some participant found it difficult to come up with an answer. One participant explained, *"it depends on comparing to who…. I'm in the 70s, if compare with those in their 60s, I'm not as fit as they are*" (RC7). Therefore, I amended this item to "compared to the majority of people in your age group and same sex, how physically fit do you think you are?". Another example of vague items was items S3 and S4. These two items asked older adults to evaluate how confident they are to maintain regular PA for a short and a long period of time. From the interviews, I found that participants had varied interpretations of "a short period of time" and "a long period of time" ranging from one month to one year (short term) and three years to over ten years (long term) respectively. I did not find clear definitions for short-term and long-term PA. Therefore, I defined short-term as 3 months and long-term as 10 years according to participants' opinions. However, one participant (RC13) reported that 10-years sounded too long for him, Therefore, I added one item in the questionnaire to ask how confident is the older adult in maintaining regular PA for the next 3 years.

Five items (E1, E16, E23, E24, and E26) under the subscale of "Interaction with environment" had problems with "Inappropriate assumption(s)". There are inappropriate assumptions made about Chinese older adults in these items. Based on participants' feedback, I made the decision to delete these five items because they were difficult and confusing for Chinese older adults to answer. For example, item E1 "how confident are you to perform physical activity regularly when your mood is low?". This item makes a wrong assumption that having low mood is a barrier or is a challenging situation for older adults' PA participation. Twelve of 15 participants found this item confusing because the low mood is more like a motivation for them. One participant explained, "*...I think I would do more physical activity if I*

have a bad mood to make my mood better…" (RC8). Another example of "Inappropriate assumption(s)" item is E23 "how confident are you about keeping up some amount of physical activity when you don't have transportation?". All participants found this question difficult to answer because they usually do PA nearby their homes and did not need transportation to do PA. As two participants explained, *"I don't go far to do physical activity… I don't need the transportation"* (RC2) and *"my legs are my transportation… I don't know how to answer this question."* (RC10).

Two items were identified as being "Double-barreled", that is, there were more than one suggested question in the item (Willis, 2015). One double-barreled item was E15 "How confident are you about keeping up some amount of physical activity when you need to provide care to others, such as your grandchild, your spouse, or family member?". Eleven of 15 participants commented that looking after children was different from taking care of others. One participant explained that, "*well, that depends on who I look after. Looking after grandchild is different from looking after older or sick people… the mood is different. If I needed to look after a sick person, I don't have the mood to do exercise… if I took care of kids, I may do some.*" (RC9). Accordingly, I divided item E15 into two items – "provide care to child" and "provide care to someone who lacks the ability to maintain independent living". Another "double-barreled" item was E21 "how confident are you about keeping up some amount of physical activity when the temperature is too hot or too cold?". Eight of 15 participants noted that this item included two questions. For some older adults, the hot weather is a more significant barrier for their PA participation than cold weather. This may be because I conducted the study in Kaifeng, China where summers are hot and winters are mild (around and above 0 ℃/32℉ during winter). Participants did not have much experience doing PA in very cold weather. In other to

solve this problematic item, I made the decision to divide the original item into two items – "too hot" and "too cold".

Nine items received the code "Attitude". These items asked the respondents to rate attitudes that the respondent may not have formed. One example is the item P12, which asked older adults to rate their perceived ability of performing resistance PA. Six participants reported that they were unsure about their selections for this item because they did not or infrequently did resistance PA and were unable to give an accurate estimation. I revised and retained this item in the questionnaire because doing muscle-strengthening activities two or more times a week is highly recommended for older adults (WHO, 2010). P12 was revised. Instead of using the specific term "resistant PA", a more general wording was used– "PA that rely mainly on your muscle strength and power". Using more general wording provides respondents more flexibility to make ratings based on their related experiences (Atkinson & Lennox, 2006). E12 is another item with an "Attitude" problem. E12 asks older adults how much confidence do they have if they had a previous injury experience during PA. All participants reported that they did not know how to answer this question since no one had an injury experience before. Therefore, I decided to delete this item from the candidate item set.

One item, item M7 "how much time and effort did you put in physical activity?", was identified as having a "Mismatch" problem. The original response options for this item is "not at all effortful, a little effortful, somewhat effortful, very effortful, or extremely effortful?". One participant commented that the response options did not match with how the question was asked, *"you asked 'how much', so the options should be about how much 'amount' not 'effortful'"* (RC9). I accepted the suggestion and revised the response options to "not at all, a little amount, somewhat amount, very amount, or extremely amount?".

There are two items (M13 and E5) that were identified as having "Redundancy" problems that were not previously identified in the Question Appraisal System. For item M13 "how much pleasure do you derive from participating in physical activity?", all participants commented that the meaning of this item is very similar to the item M11 "how much joy do you derive from participating in physical activity?". Participants thought the meaning of "pleasure" and "joy" were the same and interpreted the two items in the same way. For item E5 "how confident are you about keeping up some amount of physical activity when you have physical function limitation?", 11 of 15 participants suggested combining this item with item E3 "how confident are you about keeping up some amount of physical activity if you have joint problem?". One participant explained that, "*for me, this is the same question with the joint problem question…I am thinking about my join problem when I answer this question*" (RC3). According to participants' comments I deleted item M13 and combined item E3 with item E5.

In addition, I also identified a problem with the statement of instruction for completion of the questionnaire ("Completed instruction"). The majority of participants had difficulty in understanding the instructions regarding how to response to the survey questions. Eleven of 15 participants said they had no previous experience answering questions by using a Likert scale. In order to amend this problem, I created a visualized rating scale for the participants (see Figure 5) to use and added a practice question in the statement of instruction to help participants respond using a Likert scale.

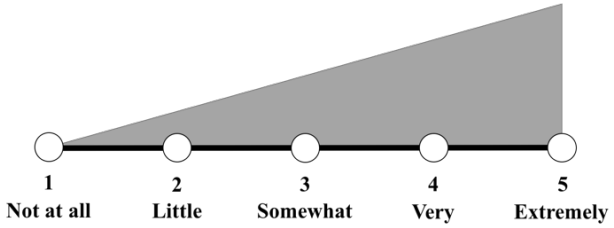

Figure 5. The rating scale for the Perceived Physical Literacy for Chinese Elderly Questionnaire

In summary, by referencing the findings from the cognitive interviews, I revised 43 items, discarded 7, and added 2 items. I again invited the seven experts to rate the relevance of the revised questionnaire items, five experts accepted the invitation. The experts rated all revised items are relevant (3 or 4 point). The I-CVIs of all 72 retained items was 1.0 and the S-CVI/Ave. for the questionnaire was 1.0.

Overall, revisions after the expert panel review with 7 experts and cognitive interviews with 15 Chinese older adults yielded a new version of the Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0), which included 72 items within 6 hypothesized subscales ("Motivation", "Physical competence", "Interaction with environment", "Sense of self", "Interaction with others", and "Knowledge and understanding") (See Appendix 9).

Results of Stage 3— Questionnaire Testing and Refining

Description of the Sample

From July 2018 to August 2018, a total of 388 community-dwelling Chinese older adults in Kaifeng, China were recruited and completed the face-to-face, paper-and-pencil questionnaire survey interviews using the developed Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0). Table 10 presents he demographic information of the participants. The age of participants ranged from 60 to 88 years with a mean of 68.20 (*SD*=6.04). Over half of the participants were female (*n*=226, 58.2%), and the majority of participants were married (85.6%), lived with a spouse (77.9%), and lived in a urban area (77.1%). About one-tenth (11.1%) of participants never received school education, half (50.8%) received primary and middle school education, and 37.6% had a high school of higher education. As for their health status, the majority (71.4%) perceived good or very good health status, 90.5% were independent in walking, and 77.3% had one or more comorbidities (e.g. hypertension, diabetes, cancer,

arthritis, etc.). Eighty one percent of participants self-identified as regular PA participants (participating in PA at least three times a week and 30 minutes per time), and over half (51.5%) had more than five years' experience of regular PA participation.

Table 10.

Demographic Characteristics of the Survey Participants (N=388)

Demographic characteristics	Mean (*SD*)	n (%)
Age, years [range 60-88]	68.20 (6.04)	
Gender		
Male		162 (41.8)
Female		226 (58.2)
Education level[a]		
Never school		43 (11.1)
Primary school education		88 (22.7)
Middle school education		109 (28.1)
High school education		79 (20.4)
College education		63(16.2)
Graduate school education		4 (1.0)
Marital status		
Married		332 (85.6)
Widowed/Unmarried		45 (11.6)
Retirement		
Retired		328 (84.5)
Not retired		51 (13.2)
Never worked		9 (2.3)
Living area		
Urban		299 (77.1)
Rural		89 (22.9)
Living Arrangement[b]		
Lives alone		35 (9.0)
Lives with spouse		300 (77.3)
Lives with adult children		93 (24.0)
Lives with others		11 (2.8)
Ambulatory status		
Independent in walking		351 (90.5)
Using of ambulation assistive device		37 (9.5)
Perceived health status		
Very poor		3 (0.8)
Poor		10 (2.6)
Fine		98 (25.3)
Good		192 (49.5)

Very good	85 (21.9)
Comorbidities	
No comorbidity	88 (22.7)
1 comorbidity	86 (22.2)
2 comorbidities	83 (21.4)
3 or more comorbidities	131 (33.7)
Regular PA participation	
Not regular	73 (18.8%)
< 1 year	32 (8.2%)
1-5 years	61 (15.7)
5-10 years	85 (15.7%)
10-15 years	83 (21.9%)
Over 15 years	54 (13.9%)

Note. SD=standard deviation; PA= physical activity; [a]Percent not sum to 100 due to missing data; [b]Sum of percent over 100 due to participants can select more than one option; Regular PA participation is participating in PA at least three times a week and 30 minutes per time.

Results of Item-level Analysis

The percentage of missing data

I collected the data through face-to-face interviews, so all questionnaires were 100% complete. However, some participants selected "do not know" to respond to particular items. The reasons for selecting "do not know" included "do not have the experience" or "do not have the attitude" related to the question(s), "difficult to select the appropriate option", and simply "do not want to answer". In this study, the response option "do not know" was treated as non-random missing data.

A high percentage of missing data for an item indicates that the item may not be a good response item. If an item's missing response rate is greater than 10%, the item should be considered for deletion (WHOQOL Group, 1998). The average missing response rates of the Perceived Physical Literacy for Chinese Elderly Questionnaire's items were low (see Table 12). However, five items (PLb24, PLb26, PLc32, PLc35, and PLc45) contained over 10% of missing data, the missing response rates for these items are 11.08%, 14.18%, 18.30%, 11.88%, and 12.37%, respectively.

The frequency of endorsement

Table 12 summaries the distribution of responses on 5-point Likert options among 72 items. The response options were: 1= “not at all”, 2= “a little”, 3= “somewhat”, 4 = “very” and 5 = “extremely”. When examining each item for the endorsement rates on two extreme options (1= “not at all” and 5= “extremely”), one item, PLb22, had over 40% of the participants select an extreme response (5= “extremely”), which indicates that this item has a ceiling effect and the item may be too “easy” for the participants (Donna et al.,2001).

As for detection of skewed items, I found a total of 5 items (PLa5, PLa11, PLa13, PLb22, and PLb24) that had less than 10% of endorsement rate in two adjacent extreme response options. Specifically, four items (PLa5, PLa11, PLa13, and PLb22) were negatively skewed (less than 10% of total endorsement rate in responses 1= “not at all” and 2= “a little”), and one item (PLb24) was positively skewed (less than 10% of total endorsement rate in responses 4 = “very” and 5 = “extremely”). By examining the skewed items across different hypothesized subscales, I found three of the five skewed items (PLa5, PLa11, PLa13) were in the hypothesized subscale of “Motivation”, and one skewed item (PLb22) was in the hypothesized subscale of “Physical competence”.

The item-total and inter-item correlations

For the item-total correlation, 33 items were highly correlated with the total score of the hypothesized subscales they belonged to (r>0.7) (see Table 12). The high item-total correlation between the item and the total subscale indicates items within the subscale are over-redundant.

I computed the inter-item correlation coefficients within each hypothesized subscale. Table11 presents the extracted and summarized correlation matrix among the identified highly correlated items (r>0.75). Of six hypothesized subscales, 34 items were highly correlated with

one or more other item(s) within the same hypothesized subscale, with the coefficient ranging from 0.751 to 0.847. These items were in the subscales of “Motivation” (PLa2, PLa4, PLa5, PLa9, PLa10, PLa11, PLa12, and PLa14), “Physical competence” (items PLb23, PLb24, PLb26), “Interaction with environment” (PLc28, PLc29, PLc30, PLc31, PLc32, PLc33, PLc34, PLc35, PLc35, PLc37, PLc38, PLc39, PLc40, PLc41, PLc42, PLc44, PLc45, PLc46, and PLc47), “Sense of self” (items PLf51 and PLf57), and “Interaction with others” (items PLe60 and PLe61). The high inter-item correlations between items indicated these items are over-redundant and participants responded them in a very similar manner.

Table 11.

Correlation Matrix among the Highly-correlated Items (r>0.75)(N=388)

	PLa2	PLa4	PLa5	PLa9	PLa10	PLa11	PLa12	PLb23	PLb24	PLc28	PLc31	PLc34	PLc35	PLc37	PLc38	PLc39	PLc41	PLc42	PLd51	PLe60
PLa4	**0.764**	1.000	**0.794**																	
PLa10	0.667	0.710	0.613	**0.766**																
PLa11	0.596	0.594	0.659	0.651	**0.784**															
PLa12	0.671	**0.763**	0.705	0.701	**0.758**	0.669														
PLa13	0.687	0.656	**0.801**	0.661	0.673	**0.753**	**0.765**													
PLa14	0.691	**0.781**	**0.764**	0.736	0.694	0.726	0.679													
PLb24	0.219	0.203	0.247	0.304	0.319	0.352	0.252	**0.819**												
PLb26	0.239	0.239	0.268	0.316	0.291	0.320	0.302	0.669	**0.800**											
PLc29	0.390	0.466	0.422	0.486	0.466	0.559	0.497	0.419	0.507	**0.828**										
PLc30	0.351	0.485	0.400	0.463	0.468	0.490	0.426	0.430	0.452	**0.755**										
PLc32	0.404	0.460	0.464	0.532	0.487	0.548	0.480	0.374	0.412	**0.753**	0.605									
PLc33	0.422	0.450	0.406	0.548	0.505	0.542	0.473	0.544	0.593	**0.781**	0.667									
PLc34	0.364	0.466	0.388	0.501	0.466	0.535	0.499	0.343	0.428	**0.776**	0.586									
PLc35	0.394	0.451	0.411	0.526	0.468	0.502	0.453	0.500	0.520	**0.800**	0.659	**0.803**								
PLc39	0.455	0.500	0.438	0.495	0.503	0.531	0.479	0.408	0.449	0.698	0.570	0.650	0.634	0.586	**0.791**					
PLc40	0.417	0.509	0.441	0.499	0.497	0.533	0.491	0.412	0.434	0.708	0.568	0.643	0.658	0.590	**0.752**	**0.844**				
PLc42	0.476	0.542	0.513	0.566	0.533	0.592	0.552	0.537	0.510	0.686	**0.814**	0.590	0.683	0.669	0.661	0.670	0.702			
PLc44	0.390	0.462	0.412	0.533	0.485	0.542	0.455	0.512	0.503	**0.824**	0.675	0.702	0.707	0.670	0.727	0.709	0.621	0.664		
PLc45	0.405	0.462	0.506	0.521	0.508	0.533	0.472	0.439	0.517	0.722	0.595	**0.751**	**0.767**	0.643	0.650	0.747	0.584	0.621		
PLc46	0.385	0.421	0.421	0.454	0.445	0.491	0.407	0.491	0.602	0.660	0.700	0.643	0.624	**0.753**	0.604	0.637	0.679	0.633		
PLc47	0.391	0.377	0.411	0.498	0.465	0.529	0.486	0.624	0.588	0.587	**0.777**	0.553	0.611	0.681	0.598	0.556	**0.815**	**0.755**		
PLd57	0.425	0.495	0.510	0.553	0.523	0.634	0.546	0.431	0.409	0.587	0.520	0.510	0.539	0.565	0.542	0.580	0.482	0.636	**0.788**	
PLe61	0.440	0.415	0.411	0.473	0.425	0.551	0.484	0.409	0.405	0.548	0.452	0.462	0.487	0.498	0.491	0.539	0.478	0.488	0.499	**0.847**

Note. r=Pearson's correlation coefficient; PLa=Motivation; PLb=Physical competency; PLc=Interaction with environment; PLd=Sense of self; PLe=Interaction with others; $r > 0.75$ are in boldface.

Table 12.

Summary of Item-level Analysis (N=388)

Items		Missing		Endorsement Frequency (%)					Inter-item correlation	Item-Total correlation	Decision
		n	%	1	2	3	4	5			
Motivation											
PLa1	Health value	2	0.52	3.06	7.47	29.12	28.35	31.47		0.699	Kept
PLa2	Mental value	3	0.77	1.55	11.86	27.84	28.35	29.64		**0.723**	Kept
PLa3	Social value	7	1.80	2.84	14.18	30.15	30.41	20.62		0.606	Kept
PLa4	Important for me	3	0.77	1.55	10.05	21.91	32.22	33.51	*r*(PLa2)=**0.764** *r*(PLa5)=**0.794** *r*(PLa14)=**0.781**	**0.749**	**Deleted**
PLa5	Important for older adults	1	0.26	**1.29**	**8.25**	21.13	33.25	35.82	*r*(PLa13)=**0.801** *r*(PLa14)=**0.764**	**0.712**	**Deleted**
PLa6	Time and effort	4	1.03	4.90	13.92	30.93	31.19	18.04		0.689	Kept
PLa7	Effort to do well	2	0.52	1.29	13.40	32.99	32.22	19.59		**0.736**	Kept
PLa8	Enjoyment	7	1.80	2.06	15.98	30.41	30.41	19.33		**0.785**	Kept
PLa9	Satisfaction	6	1.55	1.03	12.11	35.05	32.99	17.27		**0.720**	Kept
PLa10	Joy	4	1.03	2.84	13.40	29.38	28.35	25.00	*r*(PLa9)=**0.766** *r*(PLa12)=**0.758**	**0.765**	**Deleted**
PLa11	Happiness	7	1.80	**0.22**	**9.57**	30.74	32.02	25.26	*r*(PLa10)=**0.784**	**0.721**	**Deleted**
PLa12	Interest	9	2.32	0.52	11.60	27.58	29.90	28.09		**0.734**	Kept
PLa13	Want	7	1.80	**0.52**	**9.28**	27.06	33.25	28.09	*r*(PLa5)=**0.801** *r*(PLa11)=**0.753** *r*(PLa12)=**0.765**	**0.754**	**Deleted**
PLa14	Part of daily life	1	0.26	3.09	14.69	28.61	26.55	26.80		**0.782**	Kept
PLa15	Restlessness	5	1.29	9.02	20.88	30.41	23.45	14.95		**0.774**	Kept
Physical competency											
PLb16	Physically fit	9	2.32	6.96	19.59	43.81	19.33	7.99		0.521	Kept
PLb17	Walking	4	1.03	1.80	12.89	29.90	30.41	23.97		0.520	Kept
PLb18	Climbing	0	0	2.58	14.18	25.00	29.64	28.61		0.693	Kept
PLb19	Squatting/kneeling	6	1.55	3.35	13.92	28.35	26.55	26.29		0.671	Kept
PLb20	Carrying	3	0.77	7.73	24.48	27.32	22.42	17.27		0.641	Kept
PLb21	Grip	2	0.52	1.55	10.05	26.03	28.09	33.76		0.556	Kept
PLb22	Low intensity PA	2	0.52	**0.26**	**7.22**	18.81	32.22	**40.98**		0.584	**Deleted**

PLb23	Moderate intensity PA	11	2.84	10.31	24.23	30.67	17.78	14.18		**0.703**	Kept
PLb24	High intensity PA	**43**	**11.08**	30.67	25.26	25.91	**9.54**	**0.12**	*r*(PLb23)=**0.819** *r*(PLb26)=**0.800**	0.641	**Deleted**
PLb25	Aerobic/endurance PA	7	1.80	2.58	26.03	33.51	21.13	14.95		0.693	Kept
PLb26	Muscle-strengthening PA	**55**	**14.18**	24.74	26.55	19.33	11.34	3.87	*r*(PLb24)=**0.800**	0.636	**Deleted**
PLb27	Balance PA	21	5.41	15.72	34.28	24.48	11.86	8.25		0.674	Kept
Interaction with environment											
PLc28	Stress	39	10.05	15.98	23.20	27.32	16.24	7.22	*r*(PLc29)=**0.828** *r*(PLc30)=**0.755** *r*(PLc32)=**0.753** *r*(PLc33)=**0.781** *r*(PLc34)=**0.776** *r*(PLc35)=**0.800** *r*(PLc44)=**0.824**	**0.748**	**Deleted**
PLc29	Limited physical function	36	9.28	15.72	26.29	25.77	15.21	7.73		**0.719**	Kept
PLc30	Pain	24	6.19	17.53	23.20	25.00	18.04	10.05		**0.700**	Kept
PLc31	Lazy	6	1.54	5.93	19.85	34.79	24.23	13.66	*r*(PLc42)=**0.814**	0.626	Kept
PLc32	Balance problem	**71**	**18.30**	10.31	20.88	26.55	18.04	8.51		0.674	**Deleted**
PLc33	Lack of time	26	6.70	13.40	25.52	29.90	16.49	7.99		0.687	Kept
PLc34	Chronic health condition	33	8.51	22.16	26.03	21.65	13.66	7.99		0.686	Kept
PLc35	No regular routine	**46**	**11.86**	24.48	21.91	24.48	13.14	4.12	*r*(PLc34)=**0.803**	**0.736**	**Deleted**
PLc36	No companion	6	1.55	7.73	20.88	30.15	25.77	13.92		0.628	Kept
PLc37	Provide care to Child	37	9.53	12.37	21.91	26.55	17.53	9.54		0.674	Kept
PLc38	Lack of PA program	24	6.19	11.34	20.36	30.67	18.81	12.63	*r*(PLc40)=**0.752**	0.669	Kept
PLc39	Lack of exercise equipment	18	4.64	11.86	23.20	28.35	20.10	11.86	*r*(PLc38)=**0.791** *r*(PLc40)=**0.844**	0.707	**Deleted**
PLc40	Lack of PA space	21	5.41	10.57	21.65	29.64	20.36	12.37		0.662	Kept
PLc41	Bad weather	15	3.87	18.56	21.13	30.93	16.49	9.02		0.617	Kept
PLc42	Hot weather	5	1.29	7.99	21.91	33.51	25.52	9.79		0.626	Kept
PLc43	Air quality	23	5.93	31.19	23.45	21.39	12.63	5.41		0.643	Kept
PLc44	Not convenient	30	7.73	10.31	26.03	27.06	18.81	10.05		**0.718**	Kept
PLc45	Neighborhood walkability	**48**	**12.37**	14.69	22.16	25.26	20.62	5.67	*r*(PLc34)=**0.751** *r*(PLc35)=**0.767**	**0.720**	**Deleted**
PLc46	Provide care to others	35	9.02	14.95	20.10	27.84	15.72	9.02	*r*(PLc37)=**0.753**	0.625	Kept

PLc47	Cold weather	14	3.61	16.24	21.91	30.15	17.27	10.82	*r*(PLc31)=**0.777** *r*(PLc41)=**0.815** *r*(PLc42)=**0.755**	0.627	**Deleted**
Sense of self											
PLd48	As well as others	9	2.32	3.35	18.56	27.32	29.64	18.81		**0.746**	Kept
PLd49	As much as others	12	3.09	4.38	18.81	28.87	27.58	17.27		**0.736**	Kept
PLd50	Maintain 3 months	9	2.32	1.55	15.72	26.03	31.70	22.68		**0.743**	Kept
PLd51	Maintain 10 years	32	8.25	9.79	24.74	28.09	20.88	8.25		0.680	Kept
PLd52	Maintaining with aging	25	6.44	11.60	32.73	29.12	11.08	9.02		0.497	Kept
PLd53	Overcome barriers	14	3.61	3.61	23.45	35.57	24.23	9.54		**0.733**	Kept
PLd54	Achieve goals	12	3.09	2.32	16.24	35.05	31.96	11.34		**0.722**	Kept
PLd55	Achieve more	14	3.61	4.90	23.20	32.73	25.26	10.31		**0.738**	Kept
PLd56	Positive sense of self	5	1.29	4.64	11.34	37.11	26.29	19.33		0.666	Kept
PLd57	Maintain 3 years	22	5.67	4.12	18.30	31.19	26.55	14.18	*r*(PLd51)=**0.788**	**0.760**	**Deleted**
Interaction with others											
PLe58	Work well with others	8	2.06	7.22	18.81	36.34	26.03	9.54		**0.718**	Kept
PLe59	Get along with others	9	2.32	4.64	13.92	35.31	29.90	13.92		**0.723**	Kept
PLe60	Join in a group	28	7.21	9.02	16.24	36.08	20.62	10.82	*r*(PLe61)=**0.847**	**0.769**	**Deleted**
PLe61	Fill in a group	29	7.47	8.76	16.24	36.08	19.85	11.60		**0.703**	Kept
PLe62	Gain guidance	22	5.67	6.19	17.53	35.57	25.26	9.79		**0.724**	Kept
PLe63	Provide support	4	1.03	4.12	14.69	22.68	34.28	23.20		0.656	Kept
PLe64	Lead others	21	5.41	15.98	23.45	22.42	20.36	12.37		0.659	Kept
PLe65	Gain information	21	5.41	5.41	18.30	37.89	21.13	11.86		**0.712**	Kept
Knowledge and understanding											
PLf66	Suitable PA for me	3	0.77	4.12	17.78	27.84	30.41	19.07		0.674	Kept
PLf67	Suitable amount for me	8	2.06	7.22	16.49	31.96	28.35	13.92		0.687	Kept
PLf68	Suitable adjustment	18	4.64	7.73	19.85	34.02	25.00	8.76		0.680	Kept
PLf69	Improvement	14	3.61	3.87	21.65	28.35	24.48	18.04		0.680	Kept
PLf70	PA for well-being	2	0.52	2.58	17.01	28.35	29.12	22.42		0.584	Kept
PLf71	PA recommendation	9	2.32	5.15	29.12	37.63	18.30	7.47		**0.713**	Kept
PLf72	Prevent injury	6	1.55	9.02	23.20	30.41	22.94	12.89		0.627	Kept

Note. PA= physical activity; r=Pearson's correlation coefficient; PLa=Motivation; PLb=Physical competency; PLc=Interaction with environment; PLd=Sense of self; PLe=Interaction with others; PLf=Knowledge and understanding; Value out of criteria are in boldface.

Item Reduction According to the Item-level Analysis

I integrated findings from the item-level analysis to inform item reduction. Table 12 integrates the results of all item-level analysis for each item and lists the decision whether items were deleted or not. I made decisions to delete potentially poorly performing items based on the criteria: (1) eliminating items with over 10% of missing data (Hobart et al., 2001; WHOQOL group,1998); (2) eliminating items with a floor or celling effect (the endorsement frequencies on either extreme options >40%) and highly skewed (less than 10% of total endorsement rate in two adjacent extreme response options) (Hobart et al., 2001); (3) items which were over-redundant with other items in the same subscale (inter-item correlation >0.75), keeping items that demonstrated better results in other item-level analysis and cover the most theoretical meaning (Lam, 2015).

In the hypothesized subscale "Motivation", I made decisions about eliminating items PLa4, PLa,5 PLa10, PLa11, and PLa13. According to the item reduction criteria, I first discarded the items PLa11 "happiness" and PLa13 "want", which were highly positively skewed (the total endorsement rate in responses 1= "not at all" and 2= "a little" are 9.77% and 9.80%, respectively) and had high item-total correlation coefficients (r=0.721 and 0.754, respectively). Next, both the item-total correlation and inter-item correlation indicated that items PLa4 "PA is important for me", PLa5 "PA is important for older adults", and PLa14 "PA is important part of daily life" were over-redundant. The meanings of these three items were quite similar, all to some extent attempted to evaluate older adults' perceived importance toward PA. I first deleted item PL5, which was also a positivity skewed item. For the remaining two items (PLa4, PLa14), I decided to keep item PLa14 because: (1) PLa4 was also highly correlated with item PLa2 "value the mental benefits of PA"; and (2) the meaning of PLa14 was able to partly cover the

meaning of PLa4. For example, one who considers PA as an important part of his/her daily life would believe PA is important for him/her. I discarded item PLa10 “joy”, because it had a high item-total correlation coefficient (r= 0.765) and was highly correlated with both PLa9 “satisfaction” and PL12 “interest”. This indicated that PLa10 was over-redundant and participants responded to this item with two other items in a very similar way.

In the hypothesized subscale “Physical competence”, I discarded three items PLb22, PLb24, and PL26. Both PLb24 “high intensity PA”, and PL26 “muscle-strengthening PA” had over 10% of missing data (11.08% and 14.18% respectively), indicating that these items may not be appropriate questions for some participants. Some Chinese older adults may not have had prior experience with performing high-intensity and muscle-strengthening PA and found it is difficult to respond to the item(s). I deleted item Pla22 “low-intensity PA”, because it was highly skewed and had a ceiling effect (the total endorsement rate in responses 1= “not at all” and 2= “a little” is 7.48%, and the endorsement rate in response 5= “extremely” is 40.98%). Indicating doing half an hour of low intensity PA was a very easy task for the majority of participants and the item had limited discriminative power (Chiang, 2015).

In the hypothesized subscale “Interaction of environment”, I deleted six items PLc28, PLc32, PLc35, PLc39, PLc45, and PLc26. Because of the high missing response rate, I first discarded items PLc32, PLc35, and PL45. About 18% of participants (n=71) selected “do not know” for item PLc32 “confidence of keeping up PA if have balance problem”. This may indicate participants did not have balance problems and had no prior experience and perception to help them make a selection. For item PLc45 “confidence of keeping up PA when some issues interrupt the daily routine” the missing response rate was 11.88%. One possible explanation for the high missing rate is that the statement for this item was difficult to comprehend for some

participants since the phrase “some issues” is not clear enough. The item PLc46 “confidence of keeping up PA when the neighborhood is not convenient for walking” also had a high missing response rate (12.37%). It is possible that some older adults who participated in this study never encountered such problems before, or they did not consider lacking of the neighborhood walkability as a challenging situation for their PA participation. Next, I discarded item PLc28 “confidence of keeping up PA when experience great stress” because this item was highly correlated with items PLc29, PLc30, PLc32, PLc33, PLc34, PLc35, and PLc44 (r_s>0.753) and had a high item-total correlation coefficient (r=0.748). Stress is a general term applied to various mental and physiological pressures people may experience in their lives (Revathi & Raju, 2014). Many situations, such as limited physical function, pain, and lack of time, can all cause stress. Therefore, the meaning of PLa28 may/can be covered by other items in the subscale, making this item over-redundant. The items PLc38 “lack of PA programs in the community”, PLc39 “lack of public PA equipment”, and PLc40 “lack of PA space/facilities” were highly correlated with each other (r_s>0.752). All three items are about community PA resources. I deleted item PL39 because this item was also had a high item-total correlation coefficient (r=0.707). In addition, the meaning of PL39 may/can be covered by item PLc40 since usually PA equipment is provided in PA space/facilities. Another item deleted from this hypothesized subscale was item PLa47 “confidence of keeping up performing PA when the weather is too cold”. This item had high correlation coefficients with both PLc41 “bad weather” and PLc42 “too hot” (r=0.815, 0.755, respectively), suggesting the meaning of this item is similar to the other items. Participants might consider “too cold” as a type of “bad weather”. Therefore, based on the reduction criteria, I deleted PLa47.

In the hypothesized subscale "Sense of self", I deleted item PLd57 "confidence of keeping doing PA regularly for 3 years". This item had a high item-total correlation coefficient (r=0.760) and was highly correlated with item PLd52 "confidence of keeping doing PA regularly for 3 years". Both PLd52 and PLd57 are about long-term regular PA participation confidence. I decided to retain item PLd52 because its item-total correlation coefficient was in the recommended range (r=0.680). Further the meaning of PLd52 covers item PLd57, that is, a person who has confidence to keep doing PA regularly for 10 years is very likely to have confidence to maintain regular PA participation for 3 years.

In the hypothesized subscale "Interaction with others", item PLe60 "ability of join in a group" and item PLe61 "ability of fill in a group" were highly correlated (r=0.847). I made the decision to keep item PLe61 and discarded PLe60, because the item-total correlation coefficient of PLe60 was higher (r=0.769) and the meaning of PLe60 covered PLe6. A person who has the social ability to join groups is very likely to also have the ability to join a new PA group.

In the hypothesized subscale "Knowledge and understanding", although one items had high item-total correlation coefficient (*r=0.713*), the item had the unique meaning and performed good on other statistical tests of the item-level analysis. Therefore, I retained all items in the hypothesized subscale.

To summarize, I discarded a total of 16 items (five from "Motivation", three from "Physical competence", six from "Interaction with environment", one from "Sense of self", and one from "Interaction with others) and retained 56 items for exploratory factor analysis.

Results of Exploratory Factor Analysis

I conducted the Exploratory Factor Analysis (EFA) using Mplus Software (version 7.0, Muthen & Muthen, 2012). In this study, the primary aims of EFA were to determine the number

of factors underlying the developed perceived physical literacy questionnaire items and to use the factor analysis as an item reduction strategy to keep only those that best measure each factor (DeVellis, 1991).

The developed questionnaire used a Likert scale, indicating the data collected was ordinal. Therefore, I chose to use the unweighted least squares with mean and variance (ULSMV) estimation method for data analysis (Muthén, du Toit, & Spisic, 1997). The analysis used oblique (Promax) rotation because according to the conceptual framework of physical literacy (Whitehead, 2010), I assumed there is a correlation among the factors (attributes) of physical literacy.

I identified the number of factors based on the eigenvalue-one criterion, scree plot, content interpretability, and the goodness-of-fit (RMSEA ≤ 0.06; CFI ≥ 0.95; TLI ≥ 0.95; and SRMR ≤ 0.08) (Hu, & Bentler, 1999). First, among the 56 items, I conducted principal component analysis to extract factors with a criterion of eigenvalue >1.0. The results identified nine factors extracted from the data with eigenvalues greater than 1.0 (range from 15.39 to 1.02). Then, by examining the scree plot (Figure 6), the natural bend or break point in the dataset where the curve flattened out was at the point of factors 4 and 5. This suggested a four- or five-factor solution (Tabachnick & Fiddell, 2001). However, considering the six hypothesized factors (attributes) of physical literacy, I explored a four to seven factor EFA model. Table 13 demonstrates the goodness-of-fit results of the four to seven factor EFA model. The four-factor model had three fit indicators (RMSEA=0.07, CFI=0.926, and TLI=0.916) did not meet the recommended criteria. The five-, six-, and seven-factor solutions were a good fit with satisfied goodness-of-fit indexes, and the differences between them were small. I selected the six-factors

solution because the content of the six-factor solution was the most interpretable solution and in line with the preconceived physical literacy conceptual framework used in this study.

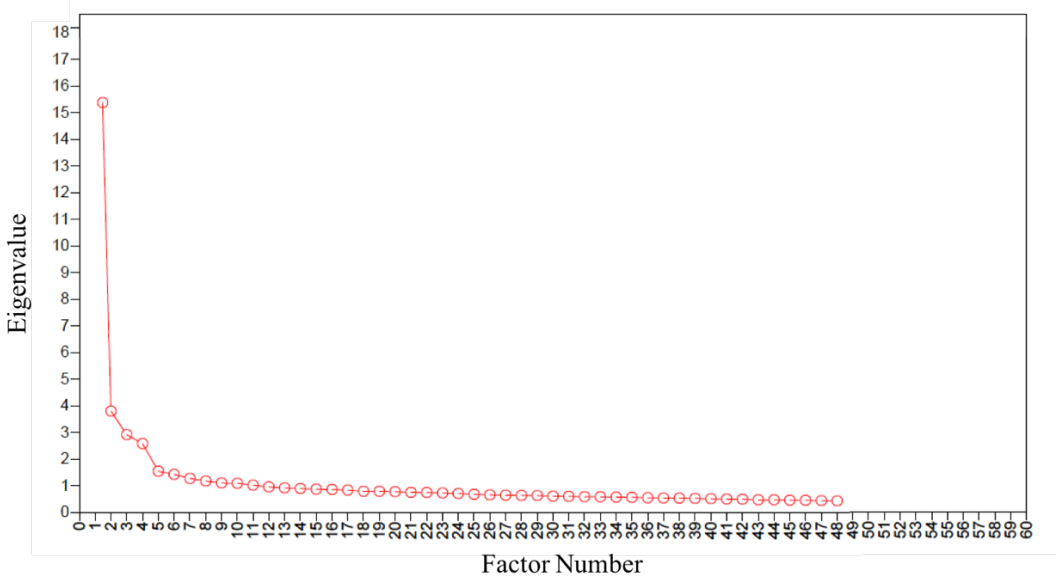

Figure 6. Scree plot between eigenvalue and factor number

Table 13.

Summary of fit Indices of Tested Four to Seven Factor Models (N=388)

Model	RMSEA (CI)	CFI	TLI	SRMR
Four factor	0.070 (0.067, 0.073)	0.926	0.916	0.051
Five factor	0.055 (0.052, 0.058)	0.959	0.962	0.042
Six factor	0.052 (0.049, 0.056)	0.963	0.965	0.032
Seven factor	0.051 (0.047, 0.054)	0.966	0.968	0.026

Note. CI= 90% confidence interval; RMSEA = root mean square error of approximation; CFI=comparative fit index; TLI=tucker lewis index; SRMR=standardized root mean squared residual; The recommended criteria is: RMSEA $\leqslant$0.06, CFI $\geqslant$0.95, TLI $\geqslant$0.95, and SRMR$\leqslant$ 0.08.

I estimated the six-factor EFA model among the 56 items by applying the ULSMV with the Promax rotation. The rotated factor loading matrix is shown in Table 14. Based on the results, the items were considered to be deleted if: (1) factor loadings were <0.32, and (2) loaded on more than one factor (cross-loading).

Of the 56 perceived physical literacy items, I eliminated 4 items because: (1) the factor loading of items PLb16 “perceived physically fit”, PLd52 “confidence of maintaining PA participation with aging”, and PLd64 “ability of being the leader to bring others to do PA” were below 0.32 on all factors; (2) item of PLc30 “confidence of keeping up PA if have chronic pain” cross-loaded on two factors.

After deleting these items, I ran the six-factor EFA model again among the remaining 52 items. The results suggested that another five items need to be removed from the model (see Table 15); items PLb27 “ability of performing balance PA”, PLc31“confidence of keeping up doing PA when feel lazy”, PLc44 “confidence of keeping up doing PA when the PA is not convenient”, PLd53 “confidence of overcome barriers”, and PLd55 “confidence of doing more PA” were removed.

I deleted the five unsatisfactory items and ran the six-factors EFA model again among the remaining 47 items. The rotated factor loading matrix from the remaining items’ factor loadings were more than 0.32 and had no cross-loading (see Table 16). Table 17 illustrates the results of the analysis of the goodness-of-fit for all EFAs performed. Overall, the final factor model and set of items for each content domain were acceptable according to the fit indexes criteria (RMSEA=0.045, CFI=0.973, TLI=0.964, and SRMR=0.028).

Table 14.

Results of Rotated Matrix of 6-factor Model among 56 Items(N=388)

Item		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Motivation							
PLa1	Health value	**0.734**	0.055	0.066	0.081	-0.035	0.121
PLa2	Mental value	**0.744**	0.073	0.064	0.047	0.084	0.041
PLa3	Social value	**0.560**	0.132	0.071	-0.077	0.096	0.191
PLa6	Time and effort	**0.666**	-0.092	0.113	0.142	0.029	0.137
PLa7	Effort to do well	**0.556**	0.104	-0.080	0.205	0.170	0.024
PLa8	Enjoyment	**0.744**	0.016	-0.031	0.122	0.116	0.116

PLa9	Satisfaction	**0.589**	0.048	0.089	0.158	0.102	0.120
PLa12	Interest	**0.637**	0.157	-0.010	0.119	0.120	0.108
PLa14	Part of daily life	**0.735**	-0.060	0.117	0.086	0.064	0.178
PLa15	Restlessness	**0.580**	-0.002	0.237	0.095	0.108	0.024
Physical competence							
PLb16	Physically fit	0.251	0.304	0.090	0.240	0.029	0.132
PLb17	Walking	0.195	**0.700**	-0.130	0.143	0.028	0.010
PLb18	Climbing	0.014	**0.776**	-0.006	0.069	0.111	0.064
PLb19	Squatting	0.015	**0.697**	0.127	0.030	0.143	0.031
PLb20	Carrying	-0.017	**0.730**	-0.039	0.104	0.058	0.048
PLb21	Grip	0.172	**0.535**	0.073	-0.094	0.151	0.105
PLb23	Moderate intensity PA	-0.022	**0.623**	0.194	0.138	0.047	-0.006
PLb25	Aerobic/endurance PA	-0.028	**0.566**	0.254	0.167	0.047	0.077
PLb27	Balance PA	-0.102	**0.507**	0.295	0.068	0.027	0.072
Interaction with environment							
PLc29	Limited physical function	0.052	-0.058	**0.609**	0.254	0.089	0.163
PLc30	Pain	-0.004	0.052	**0.442**	**0.424**	0.080	0.088
PLc31	Lazy	0.301	0.250	**0.499**	0.070	0.087	0.059
PLc33	Lack of time	0.085	0.061	**0.490**	0.212	0.112	0.135
PLc34	Chronic health condition	0.104	-0.096	**0.465**	0.265	0.046	0.218
PLc36	No companion	0.206	-0.023	**0.391**	0.294	0.307	-0.085
PLc37	Provide care to Child	0.048	0.261	**0.577**	0.089	0.114	0.075
PLc38	Lack of PA program	0.044	0.030	**0.404**	0.247	0.270	-0.027
PLc40	Lack of PA space	0.207	0.006	**0.404**	0.192	0.301	-0.013
PLc41	Bad weather	0.093	0.256	**0.589**	-0.132	0.244	0.062
PLc42	Hot weather	0.238	0.193	**0.374**	0.169	0.183	0.019
PLc43	Air quality	0.087	-0.015	**0.706**	0.157	0.062	-0.062
PLc44	Not convenient	0.063	0.027	**0.521**	0.299	0.149	0.092
PLc46	Provide care to others	-0.055	0.263	**0.637**	-0.008	0.051	0.194
Sense of self							
PLd48	As well as others	0.109	0.218	-0.022	**0.541**	0.156	0.173
PLd49	As much as others	0.090	0.255	0.006	**0.596**	0.121	0.084
PLd50	Maintain 3 months	0.184	0.110	0.057	**0.543**	0.199	0.018
PLd51	Maintain 10 years	-0.021	0.216	0.221	**0.349**	0.014	0.277
PLd52	Maintaining with aging	0.066	-0.060	0.065	0.277	0.105	-0.130
PL53	Overcome barriers	0.081	0.023	0.312	**0.511**	0.207	0.107
PLd54	Achieve goals	0.094	0.100	0.190	**0.421**	0.172	0.145
PLd55	Achieve more	-0.002	0.309	0.055	**0.395**	-0.003	0.319
PLd56	Positive sense of self	0.026	0.318	-0.029	**0.397**	0.050	0.282
Interaction with others							
PLe58	Work well with others	0.063	0.029	0.071	0.064	**0.670**	0.100
PLe59	Get along with others	0.096	-0.004	0.013	0.013	**0.749**	0.116
PLe61	Fill in a group	-0.011	0.163	-0.003	0.017	**0.652**	0.204
PLe62	Gain guidance	-0.103	0.029	0.025	0.058	**0.812**	0.075
PLe63	Provide support	0.217	-0.002	-0.140	0.291	**0.397**	0.185
PLe64	Lead others	0.102	-0.103	0.089	0.296	0.309	0.266
PLe65	Gain information	-0.087	0.068	0.064	0.049	**0.588**	0.265
Knowledge and understanding							

PLf66	Suitable PA for me	0.176	0.092	-0.048	-0.137	0.280	**0.652**
PLf67	Suitable amount for me	0.098	-0.071	0.100	-0.039	0.136	**0.754**
PLf68	Suitable adjustment	0.053	-0.011	0.002	0.305	0.114	**0.586**
PLf69	Improvement	0.118	0.066	0.018	0.090	0.239	**0.469**
PLf70	PA for well-being	0.180	0.071	-0.014	0.071	0.160	**0.658**
PLf71	PA recommendation	-0.017	0.040	0.067	0.091	0.108	**0.715**
PLf72	Prevent injury	-0.007	-0.018	0.059	0.123	0.188	**0.626**

Note. PLa=Motivation; PLb=Physical competency; PLc=Interaction with environment; PLd=Sense of self; PLe=Interaction with others; PLf=Knowledge and understanding; Factor loadings > 0.32 are in boldface.

Table 15.

Results of Rotated Matrix of 6-factor Model among 52 Items (N=388)

Item		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Motivation							
PLa1	Health value	**0.728**	0.059	0.067	0.092	-0.042	0.129
PLa2	Mental value	**0.733**	0.071	0.062	0.071	0.083	0.044
PLa3	Social value	**0.564**	0.151	0.070	-0.086	0.087	0.205
PLa6	Time and effort	**0.657**	-0.090	0.126	0.145	0.029	0.134
PLa7	Effort to do well	**0.553**	0.104	-0.064	0.197	0.161	0.035
PLa8	Enjoyment	**0.739**	0.015	-0.028	0.136	0.119	0.110
PLa9	Satisfaction	**0.579**	0.043	0.099	0.164	0.104	0.119
PLa12	Interest	**0.627**	0.147	-0.016	0.145	0.125	0.107
PLa14	Part of daily life	**0.727**	-0.060	0.114	0.107	0.074	0.165
PLa15	Restlessness	**0.572**	0.002	0.244	0.096	0.107	0.030
Physical competence							
PLb17	Walking	0.193	**0.686**	-0.137	0.166	0.030	0.007
PLb18	Climbing	0.019	**0.773**	-0.023	0.088	0.113	0.060
PLb19	Squatting	0.024	**0.704**	0.115	0.019	0.148	-0.021
PLb20	Carrying	-0.012	**0.729**	-0.040	0.115	0.048	0.045
PLb21	Grip	0.166	**0.530**	0.053	-0.057	0.147	0.112
PLb23	Moderate intensity PA	-0.023	**0.618**	0.191	0.157	0.038	-0.009
PLb25	Endurance PA	-0.034	**0.555**	0.248	0.189	0.041	0.080
PLb27	Balance PA	-0.097	**0.617**	**0.388**	0.077	0.009	0.077
Interaction with environment							
PLc29	Limited physical function	0.053	-0.049	**0.618**	0.232	0.095	0.160
PLc31	Lazy	**0.398**	0.259	**0.490**	0.096	0.072	0.060
PLc33	Lack of time	0.074	0.054	**0.505**	0.223	0.106	0.133
PLc34	Chronic health condition	0.105	-0.092	**0.465**	0.256	0.057	0.209
PLc36	No companion	0.199	-0.035	**0.369**	0.286	0.207	-0.083
PLc37	Provide care to Child	0.042	0.267	**0.577**	0.088	0.109	0.086
PLc38	Lack of PA program	0.041	0.027	**0.421**	0.237	0.259	-0.019
PLc40	Lack of PA space	0.199	0.001	**0.410**	0.195	0.301	-0.007
PLc41	Bad weather	0.085	0.263	**0.576**	-0.099	0.237	0.059
PLc42	Hot weather	0.235	0.195	**0.369**	0.200	0.173	0.005
PLc43	Air quality	0.080	-0.009	**0.724**	0.119	0.069	-0.045

PLc44	Not convenient	0.060	0.027	**0.523**	**0.399**	0.149	0.088
PLc46	Provide care to others	-0.063	0.262	**0.615**	0.025	0.059	0.184
Sense of self							
PLd48	As well as others	0.101	0.185	-0.026	**0.589**	0.159	0.145
PLd49	As much as others	0.077	0.216	0.013	**0.644**	0.118	0.061
PLd50	Maintain 3 months	0.169	0.076	0.066	**0.587**	0.190	0.006
PLd51	Maintain 10 years	-0.027	0.199	0.220	**0.386**	0.009	0.257
PLd53	Overcome barriers	0.077	0.010	**0.344**	**0.497**	0.302	0.112
PLd54	Achieve goals	0.093	0.095	0.210	**0.413**	0.154	0.153
PLd55	Achieve more	-0.008	0.288	0.064	**0.417**	-0.004	**0.385**
PLd56	Positive sense of self	0.018	0.309	-0.007	**0.394**	0.056	0.279
Interaction with others							
PLe58	Work well with others	0.058	0.020	0.076	0.072	**0.673**	0.100
PLe59	Get along with others	0.095	-0.007	0.019	0.012	**0.750**	0.123
PLe61	Fill in a group	-0.013	0.156	-0.014	0.051	**0.645**	0.199
PLe62	Gain guidance	-0.105	0.020	0.026	0.073	**0.807**	0.074
PLe63	Provide support	0.217	-0.008	-0.130	0.220	**0.376**	0.169
PLe65	Gain information	-0.088	0.067	0.064	0.061	**0.577**	0.269
Knowledge and understanding							
PLf66	Suitable PA for me	0.180	0.105	-0.061	-0.138	0.281	**0.661**
PLf67	Suitable amount for me	0.099	-0.061	0.095	-0.047	-0.047	**0.763**
PLf68	Suitable adjustment	0.047	-0.025	0.015	0.303	0.104	**0.577**
PLf69	Improvement	0.115	0.059	0.006	0.134	0.236	**0.448**
PLf70	PA for well-being	0.174	0.065	-0.026	0.106	0.154	**0.656**
PLf71	PA recommendation	-0.022	0.034	0.071	0.104	0.101	**0.716**
PLf72	Prevent injury	-0.013	-0.025	0.063	0.138	0.179	**0.630**

Note. PLa=Motivation; PLb=Physical competency; PLc=Interaction with environment; PLd=Sense of self; PLe=Interaction with others; PLf=Knowledge and understanding; Factor loadings > 0.32 are in boldface.

Table 16.

Results of Rotated Matrix of Final 6-factor Model among 47 Items (N=388)

Item		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Motivation							
PLa1	Health value	**0.721**	0.069	0.075	0.102	-0.040	0.123
PLa2	Mental value	**0.721**	0.075	0.070	0.094	0.082	0.037
PLa3	Social value	**0.559**	0.169	0.070	-0.073	0.086	0.199
PLa6	Time and effort	**0.652**	-0.076	0.146	0.136	0.029	0.134
PLa7	Effort to do well	**0.539**	0.105	-0.054	0.218	0.160	0.030
PLa8	Enjoyment	**0.732**	0.023	-0.016	0.145	0.122	0.108
PLa9	Satisfaction	**0.573**	0.056	0.111	0.160	0.107	0.119
PLa12	Interest	**0.611**	0.151	-0.001	0.177	0.119	0.097
PLa14	Part of daily life	**0.719**	-0.042	0.127	0.108	0.075	0.164
PLa15	Restlessness	**0.560**	0.005	0.251	0.107	0.107	0.026
Physical literacy							
PLb17	Walking	0.181	**0.695**	-0.121	0.178	0.014	0.003

PLb18	Climbing	0.010	**0.800**	0.002	0.084	0.086	0.057
PLb19	Squatting	0.024	**0.735**	0.137	-0.014	0.130	-0.018
PLb20	Carrying	-0.025	**0.731**	-0.012	0.125	0.027	0.039
PLb21	Grip	0.166	**0.543**	0.055	-0.062	0.143	0.111
PLb23	Moderate intensity PA	-0.047	**0.565**	0.183	0.237	0.032	-0.035
PLb25	Endurance PA	-0.119	**0.570**	0.276	0.159	0.001	0.046
Interaction with environment							
PLc29	Limited physical function	0.057	-0.033	**0.660**	0.180	0.085	0.162
PLc33	Lack of time	0.075	0.063	**0.546**	0.188	0.095	0.130
PLc34	Chronic health condition	0.117	-0.063	**0.490**	0.193	0.058	0.212
PLc36	No companion	0.194	-0.042	**0.348**	0.273	0.199	-0.089
PLc37	Provide care to Child	0.031	0.281	**0.603**	0.081	0.088	0.080
PLc38	Lack of PA program	0.042	0.030	**0.458**	0.307	0.251	-0.023
PLc40	Lack of PA space	0.198	0.004	**0.444**	0.173	0.295	-0.012
PLc41	Bad weather	0.064	0.260	**0.554**	-0.039	0.219	0.041
PLc42	Hot weather	0.212	0.173	**0.358**	0.254	0.169	-0.011
PLc43	Air quality	0.078	-0.002	**0.769**	0.085	0.053	-0.049
PLc46	Provide care to others	-0.065	0.276	**0.626**	0.014	0.046	0.176
Sense of self							
PLd48	As well as others	0.084	0.155	0.000	**0.616**	0.159	0.130
PLd49	As much as others	0.058	0.183	0.051	**0.669**	0.112	0.045
PLd50	Maintain 3 months	0.153	0.048	0.105	**0.597**	0.188	-0.003
PLd51	Maintain 10 years	-0.043	0.176	0.242	**0.418**	0.000	0.239
PLd54	Achieve goals	0.084	0.082	0.232	**0.413**	0.153	0.144
PLd56	Positive sense of self	0.003	0.296	0.038	**0.416**	0.044	0.263
Interaction with others							
PLe58	Work well with others	0.053	0.024	0.094	0.090	**0.661**	0.093
PLe59	Get along with others	0.098	0.018	0.040	-0.003	**0.738**	0.128
PLe61	Fill in a group	-0.014	0.167	-0.001	0.065	**0.633**	0.191
PLe62	Gain guidance	-0.114	0.022	0.040	0.106	**0.793**	0.062
PLe63	Provide support	0.208	-0.013	-0.105	0.234	**0.334**	0.163
PLe65	Gain information	-0.085	0.084	0.076	0.057	**0.569**	0.266
Knowledge and understanding							
PLf66	Suitable PA for me	0.174	0.119	-0.063	-0.096	0.279	**0.642**
PLf67	Suitable amount for me	0.096	-0.042	0.096	-0.021	0.139	**0.745**
PLf68	Suitable adjustment	0.040	-0.027	0.042	0.300	0.107	**0.565**
PLf69	Improvement	0.108	0.074	0.013	0.151	0.231	**0.438**
PLf70	PA for well-being	0.168	0.063	-0.019	0.135	0.161	**0.639**
PLf71	PA recommendation	-0.025	0.036	0.082	0.120	0.106	**0.701**
PLf72	Prevent injury	-0.002	-0.010	0.084	0.112	0.186	**0.625**

Note. PLa=Motivation; PLb=Physical competency; PLc=Interaction with environment; PLd=Sense of self; PLe=Interaction with others; PLf=Knowledge and understanding; Factor loadings > 0.32 are in boldface.

Table 17.

Summary of Fit Indices of Tested Models (N=388)

Model	RMSEA (CI)	CFI	TLI	SRMR
Model 1 (56 items, 6 factors) - Removed 4 items	0.052 (0.049, 0.056)	0.963	0.965	0.032
Model 2 (52 items, 6 factors) - Removed 5 items	0.046 (0.042, 0.049)	0.972	0.964	0.028
Model 3 (47 items, 6 factors)	0.045 (0.041, 0.048)	0.973	0.964	0.028

Note. CI= 90% confidence interval; RMSEA = root mean square error of approximation; CFI=comparative fit index; TLI=tucker lewis index; SRMR=standardized root mean squared residual; The recommended criteria is: RMSEA $\leqslant$0.06, CFI $\geqslant$0.95, TLI $\geqslant$0.95, and SRMR$\leqslant$ 0.08.

Finally, the correlations between the factors were examined (see Table 18). The results showed there were significant positive correlations between the six factors. None of the correlations were >0.80 suggesting good discriminant validity between the six factors of the Perceived Physical Literacy for Chinese Elderly Questionnaire.

Table 18.

Correlation Matrix between Factors (N=388)

	M	P	E	S	O	K
Motivation	1.000					
Physical competency	0.475**	1.000				
Interaction with environment	0.659**	0.618**	1.000			
Sense of self	0.677**	0.694**	0.738**	1.000		
Interaction with others	0.616**	0.528**	0.680**	0.724**	1.000	
Knowledge and understanding	0.658**	0.495**	0.629**	0.715**	0.732**	1.000

Note. PA=physical activity; PPL = perceived physical literacy; M=motivation; P=physical competency; E=interaction with environment; S=sense of self; O=interaction with others; K=knowledge and understanding; ** $P<$ 0.001.

In summary, the EFA resulted in a six-factor structure solution. An examination of the item loading on each factor suggested the following meaning for structure. The first factor "Motivation" (10 items), represents older adults' positive attitude and intrinsic desire to engage in PA. The second factor "Physical competence" (7 items), represents the older adults' perceived physical ability to perform a variety of movement tasks. The third factor "Interaction with

environment" (11 items), represents older adults' perceived ability to participate in PA under a range of challenging situations. The fourth factor "Sense of self" (6 items), represents older adults' self-belief in the ability to undertake and maintain regular PA participation. The fifth factor "Interaction with others" (6 items), represents older adults' perceived ability to exercise well with and build supportive relationships with others. The last factor "Knowledge and understanding" (6 items), represents older adults' knowledge to evaluate, adjust, and enhance PA and the understanding of the value of being physically active. This six-factors model is consistent with the preconceived conceptual framework of physical literacy. Forty-seven items were included in the final questionnaire of Perceived Physical Literacy for Chinese Elderly. Next, I conducted a series of psychometric testing to further test the developed 47-item questionnaire's reliability and validity.

Results of Concurrent and Predictive Validity

The scale of Perceived competence (PCS), the leisure-time PA subscale of the Physical Activity Scale for Elderly (PASE), and the PA maintenance scores were used to assess the developed Perceived Physical Literacy for Chinese Elderly Questionnaire's concurrent and predictive validity**.** Table 19 presents the descriptive statistic results of participants' perceived physical literacy, PCS, leisure-time PA, and the PA maintenance score.

Table 19.

The Scores of Perceived Physical Literacy, Perceived Competence, Leisure-time PA, and PA Maintenance (N=388)

Variables	Mean	SD	Range
Perceived physical literacy	148.85	38.08	52-227
Motivation	35.36	9.14	12-50
Physical literacy	24.07	6.39	7-35
Interaction with environment	29.08	11.00	11-55
Sense of self	19.45	5.77	6-30
Interaction with others	18.72	6.06	6-30

Knowledge and understanding	22.17	6.87	7-35
Perceived competence	18.34	5.18	5-28
Leisure-time PA	34.29	24.47	0-177.64
PA maintenance[a]	2.61	1.67	0-5

Note. PA=physical activity; [a]Assigned score based on participants' self-report regular PA participation years: 0 = "not regular exerciser", 1 = "less than one year", 2 = "one to five years", 3 = "five to ten years", 4 = "ten to fifteen years", 5 = "over fifteen years".

I examined the concurrent validity of the developed 47-item perceived physical literacy questionnaire by examining correlations between the perceived physical literacy scores and the perceived competence scores. The results demonstrate that the total and subscale perceived physical literacy scores have moderate positive correlations with perceived competence scores ($r_s > 0.505$, $P<0.001$), which indicates good concurrent validity of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire (see Table 20).

Table 20.

Correlation Coefficients between Total and Subscale Perceived Physical Literacy Scores and Perceived Competence Scores (N=388)

	Total PPL	M	P	E	S	O	K
Perceived competence	0.680**	0.571**	0.573**	0.572**	0.664**	0.505**	0.579**

Note. PA=physical activity; PPL = perceived physical literacy; M=motivation; P=physical competency; E=interaction with environment; S=sense of self; O=interaction with others; K=knowledge and understanding; ** $P< 0.001$.

I conducted a multiple regression to test the predictive validity of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire. The regression analysis showed that after controlling for covariates (i.e., age, gender, education level, marital status, living area, ambulatory status, perceived heath status, and number of co-morbidities), the total perceived physical literacy score independently significantly correlated with participants' leisure-time PA score (β=0.246, $P<0.001$) and PA maintenance score (β=0.023, $P<0.001$) (see Table 21 and Table 22). This indicates that the developed Perceived Physical Literacy for Chinese Elderly Questionnaire has good predictive ability for Chinese older adults' PA behavior.

Table 21.

Results of Multiple Linear Regression Analysis Demonstrating the Predictive Ability of the Total Perceived Physical Literacy for Chinese older adults' Leisure-time PA (N=388)

Variables	Leisure-time PA			
	β	Beta	*t*	*P*
(Constant)	-3.579	-----	-0.198	0.843
Age	-0.101	-0.025	-0.461	0.645
Sex	-0.171	-0.003	-0.070	0.944
Education level	0.252	0.074	1.404	0.161
Marital status	-1.842	-0.025	-0.468	0.640
Living area	5.864	0.102	1.996	0.047
Ambulatory status	-9.528	-0.040	-0.766	0.444
Perceived health status	1.949	0.064	1.121	0.263
Number of co-morbidities	-0.343	-0.033	-0.645	0.520
Total perceived physical literacy	0.246	0.351	6.288	<0.001

Note. β = unstandardized coefficients; Beta = standardized coefficients. Coding of covariates was: gender (*1 = female, 2=male*), education level *(1=never school, 2=primary school, 3= middle school, 4= high school, 5=college or higher),* marital status *(1=married, 2= widowed or unmarried)*, living area *(1=urban, 2=rural),* and ambulatory status *(1=independent walking, 2= need assistive device)*.

Table 22.

Results of Multiple Linear Regression Analysis Demonstrating Predictive Ability of the Total Perceived Physical Literacy for Chinese Older Adults' PA Maintenance (N=388)

Variables	PA maintenance[a]			
	β	Beta	*t*	*P*
(Constant)	-5.281	-----	-4.408	<0.001
Age	0.057	0.206	3.959	<0.001
Sex	0.282	0.083	1.751	0.081
Education level	0.009	0.039	0.779	0.436
Marital status	-0.127	-0.025	-0.489	0.625
Living area	0.351	0.087	1.804	0.072
Ambulatory status	-0.160	-0.010	-0.195	0.846
Perceived health status	-0.098	-0.046	-0.849	0.396
Number of co-morbidities	-0.013	0.018	-0.369	0.712
Total perceived physical literacy	0.023	0.473	8.912	<0.001

Note. β = unstandardized coefficients; Beta = standardized coefficients. Coding of covariates was: gender (*1 = female, 2=male*), education level *(1=never school, 2=primary school, 3= middle school, 4= high school, 5=college or higher),* marital status *(1=married, 2= widowed or unmarried)*, living area *(1=urban, 2=rural),* and ambulatory status *(1=independent walking, 2= need assistive device)*; [a]Assigned score based on participants' self-report regular PA participation

years: 0 = “not regular exerciser”, 1 = “less than one year”, 2 = “one to five years”, 3 = “five to ten years”, 4 = “ten to fifteen years”, 5 = “over fifteen years”.

Results of Known-group Validity

I preformed known-group validity to generate evidence of contrast validity (Kline, 2013). Independent t-test was used to test the known-groups method that the perceived physical literacy of less physically active Chinese older adults was lower than physical literacy of those highly physical active older adults. The results showed that Chinese older adults who reported more leisure-time PA participant (leisure-time PA score ≥ 27) had significantly better perceived physical literacy than those reported less leisure-time PA (leisure-time PA score < 27) (t=-7.19, P<0.001). Additionally, Chinese older adults who reported longer regular PA participant (≥ 5 years) had significantly better perceived physical literacy than those reported no regular PA participation or short regular PA participation (<5 years) (t=-6.76, P<0.001). Table 23 and Table 24 present detailed results of the known-groups comparison, providing evidence to support the construct validity of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire.

Table 23.

Known-group Comparison of Perceived Physical Literacy between Low and High Physically Active Chinese Older Adults (N=388)

	Low physically active group (n=184)		High physically active group (n=204)		Statistical analysis	
	Mean	SD	Mean	SD	*t*	*P*
Total PPL	134.67	34.20	161.64	36.92	-7.19	<0.001
Motivation	3.21	0.90	3.83	0.82	-5.46	<0.001
Physical competency	3.18	0.89	3.67	0.87	-6.26	<0.001
Interaction with environment	2.32	0.87	2.93	1.02	-6.90	<0.001
Sense of self	2.91	0.90	3.54	0.92	-5.28	<0.001
Interaction with others	2.84	1.00	3.37	0.95	-5.36	<0.001
Knowledge and understanding	2.90	0.97	3.41	0.92	-7.44	<0.001

Note. PPL=perceived physical literacy; SD=standard deviation

Table 24.

Known-group Comparison of Perceived Physical Literacy between Chinese Older Adults with Short (no regular PA or < 5 years) versus Long (≥ 5 years) Regular PA Participation (N=388)

	Regular PA < 5 years (n=166)		Regular PA PA≥5 years (n=222)		Statistical analysis	
	Mean	SD	Mean	SD	*t*	*P*
Total PPL	132.86	38.89	160.81	32.78	-6.76	<0.001
Motivation	3.19	0.98	3.79	0.77	-3.74	<0.001
Physical competency	3.24	0.95	3.59	0.85	-6.50	<0.001
Interaction with environment	2.28	0.99	2.92	0.91	-7.18	<0.001
Sense of self	2.86	1.02	3.53	0.81	-5.66	<0.001
Interaction with others	2.80	1.04	3.36	0.92	-7.91	<0.001
Knowledge and understanding	2.74	0.99	3.48	0.85	-7.67	<0.001

Note. PPL=perceived physical literacy; PA=physical activity; SD=standard deviation

Result of Reliability Testing

Internal consistency reliability

I evaluated the internal consistency of the developed Perceived Physical Literacy for Chinese Elderly Questionnaire using Cronbach's alpha statistics and item-to-total correlation. For a new scale to be considered reliable its Cronbach's alpha should be >0.70 (Nunnally & Bernstein, 1994). Additionally, if the scales has a moderate correlation (r > 0.3 and <0.7) between item and subscale the instrument is considered good (Ferketich, 1991; Portney & Watkins 2009). Table 25 presents the Cronbach's alpha values for the whole perceived physical literacy questionnaire and for each subscale and the item-total correlation coefficient for each item.

The Cronbach's alpha of the Perceived Physical Literacy for Chinese Elderly Questionnaire is 0.877, ranging from 0.824 to 0.913 for each subscale. All items' item-total correlation coefficients are greater than 0.3. Although seven items' item-to-total correlation coefficients are slightly higher than 0.7 (ranging from 0.724 to 0.744), overall, the results

indicate that the developed Perceived Physical Literacy for Chinese Elderly Questionnaire has good internal consistency.

Test-rest reliability

The test-retest reliability demonstrates the reproducibility of an instrument (Lohr, 2002). A power analysis for sample size was conducted. According to the power analysis result (having a power of 0.8 to detect a test-retest correlation of 0.5 at a significant level of 0.05), the minimal sample size for testing the test-rested reliability was 29. However, only 17 participants completed the test-retest. I examined the test-retesting reliability among the 17 paired questionnaires using an intra-class correlation coefficient (ICC). The results showed the ICC for the overall questionnaire is 0.701, ranging from 0.699 to 0.768 (see Table 25), indicating the questionnaire and its six subscales had good stability.

Table 25.

Summary of Reliability Testing (N=344)

Item		Item-total correlation coefficient	Cronbach's alpha	Intra-class correlation coefficient (n=17)
Overall			0.877	0.701
Motivation			0.841	0.768
PL1	Health value	0.661		
PL2	Mental value	0.694		
PL3	Social value	0.555		
PL6	Time and effort	0.655		
PL7	Effort to do well	0.611		
PL8	Enjoyment	**0.744**		
PL9	Satisfaction	0.649		
PL12	Interest	0.676		
PL14	Part of daily life	**0.734**		
PL15	Restlessness	0.609		
Physical literacy			0.899	0.714
PL17	Walking	0.598		
PL18	Climbing	0.688		
PL19	Squatting	0.647		
PL20	Carrying	0.617		
PL21	Grip	0.511		

PL23	Moderate intensity PA	0.566		
PL25	Endurance PA	0.614		
Interaction with environment			0.849	0.699
PL29	Limited physical function	**0.731**		
PL33	Lack of time	**0.719**		
PL34	Chronic health condition	0.631		
PL36	No companion	0.643		
PL37	Provide care to Child	0.676		
PL38	Lack of PA program	**0.704**		
PL40	Lack of PA space	0.671		
PL41	Bad weather	0.638		
PL42	Hot weather	0.677		
PL43	Air quality	0.668		
PL46	Provide care to others	0.644		
Sense of self			0.913	0.703
PL48	As well as others	**0.728**		
PL49	As much as others	**0.715**		
PL50	Maintain 3 months	0.692		
PL51	Maintain 10 years	0.581		
PL54	Achieve goals	0.637		
PL56	Positive sense of self	0.597		
Interaction with others			0.901	0.774
PL58	Work well with others	0.646		
PL59	Get along with others	0.678		
PL61	Fill in a group	0.653		
PL62	Gain guidance	0.668		
PL63	Provide support	0.527		
PL65	Gain information	0.618		
Knowledge and understanding			0.824	0.761
PL66	Suitable PA for me	0.674		
PL67	Suitable amount for me	0.687		
PL68	Suitable adjustment	0.680		
PL69	Improvement	0.680		
PL70	PA for well-being	0.584		
PL71	PA recommendation	**0.713**		
PL72	Prevent injury	0.627		

Note. PLa=Motivation; PLb=Physical competency; PLc=Interaction with environment; PLd=Sense of self; PLe=Interaction with others; PLf=Knowledge and understanding; Value out of criteria are in boldface.

Summary

In summary, the psychometric testing results for the developed Perceived Physical Literacy for Chinese Elderly Questionnaire indicate the questionnaire is reliable and valid, with

concurrent, predictive, and known-group validity and good internal consistency and test-retest reliability.

Chapter 5 Discussion

In this study, I developed a self-report questionnaire that measures Chinese older adults' perceived physical literacy based on the conceptual framework of physical literacy developed by Whitehead (2010; 2013) and guided by the modified conceptual definition of physical literacy proposed in this study (described in the Chapter 2).

Description of the Questionnaire

The final version of the questionnaire, Perceived Physical Literacy for Chinese Elderly, contains 47 items using a 5-point Likert scale from "1 = not at all" to "5 = extremely". The results of exploratory factor analysis (EFA) revealed six underlying factors/subscales of the questionnaire, reflecting the six attributes of physical literacy (Whitehead, 2010), including motivation (10 items), physical competence (7 items), interaction with the environment (11 items), sense of self (6 items), interaction with others (6 items), and knowledge and understanding (7 items).

The first factor, motivation, assesses Chinese older adults' attitude towards and intrinsic desire for PA participation: perceived value of PA (i.e., the value of PA for physical, mental, and social health), perceived importance of PA (i.e., the time and effort spent on PA, the effort made to do well in PA, and the important position of PA in daily life), and perceived affective experience from PA (i.e., the enjoyment, satisfaction, and interest derived from PA participation and the sense of restlessness when not doing PA). The items regarding the perceived value of PA and perceived importance of PA represent older adults' attitudes towards PA. A systematic review of qualitative research (Devereux-Fitzgerald, Powell, Dewhurst, & French, 2016) identified that perceived value was a key factor in determining older adults' acceptability of PA participation. The appreciation of physical, mental, and social health were the major triggers for

older adults to adopt and maintain a physically active lifestyle (Cousins, 2003; Devereux-Fitzgerald, 2016). Those who highly value PA prioritize it and make efforts to incorporate PA in their daily life (Devereux-Fitzgerald et al., 2016). As for the items of perceived affective experience, these items reflect older adults' intrinsic motivation for PA participation. Intrinsic motivation refers to older adults participating in PA for its own sake, for the enjoyment and satisfaction derived from participation (Deci & Ryan, 1985). Both qualitative and quantitative studies found that intrinsic motivation plays a decisive role in older adults' PA maintenance (Dacey, Baltzell, & Zaichkowsky, 2008; Devereux-Fitzgerald et al., 2016). Therefore, I believe that perceived value and importance of PA and the perceived affective experience from PA are critical components to measuring Chinese older adults' attitudes and levels of motivation in PA participation. The scree plot (Figure 5) created from the factor analysis shows that "Motivation" contributes the greatest amount of total variance of the questionnaire and is a dominant factor to the other five factors. This finding is consistent with the hypotheses proposed by Whitehead (2010) that motivation is a central component of the concept of physical literacy and serves as a foundation on which the other five attributes function.

The second factor, physical competence, assesses Chinese older adults' perceived physical ability to perform a variety of movement tasks. Similar to the majority of existing physical competence measurements (Bergner et al., 1981; Cress et al., 1996; Jones et al., 2008; Rejeski et al., 1998; Ryckman et al., 1982; Spertus et al., 1995; Taylor et al., 2013; Ware, 2000), the items in the factor measure Chinese older adults' physical ability by asking about their perceived ability to perform basic physical movements (i.e., walking, climbing, squatting, carrying, and grasping) and their ability to carry out types of PA (i.e., moderate intensity PA and endurance PA). It is interesting to note that in this study, during the process of questionnaire

refining, the items about older adults' ability to perform high-intensity PA, muscle-strengthening PA, and balance training failed to meet the criteria and were deleted in the final questionnaire. One possible explanation for this is that the majority of Chinese older adults did not have prior experience with these types of PA and felt confused by these items. According to a national report (General Administration of Sports of China, 2015), 63.4% to 78.7% of Chinese older adults mainly chose walking for exercise and only 4% to 7% of older adults engaged in high-intensity PA. A regional survey regarding older adults' PA in Henan province (the data collection of this study was conducted in Kaifeng, a district in Henan province) demonstrated that 95.7% of respondents engaged in walking for exercise, whereas only 16.1% engaged in some balance or/and muscle-strengthening PA and only 3.6% performed vigorous PA (Shen, 2015). I considered that although high-intensity, balance, and muscle-strengthening PA are recommended for older adults (WHO, 2010), they may not be appropriate indicators for assessing Chinese older adult's perceived physical competence.

The third factor, interaction, assesses Chinese older adults' confidence in their ability to contine to participate in PA under challenging situations. Challenging situations include personal (i.e., limited physical function, lack of time, chronic health condition), interpersonal (i.e., no companion, provide care to child, and provide care to others), and physical environmental (i.e., lack of PA program, lack of PA space, bad weather, hot weather, and air pollution). These identified challenging situations are generally consistent with common barriers that emerged from previous literature regarding Chinese older adults' PA participation (described in Chapter 2). During the item reduction process, one surprising result was the high missing response rate of "neighborhood walkability". During the psychometric evaluation of the Perceived Physical Literacy for Chinese Elderly Questionnaire, over 12% of participants responded "I don't know"

to this item. I cannot provide an accurate explanation of this high missing rate. However, it is possible that some older adults who participated in this study might never have encountered this problem. Therefore, lack of neighborhood walkability may not be a challenging situation that would limit their PA participation. Previous studies identified that Chinese older adults who perceived neighborhoods as having good walkability reported significantly higher levels of leisure-time PA (Cerin et al., 2013, Gao, Fu, Li, & Jia, 2015). Considering that walking is the main PA choice for Chinese older adults (General Administration of Sports of China, 2015), future testing of the Perceived Physical Literacy for Chinese Elderly Questionnaire needs to occur in different regions and cities in China to see if other Chinese older adults respond differently when answering this question.

The fourth factor, sense of self, assesses Chinese older adults' belief in their own ability to participate in regular PA. Sense of self is measured by an individual's general sense of self (i.e., positive sense of self), self-confidence to undertake PA (i.e., as well as others and as much as others), maintain PA (i.e., maintain 3 months and maintain 10 months), and achieve PA goals. Previous literature supports the significance of this factor, as high self-efficacy (belief of personal ability) and self-esteem (positive sense of self) are major determinates of older adults' PA initiation and maintenance (Eyler et al., 2002; Fox & Lindwall, 2014; Trost et al., 2002; Van Cauwenberg et al., 2011). One interesting finding from the item generation was that Chinese older adults described their sense of ability to undertake PA by comparing themselves to others in their same age group and sex. This finding can be explained by the social comparison theory, which postulates that humans judge and develop thier sense of self by comparing to others (Festinger, 1954; Suls & Wills, 1991). In this study, I wrote the items based on Chinese older adults' perspectives and descriptions (e.g., "How confident are you in doing physical activity as

much as other people in your age group and same sex?"). However, this is somewhat inconsistent with physical literacy. Physical literacy proposes that individuals develop a positive sense self though previous positive PA-related experiences (Whitehead, 2010). Thus, future studies on the Perceived Physical Literacy for Chinese Elderly Questionnaire may include additional items written as described in the physical literacy literature (e.g., "How confident are you in doing physical activity regularly according to your experience?").

The fifth factor, interaction with others, assesses Chinese older adults' ability to exercise well with (i.e., work well with others, get along with others, and fill in a group) and build supportive relationships with others (i.e., gain guidance, gain information, and provide support). The significant impact of social factors on older adults' PA participation is already well documented in the literature (Eyler et al., 2002; Hu et al., 2018; Koeneman et al., 2011; Plonczynski, 2003; Trost et al., 2002; Van Cauwenberg et al., 2011). However, prior studies only aimed to determine how social factors (e.g., social support and social network) influence older adults' PA behavior rather than explore the relationship between older adults' own social ability and their PA participation. I wrote the items in this factor from a physical literacy perspective and based on the item development interview results. I proposed that a physically literate older adult should exhibit good social competence to work well and build supportive relationships with others. Physically literate older adults can take the initiative to gain support that they need rather than waiting for support from others. Moreover, the majority of Chinese older adults are interested in group exercise (General Administration of Sports of China, 2015). Therefore, Chinese older adults not only need the social ability to exercise well with others but they also need the ability to exercise well within groups.

The last factor, knowledge and understanding, assesses Chinese older adults' knowledge of PA and the understanding of the value of being physically active. This factor is measured by how much older adults know about themselves (i.e., suitable PA for them, suitable amount for them, suitable adjustment, and improvement) and how much they know about PA (i.e., PA for well-being, PA recommendation, and preventing injuries). Having good knowledge about health, fitness, and PA is a significant determinate of older adults' PA behavior (Eyler et al., 2002; Hu et al., 2018; Trost et al., 2002; Van Cauwenberg et al., 2011). However, most Chinese older adults have never received formal physical education and their PA knowledge level is low (Chen, 2015; Guo, 2015; X. Zhang, 2013). One study found that only 3.3% of Chinese older adults chose the type and the amount of PA based on their own health needs and/or professional suggestions. Over 50% chose PA simply by following others and 17% by following trends (Chen, 2015). Therefore, improving Chinese older adults' knowledge and understanding of PA is urgently needed. It is noteworthy that in the original definition of physical literacy, Whitehead (2010) proposed that individuals need to know "the essential principles of movements and performance" (p. 65) and a physically literate person can make "a simple diagnosis of what is making a movement more or less effective and then into an understanding of how to improve and develop the movement pattern or skill" (p. 65). As we see, the original definition focuses more on the knowledge of how to evaluate and improve movements. However, in this study, Chinese older adults were more concerned about their knowledge about how to make suitable PA choices for themselves. I decided to write items for this factor based on Chinese older adults' perspective because I hold the opinion that developing movement skills is not a priority task for older adults. Instead, the focus should be on learning how to engage in purposeful PA, to make

choices, and select activates that can improve Chinese older adults' physical and psychological well-being (Almond, 2010).

Psychometric Properties of the Questionnaire

Content validity. I invited seven experts to evaluate the content validity of the developed 82-item Perceived Physical Literacy for Chinese Elderly Questionnaire (version 1.0). Based on the experts' responses, the S-CVI/Ave of the preliminary questionnaire was 0.91 (>0.8) and 66 items (80.5%) obtained a satisfactory I-CVI score (>0.78). Based on the experts' comments and findings from cognitive interviews, I revised a total of 49 items, deleted 14 items, divided 3 items into 6 items, and added 1 new item to the questionnaire. I then invited the same seven experts (two experts did not complete the evaluation) again to evaluate the content validity of the revised Perceived Physical Literacy for Chinese Elderly Questionnaire (version 2.0). All five experts rated all retained 72 items as relevant, yielding a S-CVI/Ave of 1.0. This finding indicated the Perceived Physical Literacy for Chinese Elderly Questionnaire had good content validity for measuring the concept of perceived physical literacy.

Concurrent validity. Concurrent validity of the scales was supported by concurrent administration of another similar measure. In this study, I concurrently administered the Perceived Physical Literacy for Chinese Elderly Questionnaire with the Perceived Competence Scale (PCS; Williams & Deci, 1996). The PCS is a four-item measure designed to assess individuals' perceived competence in their ability to participate in PA on a regular basis. Perceived competence is concept similar to physical literacy. The results showed that the total scores of these two measurements were positively moderately correlated ($r = 0.680$, $p < 0.001$). Further, all six subscales scores of the final perceived physical literacy questionnaire were also positivily correlated with the PCS score ($r_s > 0.505$, $p < 0.001$). These findings provide support

for convergent validity of the final Perceived Physical Literacy for Chinese Elderly Questionnaire.

Predictive validity. To determine the predictive validity of the final Perceived Physical Literacy for Chinese Elderly Questionnaire, I used multiple linear regression to explore the relationships between scores of perceived physical literacy and Chinese older adults' short-term and long-term PA behavior. Theoretically, individuals with stronger physical literacy are more likely to have better PA behavior (Whitehead, 2010). The results demonstrate that even after controlling for confounders (i.e., age, gender, education level, marital status, living area, ambulatory status, perceived health status, and number of co-morbidities), the perceived physical literacy score still was independently significantly correlated with participants' leisure-time PA score ($\beta = 0.246$, $p < 0.001$) and PA maintenance score ($\beta = 0.023$, $p < 0.001$). These findings indicate that the developed Perceived Physical Literacy for Chinese Elderly Questionnaire has good predictive ability for Chinese older adults' PA behavior. However, the most rigorous way to assess predictive validity of an instrument is to use longitudinal data (Morisky, Green, & Levine, 1986). Therefore, additional longitudinal design studies are needed to evaluate the long-term predictive ability of the Perceived Physical Literacy for Chinese Elderly Questionnaire on Chinese older adults' PA behavior .

Known-group validity. The known-group test provided additional evidence for the construct validity of the final Perceived Physical Literacy for Chinese Elderly Questionnaire. According to the results, Chinese older adults who reported more leisure-time PA participation (leisure-time PA score $\geqslant$ 27) and longer regular PA participation ($\geqslant$5 years) had significantly higher scores on their total perceived physical literacy as well as each subscale (motivation, physical competency, interaction with environment, sense of self, interaction with others, and

knowledge and understanding; $p < 0.001$). This finding indicates that the developed questionnaire is able to discriminate between groups in a manner that is consistent with the underlying theory that physically active individuals are more likely to have higher perceived physical literacy (Whitehead, 2010).

Reliability. I evaluated the reliability of the final Perceived Physical Literacy for Chinese Elderly Questionnaire by examining the internal consistency of the questionnaire and the stability of the questionnaire over a two-week period of time. The internal consistency of the final Perceived Physical Literacy for Chinese Elderly Questionnaire was determined using Cronbach's alpha and item-total correlation. The final questionnaire and its six subscales had good Cronbach's alpha values, ranging from 0.824 to 0.913. Additionally, the item-total correlation coefficients for all 47 items were greater than 0.3. The item-total correlation coefficients for seven items were slightly higher than 0.7 (ranging from 0.724 to 0.744), which indicates there is some redundancy in the content of these items. However, by further examining the meaning of these seven items, I decided to keep all of them because their meanings are unique. Overall, the results support that the Perceived Physical Literacy for Chinese Elderly Questionnaire had good internal consistency reliability. I conducted a test-retest among 17 paired questionnaires. The results showed the intraclass correlation coefficients were all satisfactory for the six subscales, ranging from 0.699 to 0.768, which indicates the questionnaire has good stability.

Overall, the results of the psychometric analysis of the Perceived Physical Literacy for Chinese Elderly Questionnaire supported good validity and reliability of the instrument. Perceived physical literacy can be operationally defined as the total self-rated score on the 47-

item Perceived Physical Literacy for Chinese Elderly Questionnaire in which the range of scores is 47 (low physical literacy) to 235 (high physical literacy).

Strengths and Limitations of the Study

By following a rigorous procedure, this study employed both qualitative and quantitative methodologies for instrument development and validation. There are strengths of this study that are important to highlight.

First, this study used an integrative method for questionnaire item generation, including item development interviews, literature reviews, and referencing existing relevant measurements. During the item generation process, the item development interview with Chinese older adults played a critical role in revealing what constituted Chinese older adults' physical literacy. Currently, few studies measuring older adults' physical literacy exist. Through the interviews with Chinese older adults, I was able to gain an enriched understanding of Chinese older adults' physical literacy and identify several key physical literacy elements. This approach ensured that the contents of the generated questionnaire were culturally appropriate and sensitive. Further, using item development interviews also allowed me to write the items according to the language and literacy level of Chinese older adults'. I was also keenly aware that the interviews conducted with Chinese older adults may not discover all key elements of physical literacy. Therefore, additional efforts to develop a rich item pool were employed by conducting several literature reviews and referencing existing relevant measurements. I integrated the three sources of information to inform the item generation. This integrative approach helped me to capture all potential key elements of older adults' physical literacy and ensure that a comprehensive item pool was developed.

Second, this study used a series of steps for item reduction. Item reduction is considered highly significant in the instrument development process, but so far there is no consensus on the best method and criteria to use (Strickland, 2000). The most common way to make decisions on retaining or discarding items is often based on statistical item performance. Some researchers also highly recommend inviting experts and the target population to examine the content of the generated items (DeVellis, 2003; Strickland, 2000). In this dissertation study, I adopted both approaches for item reduction. The candidate items were first reviewed and revised/discarded through the expert review and interviews with Chinese older adults. The reduced version was then examined based on psychometrical and statistical criteria. This approach ensured and improved the content quality of the developed questionnaire (Lam, 2015).

A third strength of this dissertation study was the use of cognitive interviews with the target population to assist with establishing the content validity of the questionnaire. Cognitive interviews helped me identify if items were clear and understandable for Chinese older adults, what the items meant to older adults, and whether their interpretations of the items were similar to what the items intended to measure (Willis, 2015). Through cognitive interviews, I was able to identify several problems from the developed items, including awkward wording, vaugeness, double-barreled, or inappropriate assumption. Based on the interviews, items were revised or discarded. My experience with cognitive interviews was particularly valuable for ensuring items were written at the literacy level of the targeted population and that the content of the items were culturally valid. Respondents' literacy level can influence interpretation of questionnaire items. Therefore, it is important for survey designers to understand the literacy of their targeted population (Alanis, 2011). The education level of Chinese older adults is low. By 2015, 29.5% of older adults in China had not attended any school and 41.5% only had elementary school

education (China National Committee on Ageing, 2016). Based on responses provided by Chinese older adults' in this study, I reworded some items and used language that was more plain or simple to ensure all the items could be easily understood by participants. Further, it is important for survey designers to understand whether items are culturally valid, since the cultural factors also influence respondents' interpretations of the items (Alanis, 2011). For example, in this study, I found that Chinese older adults' interpretation to the item "How confident are you about keeping up some amount of physical activity when you don't have transportation?" was different from what the item was intended to measure. In some Western countries, the lack of transportation has been identified as a major barrier for adults' and older adults' PA participation (Belza et al., 2004; Bodde & Seo, 2009; Mathews et al., 2010; Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004). However in China, the majority of older adults performed PA within their neighborhood (Day, 2016; Li, 2012; Yi et al., 2016; Zhang, 2013) and may not consider lack of transportation as a barrier. Through the cognitive interview, I found that Chinese older adults responded "extremely confident" simply because they did not need transportations to participate in PA. This item was not culturally valid (inappropriate assumption) in that lack of transportation was not a barrier for Chinese older adults.

This study also had limitations. One limitation is generalizability of the developed questionnaire. Throughout the three questionnaire development stages, this dissertation study only included Chinese older adults without impaired cognition. I exluded older adults with cognitive impairment because of the need for older adults to recall past events and provide detailed descriptions of their PA experiences. Additionally, cognitively impaired older adults may not have the ability to perform many PA tasks. Future studies should determine to what extent Chinese older adults with cognitive impairment are able to answer the items in the

questionnaire and to determine the minimal cognitive level required for older adults to respond to the Perceived Physical Literacy for Chinese Elderly Questionnaire.

In Stage 3 of the questionnaire development, the study was not able to include a random sample of Chinese older adults. From participants' demographic information it is clear that the recruited participants were relatively younger (68.20 ± 6.04 years), educated (37.6% had a high school of higher education), healthier (71.4% perceived good or very good health status), and more physically active (81.2% were self-identified as regular exerciser and 51.5% had participated in regular PA more than five years). This study recruited participants following the principle of voluntary participation. It is possible that older, lower educated, less healthy, and inactive older adults may have been less willing to participate in the study. Therefore, whether this developed questionnaire is suitable for assessing all Chinese older adults' perceived physical literacy needs further validation. The adequacy of the Perceived Physical Literacy for Chinese Elderly Questionnaire may not be generalizable to older adults with different demographic characteristics. Further studies are needed to determine if the questionnaire performs consistently with other groups of Chinese older adults.

Another limitation is related to the methodology. As mentioned before, the cross-sectional design for psychometric testing in Stage 3 restricted the ability of the study to examine predictive validity of the questionnaire. In addition, because of the limitation of sample size, this study was not able to test the content structure of the questionnaire using confirmatory factor analysis. Currently, there are 47 items in the final version of the questionnaire, requiring 15 to 20 minutes to complete. The Perceived Physical Literacy for Chinese Elderly Questionnaire may be considered too long and time-consuming for some older adults. Future studies should

consider applying confirmatory factor analysis and item response theory to determine if further item reduction can occur.

Conclusion and Implications

Ongoing participation in PA is necessary to achieve and sustain health benefits (Martinson et al., 2008; Penedo & Dahn, 2005). However, maintaining a physically active lifestyle is difficult for older adults due to personal, social, and environmental challenges that come with aging (e.g., increasing chronic diseases, shrinking social networks, restricted life space; Michael, Colditz, Coakley, & Kawachi, 1999; Schutzer & Graves, 2004). To address this issue, this study introduced a relatively new construct, physical literacy, into the field of Chinese older adults' PA research. Physical literacy posits that all individuals have the potential to develop physical literacy and physically literate individuals are able to be and stay physically active lifelong (Whitehead, 2010). Physical literacy provides a new perspective on how to facilitate the maintenance of PA participation. However, the study of older adults' physical literacy is in its infancy (Jones et al., 2018) with instruments for measuring older adults' physical literacy lacking. The Perceived Physical Literacy for Chinese Elderly Questionnaire addresses this knowledge gap. The developed 47-item questionnaire has a demonstrated high level of content validity, good criterion validity, and satisfied reliability. Consistent with the conceptual definition of physical literacy, this questionnaire possesses six subscales: motivation, physical competence, interaction with environment, sense of self, interaction with others, and knowledge and understanding.

There are several practical implications for this developed instrument. First, it should be highlighted that this questionnaire is an appropriate tool for assessing Chinese older adults' perceived physical literacy. Assessing Chinese older adults' physical literacy can help us

identify their disposition and capability for maintaining physically active lifestyles during their later life. Second, this questionnaire can be used to assess the effectiveness of PA intervention programs. Being physically literate should be the ultimate goal of older adults' PA promotion. Researchers can use the Perceived Physical Literacy for Chinese Elderly Questionnaire to evaluate and track Chinese older adults' physical literacy journey. Third, from the public health perspective, researchers and related health professionals should also consider using this instrument to measure perceived physical literacy in different groups of aging populations. As there is an increased awareness of physical literacy levels, this, in turn, has the potential to improve the quality of older adults' healthy active lifestyle. Results obtained from studies using the Perceived Physical Literacy for Chinese Elderly Questionnaire may provide policymakers and health professionals with an understanding of the needs of older adults to maintain the abilty to be physically active throughout their aging course.

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Appendix 1

The defintion of physical literacy in different countries

Country	Definition
Canada	Physical Literacy is moving with competence and confidence in a wide variety of physical activities in multiple environments that benefit the healthy development of the whole person (PHE Canada).
Wales	A disposition acquired by human individuals encompassing the motivation, confidence, physical competence, knowledge and understanding that establishes purposeful physical pursuits as an integral part of their lifestyle (Morgan, Bryant, & Diffey, 2013).
England	Physical Literacy can be described as the motivation, confidence, physical competence, knowledge and understanding that provides children with the movement foundation for lifelong participation in PA. Enabling them to be physically literate supports their development as competent, confident, and healthy movers (Youth Sport Trust).
Australia	Physical literacy is a concept capturing the ability to move effectively; the desire to move; the perceptual abilities that support effective movement; the confidence and assurance to attempt movement challenges; and the subsequent ability to interact effectively with their environment and other people(Keegan, Keegan, Daley, Ordway, & Edwards, 2013).
New Zealand	Fundamental skills such as running, jumping and throwing, and it is a component of long-term athletic development (LTAD) (Spengler & Cohen, 2015).
Northern Treland	The ability to use body management, locomotor and object control skills in a competent manner, with the capacity to apply them confidently, through play and practice, in settings which may lead to sustained involvement in sport and physical recreation. (Spengler & Cohen, 2015)
Scotland	Same as England
Netherlands	No explicit definition exists in the Netherlands; however, they do use physical literacy to refer to the development of fundamental movement skills. Physical literacy is sometimes accompanied by the concept of "physical alphabet," a term used by the Dutch Sport Federation to describe the Fundamentals stage of the LTAD model and, more generally, the development of fundamental movement skills such as kicking, jumping, skating, and hitting(Spengler & Cohen, 2015).
United States	SHAPE America - Physical literacy is the ability to move with competence and confidence in a wide variety of physical activities in multiple environments that benefit the healthy development of the whole person(SHAPE America, 2014). Aspen Institute - Physical literacy is the ability, confidence, and desire to be physically active for life (Aspen Institute, 2015).

Appendix 2

Preliminary Screening Questions
初步筛选问题

Introduction:
介绍：
"Before we start, I need to ask you some questions to make sure you are the fit enough to participate in this study" "开始之前，我需要先问您几个问题来确定您是不是合适参加我们这个研究"

1. Are you aged 60 years or older? 您是否已经 60 岁了呢？
Yes □ No □ *(if no, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选)*

2. Is it easy for you to communicate in Mandarin Chinese or Kaifeng dialect? 对您来说用普通话或者开封话交流容易吗？
Yes □ No □ *(if no, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

3. Do you live at home currently? 您现在住在家里吗？
Yes □ No □ *(if no, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

4. Do you have a diagnosis of any significant major psychiatric conditions? 您有没有被诊断有明显的精神疾病吗？
No □ Yes □ *(if yes, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

5. Do you have a diagnosis of dementia or any acute illness currently? 您目前有没有被诊断有老年痴呆或者其他急性病吗？
No □ Yes □ *(if yes, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

6. Is it difficult for you to hear what I am saying? 您听我讲话有没有困难吗？
No □ Yes □ *(if yes, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

7. *Using the Abbreviated Mental Test (AMT), if participant have a score ≤7, participant not eligible, end of screening. 使用简易认知测试 (AMT)，如果参与者得分小于或者等于 7，参与者不符合条件，结束筛选。*

[If the participant passed all the screening questions, give the participant the study information sheet, read the sheet, and ask for oral consent.][如果参与者通过了所有筛选问题，给参与者研究内容介绍资料，读资料，并且请求对方的口头知情同意]

[If participant did not pass the screening questions, politely tell the participant why he/she cannot participate in this study.] [如果参与者没有通过筛选问题，礼貌的告诉参与者为什么他/她无法参与本研究]

Abbreviated Mental Test (Chinese version)
简易认知测试（中文版本）

Instructions:
介绍：

- *Please ask the patient all of the following questions.*
- *Scoring: A score of 1 is obtained for every correct answer given by the patient. When assessment is complete, total the score.*
- *请问参与者以下问题*
- *评分：每个正确回答的问题给 1 分，当测试结束，合总分。*

1. How old are you? 您今年多大年龄？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

2. What time is it (to nearest hour)? 现在大概是几点钟（大致的时间）？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

3. Give the participant the following address for recall at end of test: 42 Shanghai Street (This should be repeated by the patient to ensure it has been heard correctly). 下面我会讲一个地址，讲完之后请您重复两次，然后尽可能记住这个地址。一会儿在问完所有问题以后，我会问您再重复这个地址给我：上海路 42 号
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

4. What year is it? 今年是哪一年？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

5. What is this place? 请问现在我们在什么地方呢？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

6. What jobs do these people do? (Show the participant two pictures: a nurse and a doctor)
这张图上的人是做什么工作的呢？（给被试者一张图片：一张医生的图片或者一张护士的图片）
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

7. What is your date of birth (day and month)? 您的生日是几月几号？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

8. What is the date of National Day? 国庆节是哪一天？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

9. What is the name of the present president of China? 我们中国现在的总主席是谁？
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

10. Count backwards from 20-1. 请您从 20 倒数到 1.
0 points – Incorrect □ 1 point- Correct □
0 分 – 不正确 □ 1 分- 正确 □

DON'T FORGET THE ADDRESS FOR RECALL!
不要忘记让参与者复述地址！

Total Score 总分: _____

Appendix 3

Item Development Interview Guideline
(Translated English Version)

Introduction

- "Thank you very much for taking the time to meet with me. My name is Haocen Wang, I am a graduate student at University of Wisconsin-Madison, School of Nursing."

- "We want to develop a questionnaire to measure Chinese older adults' attitude and capability for long-term regular physical activity participation. To help us design the questionnaire, we want to first know Chinese older adults' thoughts and experience with physical activities. That's why we invited you, we think your experience and thoughts may can help us with it."

  [Screen and consent the participant before start.]

- "Thank you! I would like to explain again how this interview works. The purpose of the interview is to help me to understand how Chinese older adults think about and their experiences with physical activity. There are no right or wrong answers. Please tell me your answers in your own words. Take your time in answering the questions and feel free to ask for clarification of question that seems unclear."

- "**We can skip any questions that you don't feel comfortable answering and we can stop the interview at any time point if you don't wish to continue**. This interview will be no more than 60 minutes."

- "Before we begin do you have any questions?" [If yes, answer questions.]

Interview

General information

- What kinds of physical activities do you do?
- Do you do these activities regularly? [If yes] About how much physical activity you do per week?

Motivation

- Can you describe for me the reasons you do or do not do physical activity?
- Tell me what benefits you think physical activity can bring to you?
- Do you think physical activity is **very** important? [If yes] how important? Describe; [If not] why?

Physical competence

- How do you feel about your physical ability? How do you know that?
- What are some indications to you that your physical ability has gotten worse or better over the past few years?

- What physical activity that you want to do but you don't think you have the ability to do? How do you know you are unable to do them?

Interaction with environment

- Can you describe situations in which it is more difficult for you to participate in physical activity?
- Under what conditions do you perform physical activity less well? Why?

Sense of self

- Please think about and describe how doing physical activity makes you feel about yourself.
- How much confident do you have in your ability to keep doing physical activity regularly?

Interaction with others

- Please think about a situation that you need to do some physical activities with others. How easy or difficulty is it for you to do exercise with others?
- When you need some help during physical activity, how do you get the support from others?
- Do you do group physical activity? [If yes] Tell me more about your experience of doing group physical activity. [If no] why?

Knowledge and understanding

- For your perspective, to become a regularly exerciser, what do you need to know?
- How you choose physical activity?
- [For those who do physical activity regularly] How did you make the decisions to do more or less physical activity?

End of the interview

- "This is the end of the interview. Before we finish the interview, I'm going to ask some questions about your personal information. If there is any question you do not wish to answer, simply tell me and we can skip that question."

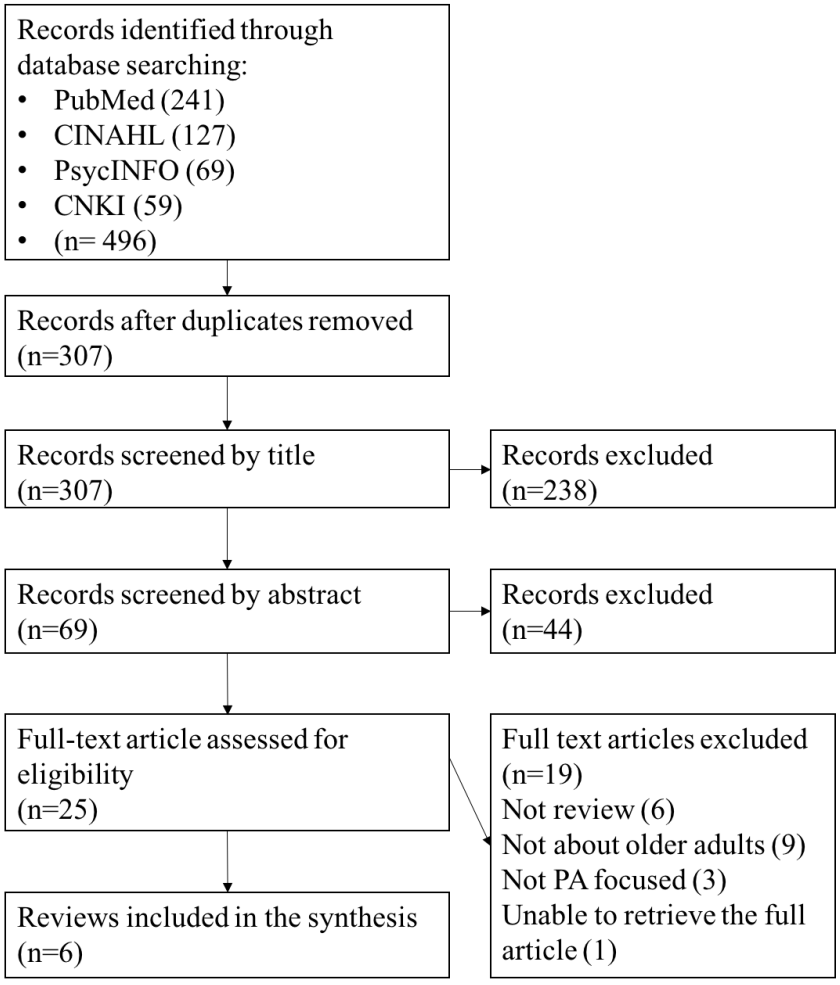
- Thank you very much for providing the time to help us! This is very helpful!"

- "Do you have additional comments to these questions?"
  [Give interviewee time to think and share additional comments.]

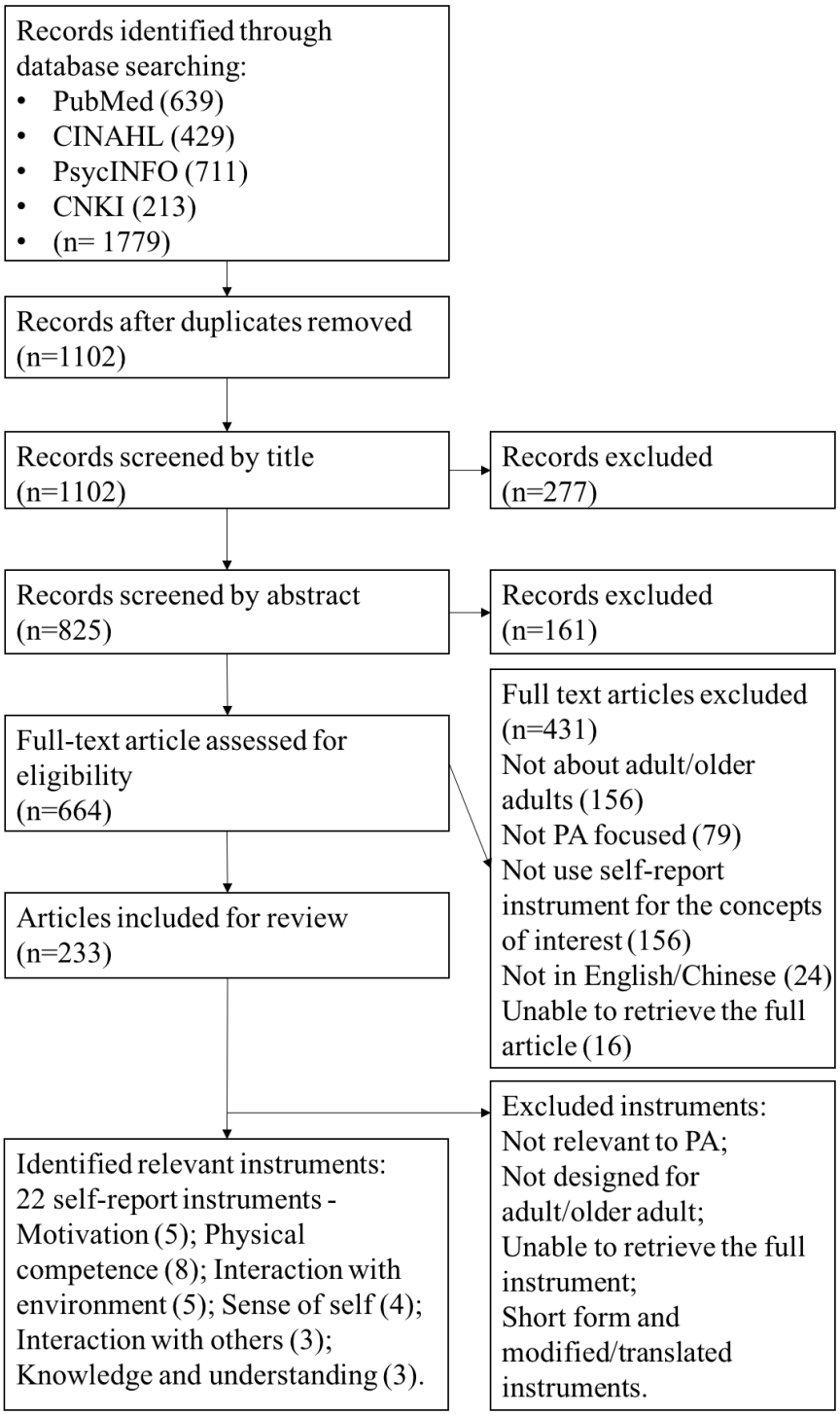
- "Do you have any other questions about the study?"
  [Answer the questions and thank again for his/her participation.]

- "My contact information is on this study information sheet. If you have any concern or question later, please feel free to contact me. Thank you again!"

Appendix 4



The searching process for literature review



The searching process for existing measurements

Appendix 5

Expert panel review form (1st round)
(Translated English Version)

Dear _____,

Thank you for agreeing to serve as a member in the expert panel for validating the content of the item pool generated for developing a questionnaire to measure Chinese older adults' perceive physical literacy. There are a total of 84 items which generated by the methods of literature review and individual interview with community-dwelling older adults.

Physical literacy is defined as the motivation, confidence, physical and social competences, knowledge and understanding required by older adults that allow them to take responsibility for engagement in a variety of physical activities regularly in a range of environments throughout the aging life course. Perceived physical literacy is an individual's own perception and judgement of his/her physical literacy level. This concept includes six attributes:

Attributes	Definition
Motivation	The positive attitude toward and intrinsic desire to engage in physical activity.
Physical competence	The physical ability to perform a variety of movement tasks
Interaction with environment	The ability to participate in physical activity under challenging intrapersonal, interpersonal, and physical environmental situations
Sense of Self	The self-belief in the ability to undertake and maintain regular physical activity.
Interaction with others	The ability to exercise with and build supportive relationships with others
Knowledge and understanding	The knowledge to evaluate, adjust, and enhance physical activity. and the understanding of the value of being physically active.

Note: In this questionnaire, physical activity is defined as a range of physical activities that can energize and enrich lives (e.g. walking for exercise, gardening, dancing with friends), which is performed with one's own choice and intention of acquiring health, wellbeing, and social benefits aiming at a better quality of life.

Enclosed is the content validation form. The items in the form are the initial item pool that we generated to develop the instrument measuring Chinese older adults' perceived physical literacy. Please provide comments on: 1. the relevancy of each item that measuring Chinese older adults' perceived physical literacy; and 2. the adequacy of the overall item pool in capture the construct of physical literacy.

If you have any questions, please do not hesitate to contact me at hwang472@wisc.edu and 136-0378-4003 for further clarification. Thank you!

Yours sincerely,
Haocen Wang
PhD candidate
University of Wisconsin-Madison

Chinese Older Adults' Perceived Physical Literacy Questionnaire
Content Validity Evaluation Form
(Translated English Version)

You are being invited to evaluate the content validity of items by assessing relevance and clarity of each developed item, as well as the overall comprehensiveness.

As you read through each question or item, please rate as follows:

- Rate the level of relevance of each item to the concept of physical literacy on a scale of 1-4. Specifically, 1=irrelevant, 2= somewhat relevant (the item needs revision), 3= quite relevant (relevant but needs minor revision), and 4= highly relevant.
- Rate the level of clarity by choosing clear (C) or not clear (NC)
- Space is provided for you to comment on individual item as needed.
- You can add any additional items.
- Please provide your overall comments and recommendation at the end of the form.

List of Items		Content Validity Item Relevance				Content Validity Clarity		Comments/Suggestions /Revisions
		Irrelevant item	Somewhat relevant	Quite relevant	Highly relevant	Not Clear	Clear	
Motivation: To measure to what extent the older adults have the positive attitude toward and intrinsic desire to engage in physical activity.								
M1	How much do you value the benefits brought by physical activity?	1	2	3	4	NC	C	
M2	How much do you value the physical health benefits brought by physical activity?	1	2	3	4	NC	C	
…… **(Only for illustration; not show all the items)**								
Additional items:								

- **Overall assessment of instrument comprehensiveness:**

- **Recommendations:**

Thank you for your time and help!

Appendix 6

Cognitive Interview Guideline
(Translated English Version)

Introduction

- "Hello, my name is Haocen Wang I am a graduate nursing student from the University of Wisconsin-Madison, School of Nursing. Thank you very much for contacting me and accepting to receive this interview!

- The reason we invited you is because we think you may can help us improve a questionnaire we developed, a questionnaire measures Chinese older adults' physical literacy. We want to find out if the questions make sense to people and if everyone interpret the questions in the same way."

  [Screen and consent the participant before start.]

- "Thank you! This interview will take about 1 hour at the most. Your answers will help us learn how to ask better questions about Chinese older adults' physical literacy."

- "I will take some notes during the interview, which to help me remember what you said. Please Feel free to say whatever comes to your mind. I'm trying to learn from you; your opinions and comments on these questions will help us to make this questionnaire better."

- "There are no wrong answers! Please don't worry about hurting my feelings if you criticize them. More comments, more better for me! If you have any thoughts about the questions during the interview, you are free to interrupt me to tell me your what you're thinking. If it is possible, please speak aloud how you think about each question, and how you select the response."

- "Again, I will try my best to protect your confidentiality. I won't ask any sensitive questions, and if you don't want to answer one question, please tell me and we can skip that question."

- "Well, we are ready to begin. Do you have any question before we start our interview?" [If yes, answer participants' questions.]

Interview

[Read each developed physical literacy survey question, and ask participants to answer each question; then ask probing questions about each question]

For example

- "Here is the question."

- [Read the question to the participant]

- "Tell me how you would answer this question."

- Ask appropriate probing questions based on participants' reaction. For example:
  - "In your opinion, what is this question asking you?"
  - "Can you tell me what does the term **** mean to you?"
  - "If you were to reword this question, how would you word it?"
  - "What were you thinking of when you heard this question?"
  - "Are there any words you find confusing in the question?"

- [Taking field note]

- [Proceed to the next question after participant has provided his/her thoughts]

Probing questions

Comprehension of the Question or Words

- "Can you tell me in your own words what this question was asking?"
- "Could you give me an example of what this means?"
- "What does this term_____ mean to you as it's used in this question?"

Decision Process &Retrieval from Memory

- "How sure are you about your answer?"
- "What were you thinking when you answer the question?"
- "How did you arrive at your answer? How easy or hard was it for you to choose an answer?"

Answer Categories

- "What do the answer choices mean to you?"
- "Tell me how you came to pick that answer."
- "Tell me why you didn't pick the other answer choices."

Response Processes

- "How hard was if for you to answer this question? What about the question made it hard for you to answer?"
- "Would the question be easier for you to answer if the question added the word_____?"
- "You looked puzzled. Are any words or phrases confusing to you? Is there any other way to ask the question to make it clearer and easier to answer?
- "What did you like about the question? What did you not like about the question?"

End of the interview

- "This is the end of the interview. Before we finish the interview, I'm going to ask some questions about your personal information. If there is any question you do not wish to answer, simply tell me and we can skip that question."

  [Complete the personal information sheet]

- Thank you very much for providing the time to help us! This is very helpful!"

- "Do you have additional comments to these questions?"
  [Give interviewee time to think and share additional comments.]

- "Do you have any questions about the study?"
  [Answer the questions and thank again for his/her participation.]

"My contact information is on this study information sheet. If you have any concern or question later, please feel free to contact me. Thank you again!"

Appendix 7

Chinese Older Adults' Perceived Physical Literacy Questionnaire (Cognitive interview)

(Translated English version)

Study Identification Number: _____

Interviewer's Name: _____

Data of Interview: _____/_____/_____ (mm/dd/yy)

Instruction

- **I'm going to ask you some questions about your attitude and opinions towards physical activity and yourself. by physical activity, in this survey, we refer to the physical activities that you do by your own choice with an aim to keep fit, stay healthy, or have fun, for example, doing tai-chi, taking a stroll, brisk walking, biking, dancing, doing radio calisthenics, swimming, stretching, lifting dumbbells, and so on. Those activities that you have to do, such as household chores, farming chores, or activities required in your jobs, are not considered as physical activity at here.**

- **Besides, doing physical activity regularly means doing physical activity at least 3 times a week, each time last about half an hour or more.**

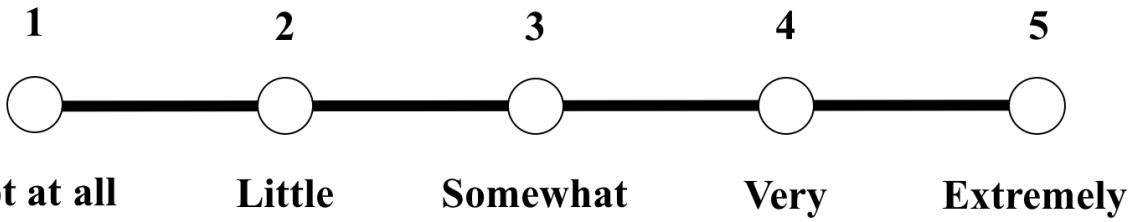
- **Please select <u>one</u> response that best describe your present opinion for each question using a 5-point scale, where 5 is "extremely", 4 is "very", 3 is "somewhat", 2 is "A little", 1 is "not at all". If you do not know how to answer a question, you can select "Do Not Know".**

- **Do you have any question before we begin?**
  [If yes, answer respondent's question.]
  [If no, start the interview]

M2	**How much do you value the physical health benefits brought by physical activity?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued? Comments:	☐Not at all valued=1 ☐A little valued=2 ☐Somewhat valued=3 ☐Very valued=4 ☐Extremely valued=5 ☐Do not know=99
M3	**How much do you value the mental benefits brought by physical activity?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued? Comments:	☐Not at all valued=1 ☐A little valued=2 ☐Somewhat valued=3 ☐Very valued=4 ☐Extremely valued=5 ☐Do not know=99

… …
(Only for illustration; not show all items)

Show card:



Appendix 8

Preliminary Screening Form

Introduction:
介绍：
"Before we start, I need to ask you some questions to make sure you are the fit enough to participate in this study" 开始之前，我需要先问您几个问题来确定您是不是合适参加我们这个研究"

1. Are you aged 60 years or older? 您是否已经 60 岁了呢？
Yes □ No □ *(if no, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选)*

2. Is it easy for you to communicate in Mandarin Chinese or Kaifeng dialect? 对于您来说用普通话或者开封话交流容易吗？
Yes □ No □ *(if no, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

3. Do you live at home currently? 您目前住在家里吗？
Yes □ No □ *(if no, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

4. Do you have a diagnosis of any significant and untreated major psychiatric conditions? 您有没有被诊断有明显的精神疾病呢？
No □ Yes □ *(if yes, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

5. Do you have a diagnosis of dementia or any acute illness currently? 您目前有没有被诊断有老年痴呆或者其他急性病呢？
No □ Yes □ *(if yes, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

6. Is it difficult for you to hear what I am saying? 您听我讲话有没有困难吗？
No □ Yes □ *(if yes, participant not eligible, end of screening)*
是的 □ 不是 □ *(如果不是，参与者不符合条件，结束筛选*

[If the participant passed all the screening questions, give the participant the study information form, read the form, and ask for oral consent.] [如果参与者通过了所有筛选问题，给参与者研究内容介绍资料，读资料，并且询问对方的口头知情同意]
[If participant did not pass the screening questions, politely tell the participant why he/she cannot participate in this study.] [如果参与者没有通过筛选问题，礼貌的告诉参与者为什么他/她无法参与本研究]

Appendix 9

Chinese Older Adults' Perceived Physical Literacy Questionnaire

(Translated English version)

Study Identification Number: _____

Interviewer's Name: _____

Data of Interview: _____/_____/_____ (mm/dd/yy)

Introduction:

- **Thank you very much for taking the time to take this survey!**

- **Before we start the survey interview, I would like to explain how this survey interview works.**
- **This interview will take about 20 to 30 minutes, and your answers will help us learn about Chinese older adults' physical activity and physical literacy.**
- **Take your time in answering the questions. There is no right or wrong, good or bad answers, so please feel free to choose any answer based on your situations or thoughts.**
- **Again, we will try our best to protect your confidentiality. We can skip any questions that you don't feel comfortable with, and we can stop this interview at any time point if you don't wish to continue.**

- **Do you have any question before we begin?**
  [If yes, answer respondent's question.]
  [If no, start the interview]

- **Frist, I'm going to ask you some questions about how much physical activity you did <u>during the past 7 days, or the last week.</u>**

  [Read the question statement; Click respondent's choice]

PA1	**Over the past 7 days, how often did you participate in sitting activities such as reading, watching TV, or doing handcrafts?**	☐NEVER (go to PA2) = 1 ☐SELDOM (1-2 DAYS) (go to PA1F) =2 ☐SOMETIMES (3-4 DAYS) (go to PA1F) =3 ☐OFTEN (5-7 DAYS) (go to PA1F) =4
PA1F	**On average, how many hours did you engage in these sitting activities per day?**	(If PA1=never=0) ☐Less than 1 hour =1 ☐1 but less than 2 hours=2 ☐2 - 4 hours=3 ☐more than 4 hours =4
PA2	**Over the past 7 days, how often did you take a walk outside your home or yard for any reason? For example, for fun or exercise, walking to work, walking the dog, etc.**	☐NEVER (go to PA3) = 1 ☐SELDOM (1-2 DAYS) (go to PA2F) =2 ☐SOMETIMES (3-4 DAYS) (go to PA2F) =3 ☐OFTEN (5-7 DAYS) (go to PA2F) =4
PA2F	**On average, how many hours per day did you spend walking?**	(If PA2=never=0) ☐Less than 1 hour =1 ☐1 but less than 2 hours=2 ☐2 - 4 hours=3 ☐more than 4 hours =4
PA3	**Over the past 7 days, how often did you engage in light physical activities such as stretching exercise, walking, fishing, singing, playing musical instruments, and so on? Light physical activity are activities that low intense, not increase your heart and breath rate, and not make you sweat.**	☐NEVER (go to PA4) = 1 ☐SELDOM (1-2 DAYS) (go to PA3F) =2 ☐SOMETIMES (3-4 DAYS) (go to PA3F) =3 ☐OFTEN (5-7 DAYS) (go to PA3F) =4
PA3F	**On average, how many hours did you engage in these light sport or recreational activities?**	(If PA3=never=0) ☐Less than 1 hour =1 ☐1 but less than 2 hours=2 ☐2 - 4 hours=3 ☐more than 4 hours =4

PA4	**Over the past 7 days, how often did you engage in moderate physical activities such as brisky walking, Tai-chi, biking, swimming, dancing and so on? Moderate physical activity are activities that have some intense, increase your heart and breath rate somewhat, and make you sweat somewhat.**	☐NEVER (go to PA5) = 1 ☐SELDOM (1-2 DAYS) (go to PA4F) =2 ☐SOMETIMES (3-4 DAYS) (go to PA4F) =3 ☐OFTEN (5-7 DAYS) (go to PA4F) =4
PA4F	**On average, how many hours did you engage in these moderate sport or recreational activities?**	(If PA4=never=0) ☐Less than 1 hour =1 ☐1 but less than 2 hours=2 ☐2 - 4 hours=3 ☐more than 4 hours =4
PA5	**Over the past 7 days, how often did you engage in strenuous physical activities such as jogging, swimming, cycling, singles tennis, aerobic dance, or other similar activities? Strenuous physical activities are activities that are intense, increase your heart and breath rate dramatically, and make you sweat a lot.**	☐NEVER (go to PA6) = 1 ☐SELDOM (1-2 DAYS) (go to PA5F) =2 ☐SOMETIMES (3-4 DAYS) (go to PA5F) =3 ☐OFTEN (5-7 DAYS) (go to PA5F) =4
PA5F	**On average, how many hours did you engage in these strenuous sport or recreational activities?**	(If PA5=never=0) ☐Less than 1 hour =1 ☐1 but less than 2 hours=2 ☐2 - 4 hours=3 ☐more than 4 hours =4
PA6	**Over the past 7 days, how often did you do any exercises specifically to increase muscle strength and endurance, such as lifting weights or pushups, etc.?**	☐NEVER (go to PAH1) = 1 ☐SELDOM (1-2 DAYS) (go to PA6F) =2 ☐SOMETIMES (3-4 DAYS) (go to PA6F) =3 ☐OFTEN (5-7 DAYS) (go to PA6F) =4
PA6F	**On average, how many hours did you engage in these strenuous sport or recreational activities?**	(If PA6=never=0) ☐Less than 1 hour =1 ☐1 but less than 2 hours=2 ☐2 - 4 hours=3 ☐more than 4 hours =4

PAH1	**During the past 7 days, have you done any light housework, such as dusting or washing dishes?**	☐NO=1 ☐YES =2
PAH2	**During the past 7 days, have you done any heavy housework or chores, such as vacuuming, scrubbing floors, washing windows, or carrying wood?**	☐NO=1 ☐YES =2
	During the past 7 days, did you engage in any of the following activities? Please answer YES or NO for each item.	
PAF1	**Home repairs like painting, wallpapering, electrical work, etc.**	☐No=1 ☐Yes=2
PAF2	**Lawn work or yard care, including snow or leaf removal, wood chopping, etc.**	☐No=1 ☐Yes=2
PAF3	**Outdoor gardening.**	☐No=1 ☐Yes=2
PAF4	**Caring for another person, such as children, dependent spouse, or another adult.**	☐No=1 ☐Yes=2
PAW	**During the past 7 days, did you work for pay or as a volunteer?**	☐NO=1(go to REG) ☐YES =2 (go to questions PAWT)
PAWT	**How many hours per week did you work for pay and or as a volunteer?** _____ hours	
PAWTY	**Which of the following categories best describes the amount of physical activity required on your job and or volunteer work?**	
	Mainly sitting with some slight arm movement (Examples: seat worker, bus driver, etc.)	☐No=1 ☐Yes=2
	Sitting or standing with some walking (Examples: cashier, general office worker)	☐No=1 ☐Yes=2
	Walking with some handling of materials generally weighing less than 50 JIN (Examples: mailman, waiter/waitress, construction worker)	☐No=1 ☐Yes=2
	Walking and heavy manual work often requiring handling of materials weighting over 50 JIN (Ex: farm or general laborer)	☐No=1 ☐Yes=2

REG **Are you a regular exerciser? That is, at most weeks, you do at least 3 times physical activity, and each time last about half an hour or more.**

☐No=1 (Go to the next section)
☐Yes=2 (Go to question REGY)

REGY **How long have you been doing physical activity regularly? Less than one year, one to five years, five to ten years, ten to fifteen years, or over fifteen years?**

☐Less than 1 year=1
☐1 to 5 years=2
☐5 to 10 years=3
☐10 to 15 years=4
☐Over 15 years=5

- **I'm going to ask you some questions about your attitude and opinions towards physical activity and yourself. by physical activity, in this survey, we refer to the physical activities that you do by your own choice with an aim to keep fit, stay healthy, or have fun, for example, doing tai-chi, taking a stroll, brisk walking, biking, dancing, doing radio calisthenics, swimming, stretching, lifting dumbbells, and so on. Those activities that you have to do, such as household chores, farming chores, or activities required in your jobs, are not considered as physical activity at here.**
- **Besides, doing physical activity regularly means doing physical activity at least 3 times a week, each time last about half an hour or more.**
- **I will read each question for you, after I read the question, please select <u>one</u> response that can best describe your present opinion for the question.**
- **Here are the opinions *[show and give the respondent the show card 1],* not at all, a little, somewhat, very, and extremely. Let's practice one question to see how this work.**

  [Read the practice question]
  How much do you like physical activity? Not at all, A little like, Somewhat like, Very like, or Extremely like?
  [Pause for the respondent to answer the question]

- ***[If the respondent has no problem for answering the question, go to ask "do you have any question before we begin"]***
- ***[If the respondent has problem for answering the question, explain more*]** **– Well, let me explain more. If you don't like physical activity, please select "not at all valued"; if you like physical activity a little bit, please select "a little like"; if you like physical activity somewhat, you can select "somewhat like"; if you very like physical activity, you can select "very valued"; and if you very very like physical activity, please select "extremely like". If you do not know how to answer a question, you can select "Do Not Know".**

- **So what is your answer?** ***[Explain how to use the scale if the respondent still don't know how to use the scale]***

- **Do you have any question before we begin?**
  [If yes, answer respondent's question.]
  [If no, start the survey]
  [Read the question statement; Click respondent's choice]

PLa1	**How much do you value the physical health benefits brought by physical activity?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued?	☐Not at all valued=1 ☐A little valued=2 ☐Somewhat valued=3 ☐Very valued=4 ☐Extremely valued=5 ☐Do not know=99
PLa2	**How much do you value the mental benefits brought by physical activity, such as making you feel good, less stress, or feel mind clearer?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued?	☐Not at all valued=1 ☐A little valued=2 ☐Somewhat valued=3 ☐Very valued=4 ☐Extremely valued=5 ☐Do not know=99
PLa3	**How much do you value the social benefits brought by physical activity, such as helping with your social networking and developing friendships?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued?	☐Not at all valued=1 ☐A little valued=2 ☐Somewhat valued=3 ☐Very valued=4 ☐Extremely valued=5 ☐Do not know=99
PLa4	**How important is physical activity for you?** Not at all important, A little important, Somewhat important, Very important, or Extremely important?	☐Not at all important=1 ☐A little important=2 ☐Somewhat important=3 ☐Very important=4 ☐Extremely important=5 ☐Do not know=99
PLa5	**How important do you think physical activity is for people in your age?** Not at all important, A little important, Somewhat important, Very important, or Extremely important?	☐Not at all important=1 ☐A little important=2 ☐Somewhat important=3 ☐Very important=4 ☐Extremely important=5 ☐Do not know=99

PLa6	**How much time and effort did you put in physical activity?** Not at all, A little amount, Somewhat amount, Very amount, or Extremely amount?	☐Not at all=1 ☐A little amount=2 ☐Somewhat amount=3 ☐Very amount=4 ☐Extremely amount=5 ☐Do not know=99
PLa7	**How hard you tried to do physical activity well?** Not at all hard, A little hard, Somewhat hard, Very hard, or Extremely hard?	☐Not at all hard=1 ☐A little hard=2 ☐Somewhat hard=3 ☐Very hard=4 ☐Extremely hard=5 ☐Do not know=99
PLa8	**How much do you enjoy the process of doing physical activity?** Not at all enjoyable, A little enjoyable, Somewhat enjoyable, Very enjoyable, or Extremely enjoyable?	☐Not at all enjoyable=1 ☐A little enjoyable=2 ☐Somewhat enjoy=3 ☐Very enjoy=4 ☐Extremely =5 ☐Do not know=99
PLa9	**How much satisfaction do you derive from participating in physical activity?** No satisfaction, A little amount satisfaction, Somewhat amount satisfaction, Very amount satisfaction, or Extremely amount satisfaction?	☐No satisfaction=1 ☐A little amount satisfaction=2 ☐Somewhat amount satisfaction=3 ☐Very amount satisfaction=4 ☐Extremely amount satisfaction=5 ☐Do not know=99
PLa10	**How much joy do you derive from physical activity?** Not at all joyful, A little joyful, Somewhat joyful, Very joyful, or Extremely joyful?	☐Not at all joyful=1 ☐A little joyful=2 ☐Somewhat joyful=3 ☐Very joyful=4 ☐Extremely joyful=5 ☐Do not know=99
PLa11	**How much happiness do you derive from physical activity?** No happiness, A little amount happiness, Somewhat amount happiness, Very amount happiness, or Extremely amount happiness?	☐No happiness=1 ☐A little amount happiness=2 ☐Somewhat amount happiness=3 ☐Very amount happiness=4

		☐Extremely amount happiness=5 ☐Do not know=99
PLa12	**How interested are you in physical activity?** Not at all interested, A little interested, Somewhat interested, Very interested, or Extremely interested?	☐Not at all interesting =1 ☐A little interesting=2 ☐Somewhat interesting=3 ☐Very interesting=4 ☐Extremely interesting=5 ☐Do not know=99
PLa13	**How much do you want to do physical activity?** Not at all want, A little want, Somewhat want, Very much want, or Extremely want?	☐Not at all want=1 ☐A little want=2 ☐Somewhat want=3 ☐Very much want=4 ☐Extremely want=5 ☐Do not know=99
PLa14	**How important is physical activity in your daily life?** Not at all important, A little important, Somewhat important, Very important, or Extremely important?	☐Not at all important=1 ☐A little important=2 ☐Somewhat important=3 ☐Very important=4 ☐Extremely important=5 ☐Do not know=99
PLa15	**How restless if you didn't do physical activity for a period of time, a feeling of missing out on something?** Not at all restless, A little restless, Somewhat restless, Very restless, or Extremely restless?	☐Not at all restless=1 ☐A little restless=2 ☐Somewhat restless=3 ☐Very restless=4 ☐Extremely restless=5 ☐Do not know=99
PLb16	**Compared to majority of people in your age group and same sex, how physically fit do you think you are?** Not at all fit, A little fit, Somewhat fit, Very fit, or Extremely fit?	☐Not at all fit=1 ☐A little fit=2 ☐Somewhat fit=3 ☐Very fit=4 ☐Extremely fit=5 ☐Do not know=99
PLb17	**What is your ability to walk continuously for half an hour at your normal pace?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4

		☐Extremely capable=5 ☐Do not know=99
PLb18	**What is your ability to climb two floors without stopping, such as from first floor to third floor?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb19	**What is your ability to squat fully?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb20	**What is your ability to carrying ten JIN, which is about the weight of one bottle of cooking oil, with your hands nonstop for five minutes?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb21	**What is your ability to grip an object, such as a stair rail, a hammer, or a full bag of groceries?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb22	**What is your ability to do light physical activity for half an hour, such as casual walking, biking, dancing slowly, or stretching?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb23	**What is your ability to do moderate physical activity for half an hour, such as brisk walking, swimming, jogging, or badminton?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5

		☐Do not know=99
PLb24	**What is your ability to do high intensity physical activity for half an hour, such as running, basketball, soccer, jumping rope?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb25	**What is your ability to do the physical activities that are not high-intensity but require endurance, such as walking, radio calisthenics, cycling, or jogging?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb26	**What is your ability to do the physical activities that rely mainly on your muscle strength and power, such as dumbbell lifting, squat, or wall push-up?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLb27	**What is your ability to do the physical activity depends on your balance, such as walking alone straight line, standing on one leg, or walk heel to toe?** Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable?	☐Not at all capable =1 ☐A little capable =2 ☐Somewhat capable =3 ☐Very capable =4 ☐Extremely capable=5 ☐Do not know=99
PLc28	**How confident are you about keeping up some amount of physical activity when you experience great stress?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc29	**How confident are you about keeping up some amount of physical activity when you have physical function limitation, such as having joint problem that affects your mobility?** Not at all confident, A little confident, Somewhat	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99

	confident, Very confident, or Extremely confident?	
PLc30	**How confident are you about keeping up some amount of physical activity when you experience chronic pain?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc31	**How confident are you about keeping up some amount of physical activity when you feel lazy?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc32	**How confident are you about keeping up some amount of physical activity when you have balance problem?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc33	**How confident are you about keeping up some amount of physical activity when you don't have much free time?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc34	**How confident are you about keeping up some amount of physical activity if you have chronic health issue, such as heart disease, cancer, or diabetes?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc35	**How confident are you about keeping up some amount of physical activity when some issues interrupt your regular routine?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5

		☐Do not know=99
PLc36	**How confident are you about keeping up some amount of physical activity when you don't have a someone to workout with?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc37	**How confident are you about keeping up some amount of physical activity when you have childcare duty?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc38	**How confident are you about keeping up some amount of physical activity when the physical activity programs you like are not available near your residence?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc39	**How confident are you about keeping up some amount of physical activity when there is no public exercise equipment near your residence?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc40	**How confident are you about keeping up some amount of physical activity when there are no physical activity facilities near your residence, such as no available parks, gyms, or public squares?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc41	**How confident are you about keeping up some amount of physical activity when the weather is very bad?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5

		☐Do not know=99
PLc42	**How confident are you about keeping up some amount of physical activity when the temperature is too hot?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc43	**How confident are you about keeping up some amount of physical activity when the outside air quality is bad?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc44	**How confident are you about keeping up some amount of physical activity when the physical activity you usually do is not convenient to do?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc45	**How confident are you about keeping up some amount of physical activity when your neighborhood is not convenient for walking, such as no sidewalks?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc46	**How confident are you about keeping up some amount of physical activity when you need to take care of someone who lacks the ability to maintain independent living, such as sick family members?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLc47	**How confident are you about keeping up some amount of physical activity when the temperature is too cold?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99

PLd48	**How confident are you in doing physical activity as good as other people in your age group and same sex?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd49	**How confident are you in doing physical activity as much as other people in your age group and same sex?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd50	**How confident are you to keep doing physical activity regularly for the next 3 months?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd51	**How confident are you to keep doing physical activity regularly for the next 10 years?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd52	**How confident are you to keep doing physical activity regularly with the fact of getting older?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd53	**How confident are you to overcome the barriers during physical activity?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99

PLd54	**When you set a physical activity goal, how confident are you to achieve that goal?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd55	**How confident are you in your ability to do more physical activity?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLd56	**How positive do you feel about yourself in general?** Not at all positive, A little positive, Somewhat positive, Very positive, or Extremely positive?	☐Not at all positive=1 ☐A little positive=2 ☐Somewhat positive=3 ☐Very positive=4 ☐Extremely positive=5 ☐Do not know=99
PLd57	**How confident are you to keep doing physical activity regularly for the next 3 years?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	☐Not at all confident=1 ☐A little confident=2 ☐Somewhat confident=3 ☐Very confident=4 ☐Extremely confident=5 ☐Do not know=99
PLe58	**What is your ability to work well with people that you are not familiar with during physical activity?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99
PLe59	**What is your ability to get along well with the people you do physical activity with?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99

PLe60	**If you were asked to participate in group physical activity, what is your ability to join in a new physical activity group?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99
PLe61	**If you were asked to participate in group physical activity, what is your ability to build good relationships with others in the group?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99
PLe62	**What is your ability to get the physical activity – related information that you need form other people, such us when you have questions about where to find a venue for your workout or where offers more physical activity programs?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99
PLe63	**What is your ability to provide support to help others with physical activity?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99
PLe64	**What is your ability to be the leader to bring others to do physical activity?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99
PLe65	**What is your ability to get the physical activity guidance that you need form other people, such us when you need someone to provide instructions or to lead the workout?** Not good at all, A little good, Somewhat good, Very good, or Extremely?	☐Not good at all=1 ☐A little good=2 ☐Somewhat good=3 ☐Very good=4 ☐Extremely good=5 ☐Do not know=99

PLf66	**How clear are you about what physical activities are the most beneficial for you?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99
PLf67	**How clear are you about what the ideal amount of physical activity is for you?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99
PLf68	**How clear are you about how to adjust or adapt your physical activity according to the conditions of your body?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99
PLf69	**How clear are you about how to enhance your physical activity ability?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99
PLf70	**How clear are you about the benefits of regular physical activity for your well-being?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99
PLf71	**How clear are you about the recommended weekly minimal physical activity amount for older adults?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99

PLf72	**How clear are you about how to prevent injury during physical activity?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear?	☐Not at all clear=1 ☐A little clear=2 ☐Somewhat clear=3 ☐Very clear=4 ☐Extremely clear=5 ☐Do not know=99

- **Thank you! Next, I am going to ask you about your perceived competence for exercising regularly.**

- **Please assuming that you were intending either to begin now a permanent regimen of physical activity regularly or to permanently maintain your regular physical activity regimen.**

- **I will read the four statement to you, and I need you to tell me that the extent to which each statement is true for you using a 7-point scale. If the statement is not true for you, please select 1 point "Not at all true"; if the statement is very true for you, please select 7 point "very true"; the higher point means the statement is more true for your situation.** ***[Show participant the show card 2]***

- **Please tell me the number that can best indicate the extent to which each statement is true for you. If you do not know how to answer the question, you can select "Do Not Know".**

[Read the question statement; Circle the point]

SD1 I feel confident in my ability to exercise regularly.

1 2 3 4 5 6 7
Not at all True Somewhat True Very Ture

☐Do not know=99

SD2 75. I now feel capable of exercising regularly.

1 2 3 4 5 6 7
Not at all True Somewhat True Very Ture

☐Do not know=99

SD3 I am able to exercise regularly over the long term.

1 2 3 4 5 6 7
Not at all True Somewhat True Very Ture

☐Do not know=99

SD477. I am able to meet the challenge of exercising regularly.

1	2	3	4	5	6	7
Not at all True			Somewhat True			Very Ture

☐Do not know=99

- **Before we finish the interview, I'm going to ask some questions about your personal information. If there is any question you don't wish to answer or you don't know the answer simply tell me and we can skip that question.**

AGE What is your year of birth?

_____Year
☐Refused =88
☐Do not know = 99

SEX How do you identify your sex? Female, Male of other?

☐Female =1
☐Male =2
☐Other =3
☐Refused =88
☐Do not know = 99

MAR What is your marital status? Are you never married, married, separated, widowed or divorced?

☐Never married =1
☐Married =2
☐Separated =3
☐Widowed =4
☐Divorced =5
☐Refused =88
☐Do not know = 99

ARE Currently, are you living in urban area or rural area?

☐Urban =1
☐Rural = 2
☐Do not know = 99

EDU **What is the level of education you have completed?**

☐No school =1
☐Some primary school =2
☐Primary school graduate =3
☐Some middle school =4
☐Middle school graduated =5
☐Some high school =6
☐High school graduated =7
☐Some college, no degree =10
☐Associate's degree =11
☐Bachelor's degree =12
☐Graduate degree =13
☐Refused =88
☐Do not know = 99

LIV **Who do you live with now? Live alone, with spouse, children, other family member, friends, or others.**

☐Live alone =1
☐Spouse =2
☐Children =3
☐Other family member =4
☐Friends =5
☐Others =6
☐Refused =8
☐Don't Know =9

RET **Are you currently retired?**

□No =1
☐Yes [Ask RETY] =2
□Refused=88
□Do not know=99

RETY [If Retired] **How many years have you retired?**

_____ Year
☐Refused = 88
☐Do not know =9

HEA How would you say your own health status? Is it excellent, good, fair or poor?

☐Very good =5
☐Good =4
☐Fair =3
☐Poor =2
☐Very poor=1
☐Refused =88
☐Do not know =99

AMB Do you need cane or walker for walking?

☐No Need =1
☐Cane= 2
☐Walker =3
☐Do not know =99

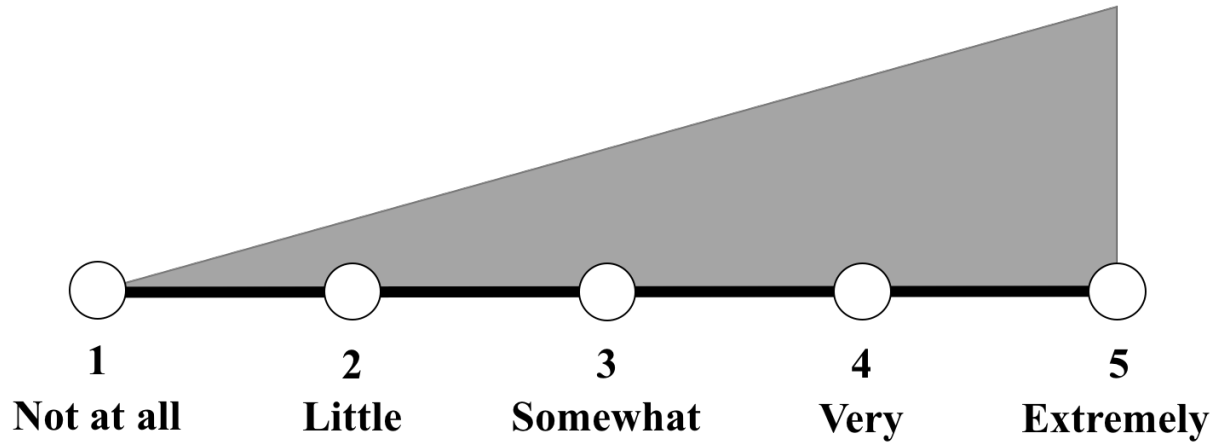
COM Last question, what health issues do you have? (Please select all known health issues)

☐**Hypertension**	☐**Hyperlipidemia**	☐**High cholesterol**	☐**Diabetes**
☐**Osteoporosis**	☐**Stroke**	☐**Joint problem**	☐**Back problem**
☐**Heart disease**	☐**Asthma**	☐**Digestive problems**	☐**Depression**
☐**Thyroid problem**	☐**Renal problem**	☐**Liver problem**	☐**Lung problem**
☐**Cancer**	☐**Chronic pain**	☐**Vision problem**	☐**Epilepsy**
☐**Other health issue:**			
☐**No health issue**			

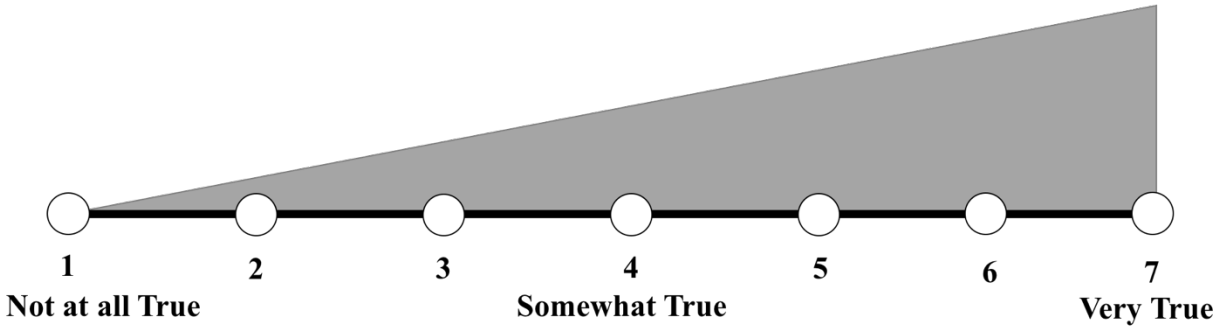
Closing:

- **Thank you! We finished our interview! Thank you very much for your time and help! If you have any question or concern about this study in the future, you are free to contact me. My contact information is on the information sheet I gave to you *[point the contact information to the respondent]*.**
- **Here is a little gift for you to thank you for your time and your help! *[Give the gift]***
- **Thank you again!**

Show card 1



Show card 2



中国老年人运动素养问卷
(Chinese version)

Study Identification Number: _____

Interviewer's Name: _____

Data of Interview: _____/_____/_____ (mm/dd/yy)

介绍:

- 非常感谢您抽空参加本次调研!
- 在开始问卷之前，我想先大致给您介绍下这次问卷。
- 整个问卷时间呢大概要 20 到 30 分钟，您的回答将帮助我们了解中国老年人的运动以及运动素养的情况。
- 我会读每个问题给您，您可以慢慢回答每个问题。您的答案没有对错之分，您按照自己的想法选择答案就行。如果有哪个问题您不愿意回答，我们可以跳过这个问题。如果您中间不想再回答了, 我们也可以随时停止。
- 您还有什么问题吗?
  [如果有，回答问题]
  [如果没有，开始问卷]

- **首先，我会问您 一些有关您在过去 7 天 或者 1 周里参加运动锻炼的情况。**

- *[读问题；勾选出答案]*

PA1	**在过去 7 天里，您有多经常坐着从事一些活动，如：读书读报、看电视、看电脑、看手机，或做手工等？**没做过，1 到 2 天，3-4 天，还是 5 到 7 天？	□不曾(跳 PA2) = 1 □很少 (1-2 天) (跳 PA1F) =2 □有时 (3-4 天) (跳 PA1F) =3 □经常 (5-7 天) (跳 PA1F) =4
PA1F	**在这些日子里，您大约平均一天总共坐着几小时？**少于 1 小时，1 到 2 小时，2 到 4 小时，还是超过 4 小时？	(如果 PA1=不曾=0) □少于 1 小时 =1 □1 到 2 小时=2 □2 到 4 小时=3 □超过 4 小时=4
PA2	**在过去 7 天里，您有多经常到户外走动，如：散步（但不包括快步走）、溜狗、买东西等？**没做过，1 到 2 天，3-4 天，还是 5 到 7 天？	□不曾(跳 PA3) = 1 □很少 (1-2 天) (跳 PA2F) =2 □有时 (3-4 天) (跳 PA2F) =3 □经常 (5-7 天) (跳 PA2F) =4
PA2F	**在您到户外走动的这些日子里，您平均一天总共走路几小时？**少于 1 小时，1 到 2 小时，2 到 4 小时，还是超过 4 小时？	(如果 PA2=不曾=0) □少于 1 小时 =1 □1 到 2 小时=2 □2 到 4 小时=3 □超过 4 小时=4
PA3	**在过去 7 天里，您有多经常从事一些轻度的运动(就是那些几乎不怎么出汗和加快您的心跳呼吸的运动)，如：做伸展运动、钓鱼、唱歌或演奏乐器等等？**没做过，1 到 2 天，3-4 天，还是 5 到 7 天？	□不曾(跳 PA4) = 1 □很少 (1-2 天) (跳 PA3F) =2 □有时 (3-4 天) (跳 PA3F) =3 □经常 (5-7 天) (跳 PA3F) =4
PA3F	**在您从事轻度运动的这些日子里，您平均一天总共做以上轻度运动几个小时？**少于 1 小时，1 到 2 小时，2 到 4 小时，还是超过 4 小时？	(如果 PA3=不曾=0) □少于 1 小时 =1 □1 到 2 小时=2 □2 到 4 小时=3 □超过 4 小时=4
PA4	**在过去 7 天里，您有多经常从事中度的运动(就是那些能使您心跳呼吸明显加快，稍出汗的运动)，如：快步走、太极拳/扇/剑、广场舞、广播体操、用一般速度游泳或骑自行车等等？**没做过，1 到 2 天，3-4 天，还是 5 到 7 天？	□不曾(跳 PA5) = 1 □很少 (1-2 天) (跳 PA4F) =2 □有时 (3-4 天) (跳 PA4F) =3 □经常 (5-7 天) (跳 PA4F) =4
PA4F	**在您从事中度运动的日子里，您平均一天总共做以上中度运动几个小时？**少于 1 小时，1 到 2 小时，2 到 4 小时，还是超过 4 小时？	(如果 PA4=不曾=0) □少于 1 小时 =1 □1 到 2 小时=2 □2 到 4 小时=3 □超过 4 小时=4
PA5	**在过去 7 天里，您有多经常从事激烈的运动（就是那些能使您心跳呼吸强烈加快，出汗多的运动），如：跑步、爬山、打**	□不曾(跳 PA6) = 1 □很少 (1-2 天) (跳 PA5F) =2 □有时 (3-4 天) (跳 PA5F) =3

	球、快节奏的跳舞、快速游泳或骑自行车等等？没做过，1 到 2 天，3-4 天，还是 5 到 7 天？	□经常 (5-7 天) (跳 PA5F) =4
PA5F	**在您从事激烈运动的日子里，您平均<u>一天总共</u>做以上<u>激烈的</u>活动几个小时？**少于 1 小时，1 到 2 小时，2 到 4 小时，还是超过 4 小时？	(如果 PA5=不曾=0) □少于 1 小时 =1 □1 到 2 小时=2 □2 到 4 小时=3 □超过 4 小时=4
PA6	**在过去 7 天里，您有多经常从事加强肌肉力量或肌肉耐力的运动，如：举哑铃，伏地挺身，仰卧起坐，引体向上等等？**没做过，1 到 2 天，3-4 天，还是 5 到 7 天？	□不曾(跳 PAH1) = 1 □很少 (1-2 天) (跳 PA6F) =2 □有时 (3-4 天) (跳 PA6F) =3 □经常 (5-7 天) (跳 PA6F) =4
PA6F	**在您从事肌肉力量运动的日子里，您大约平均<u>一天总共</u>从事以上锻炼肌肉的活动几个小时？**少于 1 小时，1 到 2 小时，2 到 4 小时，还是超过 4 小时？	(如果 PA6=不曾=0) □少于 1 小时 =1 □1 到 2 小时=2 □2 到 4 小时=3 □超过 4 小时=4
PAH1	**在过去 7 天里，是否有做一些轻松的家务，如：洗碗、扫地、清扫灰尘？**	□没有=1 □有=2
PAH2	**在过去 7 天里，是否有做一些粗重的家务，如：拖地、擦洗门窗？**	□没有=1 □有=2
	在过去 7 天里，您是否有从事以下的活动, 请回答有或者没有：	
PAF1	整修居家环境，如：粉刷室内、贴壁纸、水电工等等	□没有=1 □有=2
PAF2	整理前后院环境，如：清扫落叶、修剪树枝 等等	□没有=1 □有=2
PAF3	在户外栽花种草	□没有=1 □有=2
PAF4	照顾配偶、孙子孙女或其他家人	□没有=1 □有=2
PAW	**在过去 7 天里，您是否曾做义(志)工或做有领薪水的工作？**	□没有=1(跳 REG) □有=2(跳 PAWT)
PAWT	**如果有，那在过去 7 天中您<u>一共</u>做了几个小时的工作： _____小时**	
PAWTY	**以下哪一个答案比较接近你的工作性质？**	
	坐着用手工作，如：坐着工作的工厂流水线工人、司机等	□没有=1 □有=2
	坐或站，需要走动，如：收银员、办公室员工等	□没有=1 □有=2
	必须走且搬 50 斤以下的重物，如：快递员、服务员等	□没有=1 □有=2
	需要走动，并搬动超过 50 斤的重物，如：工地工人等	□没有=1 □有=2

REG **总的来说，您经常进行运动吗? 就是说，大多数情况，每周进行至少 3 次以上，每次半小时以上的运动。**

□不是=1 (跳下一部分)
□是的=2 (跳 REGY)

REGY **目前您已经坚持运动多少年了？少于 1 年，1 到 5 年，5 到 10 年，10 到 15 年，还是大于 15 年？**

□少于 1 年=1
□1 到 5 年=2
□5 到 10 年=3
□10 到 15 年=4
□大于 15 年=5

- **谢谢，接下来，我会问您一些问题，关于您对运动锻炼的态度和想法。我们这里说的运动，是指一些您在您为了锻炼身体，休闲娱乐等目的所做的一些运动，例如打太极拳，散走，快走，骑自行车，跳舞，广播操，游泳，伸展运动，举哑铃，之类的。但是家务劳动，种田，和在工作中必须要做的活动则不算。在问题中，经常运动是指每周至少运动 3 次，每次半小时以上。**
- **和之前一样，我读给您每个问题，我读完问题以后，请您选择一个最贴近您目前感受的选项。**
- **这是可能的选项** *[给参与者展示选项卡],* **"完全不"，"有点"，"比较"，"很"，和"非常"，如果您不知道应该如何回答某个问题，可以选择"不知道"。** *[练习回答一个问题]*
- *[读问题， 指着选项卡]* **比如说我问：您有多喜欢运动呢？是完全不喜欢，有点喜欢，比较喜欢，很喜欢，还是非常喜欢？您的回答是？** *[暂停，给对方时间回答问题]*
- *[如果对方顺利回答了问题, 问"后面的问题都是像这样选，我们开始前您还有其他什么问题吗？"]*
- *[如果对方不知道如何回答，进一步解释]* **– 没事，我再解释一下。就是说，如果您不喜欢运动，您可以选择"完全不喜欢"；如果您有点喜欢运动，您可以选择"有点喜欢" ，如果您觉得还是比较喜欢运动的，您可以选择"比较喜欢"；如果您很喜欢运动，那就选 "很喜欢"；如果您非常非常喜欢运动，那您就选 "非常喜欢"。 如果您不知道或者不想回答这个问题，您可以选择"不知道"。**
- **那现在您会选择什么？** *[如果对方还是不知道怎么回答，再进一步解释]*
- **后面的问题都是像这样选。那么在我们开始前您还有其他什么问题吗?**
  [如果有，回答问题；如果没有，开始问卷]
  - *[读问题；勾选出答案]*

PLa1	**您有多重视运动给您身体健康带来的好处呢？**完全不重视，有点重视，比较重视，很重视，或者非常重视？	□完全不重视=1 □有点重视=2 □比较重视=3 □很重视=4 □非常重视=5	□不知道 =99
PLa2	**您有多重视运动给您心理健康带来的好处呢, 比如帮助你感觉更好，降低压力, 感觉思路更清晰等等？**完全不重视，有点重视，比较重视，很重视，或者非常重视？	□完全不重视=1 □有点重视=2 □比较重视=3 □很重视=4 □非常重视=5	□不知道 =99

PLa3	**您有多重视运动给您社交方面带来的好处呢,比如帮助您社交，交友之类的？**完全不重视，有点重视，比较重视，很重视，或者非常重视？	□完全不重视=1 □有点重视=2 □比较重视=3 □很重视=4 □非常重视=5	□不知道=99
PLa4	**您认为，运动对您有多重要呢?** 完全不重要，有点重要，比较重要，很重要，或者非常重要？	□完全不重要=1 □有点重要=2 □比较重要=3 □很重要=4 □非常重要=5	□不知道=99
PLa5	**您认为，运动对您这个年纪的人来讲有多重要?** 完全不重要，有点重要，比较重要，很重要，或者非常重要？	□完全不重要=1 □有点重要=2 □比较重要=3 □很重要=4 □非常重要=5	□不知道=99
PLa6	**您投入了多少时间精力在运动当中呢？**完全没有，有点，比较多，很多，或者非常多？	□完全没有=1 □有点=2 □比较多=3 □很多=4 □非常多=5	□不知道=99
PLa7	**当您运动时，您有多尽力的去把运动做做好呢？**完全不尽力,有点尽力，比较尽力，很尽力，或者非常尽力？	□完全不尽力=1 □有点尽力=2 □比较尽力=3 □很尽力=4 □非常尽力=5	□不知道=99
PLa8	**您有多享受运动的过程呢？** 完全不享受，有点享受，比较享受，很享受，或者非常享受？	□完全不享受=1 □有点享受=2 □比较享受=3 □很享受=4 □非常享受 =5	□不知道=99
PLa9	**您从参与运动中感到了多少满足感呢？**完全不满足，有点满足，比较满足，很满足，或者非常满足？	□完全不满足=1 □有点满足=2 □比较满足=3 □很满足=4 □非常满足 =5	□不知道=99
PLa10	**您从参与运动中感到了多少快乐呢？**完全不快乐，有点快乐，比较快乐，很快乐，或者非常快乐？	□完全不快乐=1 □有点快乐=2 □比较快乐=3 □很快乐=4 □非常快乐 =5	□不知道=99
PLa11	**您从参与运动中感到了多少幸福感呢？**完全不幸福，有点幸福，比较幸福，很幸福，或者非常幸福？	□完全不幸福=1 □有点幸福=2 □比较幸福=3 □很幸福=4 □非常幸福 =5	□不知道=99
PLa12	**总的来说，您对运动有多感兴趣呢?** 完全不感兴趣，有点感兴趣，比较感兴趣，很感兴趣，或者非常感兴趣？	□完全不感兴趣=1 □有点感兴趣=2 □比较感兴趣=3 □很感兴趣=4	□不知道=99

		□非常感兴趣 =5	
PLa13	**您有多想要做运动呢?** 完全不想，有点想，比较想，很想，或者非常想？	□完全不想=1 □有点想=2 □比较想=3 □很想=4 □非常想 =5	□不知道 =99
PLa14	**您觉得，运动在您生活当中占有多重要的地位呢？** 完全不重要，有点重要，比较重要，很重要，或者非常重要？	□完全不重要=1 □有点重要=2 □比较重要=3 □很重要=4 □非常重要=5	□不知道 =99
PLa15	**如果一段时间不运动的话您有会有多少那种"少做了点什么的"不安感呢？** 完全没有不安，有点不安，比较不安，很不安，非常不安？	□完全没有不安=1 □有点不安=2 □比较不安=3 □很不安=4 □非常不安=5	□不知道 =99
PLb16	**您觉得，和大多数和您同年龄段同性别的人相比，您认为您的身体有多强健？** 完全不强健，有点强健，比较强健，很强健，非常强健？	□完全不强健=1 □有点强健=2 □比较强健=3 □很强健=4 □非常强健=5	□不知道 =99
PLb17	**您用您平常走路速度不间断的走上半小时的能力如何？** 完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb18	**您连续爬两层楼的能力如何, 比如说从一层到三层？** 完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb19	**您完全蹲下来的能力如何？** 完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb20	**您用手提十斤的东西提上五分钟的能力如何, 十斤大概是一桶食用油的重量？** 完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb21	**您用手握紧东西的能力如何，比如说握扶手，锤子，或者一整袋食物等等？** 完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99

PLb22	**您连续做半小时低强度运动的能力如何，比如半小时慢走，慢舞，或者伸展运动等等？**完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb23	**您连续做半小时中等强度运动的能力如何，比如半小时快走，慢跑，游泳，或者打羽毛球之类的？**完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb24	**您连续做半小时高强度运动的能力如何，比如半小时快跑，打篮球，踢足球，或者跳绳之类的？**完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb25	**您做那些不是很激烈但是需耐力的运动的能力如何，比如说走路，广播体操，骑自行车，或者慢跑等等？**完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb26	**您做那些需要肌肉力量的运动的能力如何，比如说举哑铃，深蹲，或者墙式俯卧撑之类的？**完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLb27	**您做那些需要平衡能力的运动的能力如何，比如走直线，单脚站立，或者脚尖脚跟连续走之类的？**完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?	□完全没有能力 =1 □有点能力 =2 □比较有能力 =3 □很有能力=4 □非常有能力=5	□不知道 =99
PLc28	**您有多少信心在您感到很大压力的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc29	**您有多少信心在您身体功能受到限制的时候坚持一定的运动量呢,比如有关节问题导致活动吃力的时候？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc30	**您有多少信心在您有慢性疼痛的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99

PLc31	**您有多少信心在您觉得有些懒的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc32	**您有多少信心在您平衡力不太好，无法稳步行走的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc33	**您有多少信心在您没有多少空余时间的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc34	**您有多少信心在您有慢性疾病的情况下坚持一定的运动量呢，比如说有心脏病，癌症，糖尿病之类的？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc35	**您有多少信心在有突发情况，打断您日常生活安排的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc36	**您有多少信心在没有人和您一起结伴做运动的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc37	**您有多少信心在您需要照顾小孩的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc38	**您有多少信心在您家附近没有您喜欢的运动项目的情况下坚持一定的运动量呢，比如说附近没有您喜欢的广场舞,广播体操，太极拳之类的运功项目？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc39	**您有多少信心在您家附近没有公共运动器材的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc40	**您有多少信心在您家附近没有运动场地的情况下坚持一定的运动量呢,比如说附近没有公园，健身**	□完全没有信心 =1 □有点信心=2	□不知道 =99

	房，或者广场之类的地方？完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□比较有信心 =3 □很有信心=4 □非常有信心=5	
PLc41	**您有多少信心在天气非常不好的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc42	**您有多少信心在天气太热的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc43	**您有多少信心在空气质量不好的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc44	**您有多少信心在您不方便做您平时习惯做的运动的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc45	**您有多少信心在您家附近不方便走路的情况下坚持一定的运动量呢，比如说没有人行道之类的？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc46	**您有多少信心在您要照顾缺少自理能力的人的情况下坚持一定的运动量呢，比如说在您要照顾生病家人之类的情况下？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLc47	**您有多少信心在天气太冷的情况下坚持一定的运动量呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd48	**您有多少信心能够和大多数您这个年龄段同性别的人运动的一样好呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd49	**您有多少信心能够和大多数您这个年龄段同性别的人运动量一样多呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99

PLd50	**您有多少信心能够接下来的 3 个月保持规律的运动呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd51	**您有多少信心能够在接下来的 10 年保持规律的运动呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd52	**您有多少信心在年龄越来越大的情况下一直保持有规律的运动呢？** 完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd53	**您有多少信心克服在运动中遇到的困难呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd54	**当您定下了运动目标后，您有多少信心去完成这个目标呢?**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd55	**您有多少信心能够做更多量的运动呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLd56	**您对自己的整体感觉有多好呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLd57	**您有多少信心能够在接下来的 3 年保持规律的运动呢？**完全没有信心，有点信心，比较有信心，很有信心，或者非常有信心？	□完全没有信心 =1 □有点信心=2 □比较有信心 =3 □很有信心=4 □非常有信心=5	□不知道 =99
PLe58	**您能够多好地和不怎么熟悉的人一起很好的配合做运动呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99

PLe59	**您能够多好地在运动中和别人相处融洽的呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLe60	**如果您被邀请参加团体运动，您能够多好地加入到一个新的运动团体中呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLe61	**如果您被邀请参加团体运动，您能够多好地和团队中的其他人建立的良好关系呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLe62	**您从他人那里得到您所需要的运动信息的能力如何呢，比如在您需要知道在哪里有运动场所或者哪里的运动项目比较多之类的信息时？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLe63	**您支持和帮助他人进行运动的能力如何呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLe64	**您领着他人一起做运动的能力如何呢？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLe65	**您从他人那里得到您所需要的运动指导的能力如何呢，比如在您需要人指导动作或者领着你进行运动时？**不好，有点好，比较好，很好，或者非常好？	□不好=1 □有点好 =2 □比较好 =3 □很好=4 □非常好=5	□不知道 =99
PLf66	**您有多清楚的知道哪些运动项目对您是最有益的呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道 =99
PLf67	**您有多清楚的知道最合适您的运动量是多少呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道 =99

PLf68	**您有多清楚的知道如何根据自己的身体情况对自己的运动进行调整呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道=99
PLf69	**您有多清楚的知道如何提高自己的运动能力呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道=99
PLf70	**您有多清楚的知道运动对您身心健康带来的好处呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道=99
PLf71	**有多清楚的知道对老年人推荐的最小运动量是多少呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道=99
PLf72	**您有多清楚的知道如何在运动中避免受伤呢？**完全不清楚，有点清楚，比较清楚，很清楚，还是非常清楚？	□完全不清楚=1 □有点清楚=2 □比较清楚=3 □很清楚=4 □非常清楚=5	□不知道=99

- **谢谢！ 下面我将问您一些问题，是关于您觉得自己有多少能力能够经常的，有规律的进行运动。**
- **回答这些问题时，请您假设您从现在要开始有规律的运动了或者要长期保持有规律的运动了。**
- **和前面一样，我读题目给您，然后您告诉我您的选择。***[给参与者看选项卡]* **请用 1 分到 7 分表达您对以下几个问题的感受程度，1 分是"完全不符合我的情况"，4 分是"比较符合我的情况"，7 分是"十分符合我的情况"。 总之，如果我说的情况越符合您的情况，您就打个更高的分数。**
- **请选择最符合您真实情况的分数。如果您不知道如何回答某个问题，或者不想回答某个问题，您可以说"不知道"。**

[读问题，圈出答案]

SD1 我对自己经常进行运动锻炼的能力很有信心. 1 分完全不符合, 7 分非常符合, 1 到 7 您给自己打几分？

1 2 3 4 5 6 7

完全不符合我的情况 比较符合我的情况 非常符合我的情况

□不知道=99

SD2 **我认为我是有能力经常进行运动锻炼的. 1 分完全不符合, 7 分非常符合, 1 到 7 分您给自己打几分？**

1 2 3 4 5 6 7
完全不符合我的情况 比较符合我的情况 非常符合我的情况

□不知道=99

SD3 **我有能力长期保持经常运动. 1 分完全不符合, 7 分非常符合, 1 到 7 分 您给自己打几分？**

1 2 3 4 5 6 7
完全不符合我的情况 比较符合我的情况 非常符合我的情况

□不知道=99

SD4 **我有能力应对经常运动带来的挑战. 1 分完全不符合, 7 分非常符合, 1 到 7 分您给自己打几分？**

1 2 3 4 5 6 7
完全不符合我的情况 比较符合我的情况 非常符合我的情况

□不知道=99

- **在结束之前，我需要问您几个关于您个人的问题。如果有哪个问题您不想回答或者不知道怎么回答某个问题的话，您告诉我，我们可以跳过那个问题。**

AGE **您是哪一年出生的呢?**

_____年
□不知道= 99

SEX **您的性别是什么？女性，男性，或者其他？**

□女性 =1
□男性 =2
□其他 =3
□不知道= 99

MAR **您目前的婚姻状况是什么? 是从来没有结过婚, 结婚了, 分居了, 寡居，还离婚了?**

□从没结过婚 =1
□结婚=2
□分居 =3
□寡居 =4
□离婚=5
□不知道= 99

ARE **您目前住在城镇区域还是农村地区呢？**

□城镇 =1
□农村 = 2
□不知道 = 99

EDU **您的最高教育水平是什么？**

□没上过学=1
□小学=2
□初中=3
□高中或者中专=4
□专科=5
□本科 =6
□研究生=7
□不知道= 99

LIV **您目前和谁一起住呢？自己一个人住，和您的配偶，和孩子，和其家里人，和朋友，还是和其他什么人一起？**

□自己一个人 =1
□配偶 =2
□孩子 =3
□其他家里人=4
□朋友 =5
□其他人 =6
□不知道=99

RET **您目前退休了吗?**

□没有 =1
□退休了 [跳 RETY] =2
□不知道=99

RETY [如果退休了] **您已经退休几年了呢?**

_____ 年
□不知道=99

HEA **您目前的健康情况如何? 非常好，比较好，一般，不大好，还是很不好？**

□非常好 =5
□比较好 =4
□一般=3
□不大好=2
□很不好=1
□不知道=99

AMB **您平常走路的时候需要住拐杖或者那种四脚的助步器呢?**

□不需要 =1
□拐杖= 2
□助步器=3
□不知道=99

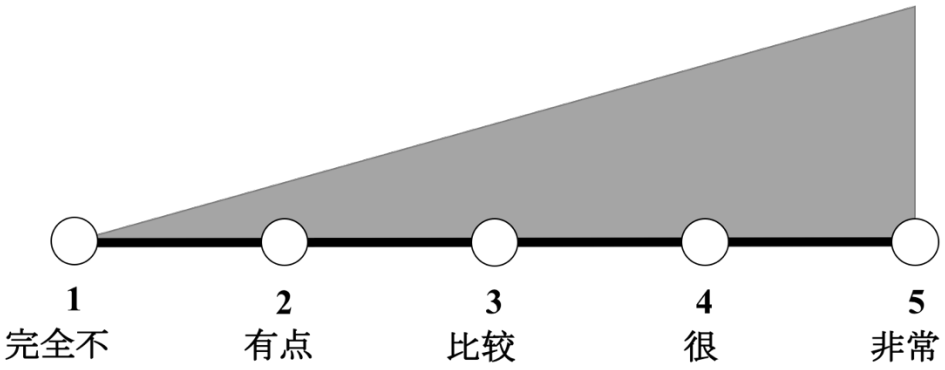
COM 最后一个问题，您现在有哪些健康问题呢？*[勾选所有问题]*

□高血压	□高血脂	□高胆固醇	□糖尿病
□骨质疏松	□中风	□关节疾病	□肩背问题
□心脏病	□哮喘	□消化系统问题	□抑郁
□甲状腺问题	□肾脏问题	□肝脏问题	□呼吸肺部问题
□癌症	□慢性疼痛	□视力问题	□癫痫
□其他健康问题:			
□没有健康问题			

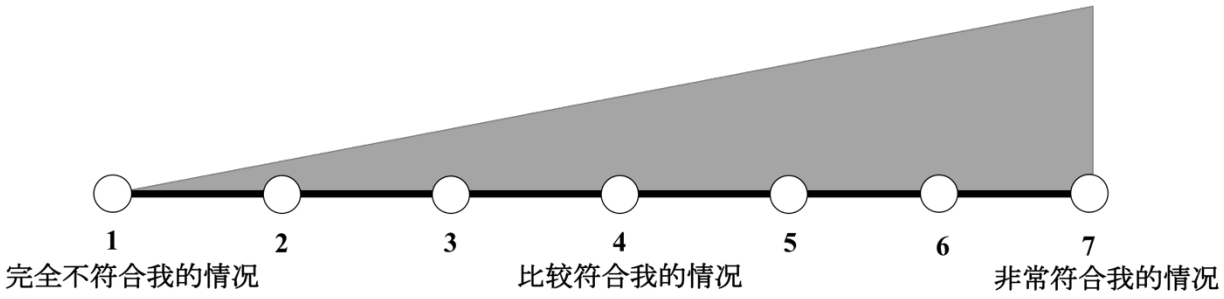
结束语:

- **谢谢！我们已经完成了所有问题！非常感谢您的时间和帮助！如果您以后有任何问题或者想法的话，请联系我们。我们的联系方式在这张信息纸上***[指给参与者指联系方式在哪里]*。
- **然后这是一份小礼物，来感谢您抽时间回答我们的问题***[给礼物]*。
- **最后再次感谢！**

选项卡 1：



选项卡 2:



Appendix 10

Table Summary of the correlates of older adults' physical activity participation

Correlates	Trost et al. (2002)	Eyler et al. (2002)	Plonczynski (2003)	Van Stralen et la. (2009)	Koeneman et al. (2011)	Hu et al. (2018)	Related physical literacy attributes
Population	Adults	Adults, female	Adults, female	Adults	Older adults	Underserved older adults	
Access to facilities	+						E
Attitudes, positive	NC			IC	IC		M
Barriers to exercise	-			IC	IC		E
Climate/weather, bad	-	-	IC			-	E
Control over exercise	+						S
Depression				IC	IC	-	E
Enjoyment of exercise	+	+	IC	IC			M
Expect benefits	+	+		IC	IC		M; K
Family responsibility		-				-	E
Fatigue		-					E
Fear of symptom		-	-				E
Frequently observe others exercising	+	IC					E; O
Functional limitation		IC		IC			P; E
Fitness status, good		+		+	IC		P
Heavy traffic	IC	IC		IC			E
Chronic diseases	-				IC		E
Injury history	+					-	E
Intention to exercise	+			+	IC		M
Knowledge of health and exercise	NC	+		IC		+	K
Lack of time	-	-				-	E
Mood disturbance	-						E
Neighborhood safety	+	+	IC	NC		+	E
Normative beliefs	NC				IC		M

Physical outcome realization				+	IC		M
Pain						-	E
Past experience, negative		-				-	E
Perceived behavior control	IC				IC		S
Perceived health/fitness, good	+	+	+				P
Physical activity intensity		IC		IC			P
Presence of sidewalks	IC	IC	IC	IC			E
Professional support		+	+		IC		E
Psychology health, good			+	NC			E
Satisfaction with facilities	+			IC	IC		E
Self-efficacy	+	+	+	+			S
Self-esteem	+	+					S
Self-motivation	+	+		IC	IC		M
Skills for coping barriers	+						E
Social isolation	-						E
Social support			+	IC	IC		O
Social support from family	+	+	IC		IC	-	O
Social support from peers	+	+	IC	IC	IC	-	O
Stress	IC	-	IC	-	IC		E
Transportation, lack		-				-	E
Unattended dogs	IC						E
Value of exercise outcomes	+						M

Note. + = Positive correlated; - = Negative correlated; IC=Inconclusive; NC= Not correlated; NA= Not applicable; M=Motivation; P=Physical competency; E=Interaction with environment; S=Sense of self; O=Interaction with others; K=Knowledge and understanding

Appendix 11

The summary of existing measurements related to physical literacy attributes

Name of the measurement	Age group	Description of the measurement	Related attributes to physical literacy
Intrinsic Motivation Inventory (McAuley, Duncan, & Tammen, 1989)	Adults	Aim: to assess participants' intrinsic motivation to PA engagement Structure: 45 items, 7 sub-scales- interest/enjoyment, perceived competence, effort, value/usefulness, relatedness Theory: the self-determination theory	Motivation Physical competence Sense of self
The Exercise Motivations Inventory (Markland & Ingledew, 1997)	Adults and Older adults	Aim: to assess individuals' PA participation motives, the measurement is applicable to both exercisers and non-exercisers Structure: 51 items, 14 sub-scales - stress management; revitalization; enjoyment; challenge; social recognition; affiliation; competition; health pressures; ill-health avoidance; positive health; weight management; appearance; strength & endurance; nimbleness Theory: Stages of Change; the self-determination theory	Motivation
Motives for Physical Activities Measure - Revised (MPAM-R) (Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997)	Adolescents and adults.	Aim: to assess the strength of five motives for participating in PA Structure: 30 items, 5 sub-scales – fitness; appearance; competence/challenge; social; and enjoyment. Theory: The self-determination theory	Motivation
Determinates of Physical activity questionnaire (DPAQ) (Taylor, Lawton, & Conner, 2013)	Young adults	Aim: to assess the determinates of PA participation Structure: 45 items, 11 sub-scales – knowledge, environmental context and resources, motivation and goals, belief about capabilities, skills, emotion, social influences, beliefs about consequences, action planning, coping planning, goal conflict. Theory: N/A	Motivation Physical competence Interaction with environment Sense of self Interaction with others

			Knowledge and understanding
Physical Activity and Leisure Motivation Scale (Molanorouzi, Khoo, & Morris, 2014)	Adolescents and adults.	Aim: to assess the motives for participating in PA Structure: 40 item, 8 sub-scales- mastery, enjoyment, psychological condition, physical condition, appearance, other's expectations, affiliation, competition/ego Theory: Intrinsic and extrinsic motivation based on self-determination theory	Motivation
Sickness Impact Profile (SIP) -Physical dimension subscale (PD) (Bergner, Bobbitt, Carter, & Gilson, 1981)	Adolescent, adults, and older adults	Aim: to assess self-perceived physical function Structure: the summary score of SIP's three subscales - Body Care and Movement (functions required in movement and balance), Ambulation (how the subject walks, climbs stairs, and the speed of walking), and Mobility (whether the subject is confined to bed, to one room, or to a building or is able to get out of the home and use public transportation) Theory: N/A	Physical competence
Physical Self-Efficacy Scale (Ryckman, Robbins, Thornton, & Cantrell, 1982)	Adults and older adults	Aim: to measure one's physical self-efficacy. Structure: 22 items, 2 subscales - perceived physical ability (perceptions of their physical competence) and physical self-presentation confidence (confidence in the presentation of physical skills) Theory: N/A	Physical competence
The Seattle Angina Questionnaire (Spertus et al., 1995)	Adults and older adults	Aim: to measure perceived limitation in performing physical activities Structure: 19 items, common daily activities- low exertional requirement (dressing yourself, walking indoors on level ground, and showering); medium exertional requirement (climbing a hill or flight of stairs without stopping, gardening, vacuuming, or carrying groceries, and walking more than a block at a brisk pace); high exertional requirement activities	Physical competence

		(jogging or running, lifting or moving heavy objects, and participating in strenuous sports) Theory: N/A	
Continuous Scale Physical Functional Performance (Cress, Buchner, Questad, Esselman, & Schwartz, 1996)	Adults and older adults	Aim: to measure physical function that a person needs to live independently Structure: 15 activities related to daily living Theory: N/A	Physical competence
Perceived Difficulty scale (Rejeski et al., 1998)	Adults and older adults	Aim: to measure the perceived difficulty of five common physical activities Structure: 5 physical activities - walking, stair climbing, light house work, heavy work around the house, and lifting and carrying Theory: N/A	Physical competence
Physical function scale (PFS) of the SF-36 (Ware, 2000)	Adults and older adults	Aim: to measure a persons' perceived physical function Structure: 10 items, PFS is a subscale of the 36-Item Short-Form Health Survey – limitation of 10 physical functions Theory: N/A	Physical competence
Physical Ability Impact (PAI) scale (Jones, Rutldge, Jones, Matallana, & Rooks, 2008)	Adults and older adults	Aim: to assess a person's function ability Structure: 12 items, includes questions about ADLs, IADLs, and advanced activities such as strenuous, more vigorous exercises and tasks Theory: N/A	Physical competence
Barriers-specific Self-Efficacy Scale, (McAuley, 1992).	Adults and older adults	Aim: to measures confidence in engaging in PA three times a week for the next three months	Interaction with the environment

		Structure: 13 items, measuring beliefs in personal abilities to PA-related barriers such as discouragement or bad weather Theory: N/A	
Exercise Self-efficacy Scale for Chinese Older Adults (Hong, Panuthai, Srisuphan, & Wannarit, 2009)	Older adults	Aim: to assess a person's confidence to overcome PA-related barriers Structure: 30 items, 6 subscales – lack of motivation, lack of support, health condition, time barriers, lack of facilities and environmental barriers. Theory: N/A	Interaction with the environment
Barriers to Physical Activity Questionnaire (Vasudevan, Rimmerm & Kviz, 2015)	Adults and older adults	Aim: to measuring barriers to PA across the intrapersonal, interpersonal, organizational, and community domains Structure: 8 subscales - health; beliefs and attitudes; family; friends; fitness center built environment; staff and policy; community built environment; and safety Theory: N/A	Interaction with the environment
Spinal cord injury (SCI) Exercise Self-Efficacy Scale (Kroll, Kehn, Ho, & Groah, 2007)	Adults and older adults	Aim: to measure exercise-related self-efficacy among persons with SCI Structure: 10 items Theory: N/A	Interaction with the environment Sense of self
Rosenberg self-esteem scale (Rosenberg, 1965)	Adults and older adults	Aim: to measure one's global self-worth by measuring both positive and negative feelings about the self. Structure: 10 items Theory: N/A	Sense of self
Physical Activity Social Support scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987)	Adults and older adults	Aim: to assess the frequency of support received from others (friends and families) for engaging in PA over the past 3 months Structure: 13 items. Theory: N/A	Interaction with others

The Quality of Relationships Inventory (Pierce, Sarason, & Sarason, 1991)	Adults and older adults	Aim: to assess the perceived level of support Structure: 25 items, 3 subscales assessing the perceived level of support, conflict, and depth in a specified relationship. Theory: N/A	Interaction with others
Physical activity knowledge (Hui, Hui, & Xie, 2014)	Adults	Aim: to assess the PA knowledge among Chinese adults with Type 2 diabetes Structure: 20 item, 4 sections - basic understanding of PA's benefits, health benefits of PA in respect of diabetes, details of PA for diabetes treatment, and the types of PA conferring health benefits in cases of diabetes. Theory: N/A	Knowledge and understanding
Health Education Inventory Questionnaire (Crandall & Steebergen, 2015)	Adults and older adults	Aim: to assess health knowledge Structure: 40 items, 8 domains - positive and active engagement in life, health-directed behavior, skill and technique acquisition, constructive attitudes and approaches, self-monitoring and insight, health service navigation, social integration and support, and emotional well-being; PA-related knowledge was assessed by a single question: "what is the minimum amount of moderate intensity activity needed per day to gain health benefits?" Theory: N/A	Knowledge and understanding

Appendix 12

Summary of item pool and item sources

Categories	Subcategories	Elements/codes	Sources	Item statement	Item
Motivation- the positive attitude towards and intrinsic desire to engage in PA	Value	Overall value	I; L; M	How much do you value the benefits brought by physical activity?	M1
		Health value	I; L; M	How much do you value the physical health benefits brought by physical activity?	M2
		Mental value	I; L; M	How much do you value the mental benefits brought by physical activity?	M3
		Social value	I; L; M	How much do you value the social health benefits brought by physical activity?	M4
	Importance	Important for me	I; M	How important is physical activity for you?	M5
		Important for older adults	I; L	How important do you think physical activity is for people in your age?	M6
		Effort	I; M	How much effort did you put in physical activity?	M7
		Effort to do well	M	How hard you tried to do physical activity well?	M8
	Affect	Enjoyment	I; L; M	How much do you enjoy physical activity?	M9
		Satisfaction	I; M	How much satisfaction do you derive from participating in physical activity?	M10
		Joy	I; M	How much joy do you derive from participating in physical activity?	M11
		Happiness	M	How much happiness do you derive from physical activity?	M12
		Pleasure	M	How much satisfaction do you derive from participating in physical activity?	M13
		Interest	I; M	How interested are you in physical activity?	M14
		Want	I; M	How much do you want to do physical activity?	M15
	Habit	Part of daily life	I	How important is physical activity in your daily life?	M16
		Restlessness	I; M	How restless if you didn't do physical activity?	M17

Physical competence - the physical ability to perform a variety of movement tasks	Ability of basic physical movements	Physically fit	I; L; M	How physically fit do you think you are?	P1
		Overall ability	L; M	How confident are you about your physical ability?	P2
		Walking	I; M	How confident are you about your ability to walk continuously for half an hour at your normal pace?	P3
		Climbing	I; M	How confident are you about your ability to climb two flights of stairs without stopping?	P4
		Squatting/kneeling	I; M	How confident are you about your ability to squat fully?	P5
		Carrying	I; M	How confident are you about your ability to carrying five kilograms, which is about your 10 bottles of water, with your hands nonstop for five minutes?	P6
		Grip	M;	How confident are you about your ability to grip an object, such as a stair rail, a hammer, or bag of groceries?	P7
	Ability of PA	Low intensity PA	I; M	How confident are you about your ability to do light physical activity for half an hour, such as casual walking, biking, dancing slowly, or stretching?	P8
		Moderate intensity PA	I; M	How confident are you about your ability to do moderate physical activity for half an hour, such as brisk walking, swimming, jogging, or badminton?	P9
		High intensity PA	I; M	How confident are you about your ability to do high intensity physical activity for half an hour, such as running, basketball, soccer, jumping rope?	P10
		Aerobic/endurance PA	I; M	How confident are you about your ability to do aerobic activities, such as walking, radio calisthenics, cycling, or jogging?	P11
		Muscle-strengthening PA	M	How confident are you about your ability to do resistance activities, such as dumbbell lifting, squat, or wall push-up?	P12

		Balance PA	M	How confident are you about your ability to do the physical activity depends on your balance, such as walking alone straight line, standing on one leg, or walk heel to toe?	P13
Interaction with environment- the ability to participate in PA under challenging environmental situations	Intrapersonal situations	Low mood	L; M	How confident are you about keeping up some amount of physical activity when your mood is low?	E1
		Stress	I; L; M	How confident are you about keeping up some amount of physical activity when you experience great stress?	E2
		Joint problem	I; L; M	How confident are you about keeping up some amount of physical activity when you experience joint problem?	E3
		Pain	I; L; M	How confident are you about keeping up some amount of physical activity when you experience chronic pain?	E4
		Function limitation	L	How confident are you to about keeping up some amount of physical activity when you have function limitation?	E5
		Lazy	M	How confident are you about keeping up some amount of physical activity when you feel lazy?	E6
		Tired	L	How confident are you about keeping up some amount of physical activity when you feel tired?	E7
		Balance problem	M	How confident are you about keeping up some amount of physical activity when you have balance problem?	E8
		Lack of time	I; L; M	How confident are you about keeping up some amount of physical activity when you don't have much free time?	E9
		Not healthy	L; M	How confident are you about keeping up some amount of physical activity when you are not healthy?	E10

	Chronic health conditions	I; L	How confident are you about keeping up some amount of physical activity if you have chronic health issue, such as heart disease, cancer, diabetes?	E11
	Injury history	L	How confident are you to perform physical activity if you have past injury history?	E12
	No regular routine	M	How confident are you about keeping up some amount of physical activity when you don't have a regular routine?	E13
Interpersonal situations	No companion	I; L; M	How confident are you about keeping up some amount of physical activity when you don't have a workout companion?	E14
	Provide care to others	I; L; M	How confident are you about keeping up some amount of physical activity when you need to provide care to others, such as your grandchild, your spouse, or family member?	E15
	Lack of encouragement	M	How confident are you about keeping up some amount of physical activity when no one encourage you to do physical activity?	E16
Physical situations	Lack of PA program	I; M	How confident are you about keeping up some amount of physical activity when the physical activity programs you like are not available near your residence?	E17
	Lack of public exercise equipment	I; L; M	How confident are you about keeping up some amount of physical activity when there is no public exercise equipment near your residence?	E18
	Lack of PA space	I; L; M	How confident are you about keeping up some amount of physical activity when there are no physical activity facilities near your residence?	E19
	Weather	I; L; M	How confident are you about keeping up some amount of physical activity when the weather is very bad?	E20

		Temperature	I; L; M	How confident are you about keeping up some amount of physical activity when the temperature is too hot or too cold?	E21
		Air quality	I	How confident are you about keeping up some amount of physical activity when the outside air quality is bad?	E22
		Lack of transportation	L; M	How confident are you about keeping up some amount of physical activity when you don't have transportation?	E23
		Heavy traffic	L	How confident are you about keeping up some amount of physical activity if the traffic is heavy in your community?	E24
		Not convenient	M	How confident are you about keeping up some amount of physical activity when the physical activity is not convenient?	E25
		Neighborhood safety	L; M	How confident are you about keeping up some amount of physical activity if your community is not safe, such as no streetlights, unattended dogs, or feeling unsafe?	E26
		Neighborhood walkability	I; L; M	How confident are you about keeping up some amount of physical activity when your neighborhood is not convenient for walking, such as no sidewalks?	E27
Sense of Self - the self-belief in the ability to undertake and maintain regular PA	Sense of ability to undertake	As well as others	I; M	How confident are you in doing physical activity as good as other people in your age group?	S1
		As much as others	I; M	How confident are you in doing physical activity as much as other people in your age group?	S2
	Sense of ability to maintain	Short-term maintenance	I; M	How confident are you to keep doing physical activity regularly for a short period of time?	S3
		Long-term maintenance	I; M	How confident are you to keep doing physical activity regularly for a long period of time?	S4
		Maintaining with aging	I	How confident are you to keep doing physical activity regularly with the fact of getting older?	S5

	Sense of ability to achieve	Overcome barriers	I; L; M	How confident are you to overcome the barriers during physical activity?	S6
		Achieve goals	I; L; M	How confident are you to achieve your physical activity goals?	S7
		Achieve more	I	How confident are you in your ability to do more physical activity?	S8
	General sense of self	Positive sense of self	I; M	How positive do you feel about yourself in general?	S9
		Control over PA	L	How easy for you to perform physical activity regularly?	S10
Interaction with others - the ability to exercise with and build supportive relationships with others	Relationship with others	Work well with unfamiliar people	I	What is your ability to work well with people that you are not familiar with during physical activity?	O1
		Get along with others	I; M	What is your ability to get along well with the people you do physical activity with?	O2
	Relationship with group	Join in a group	I	How confident are you to join in a new physical activity group?	O3
		Fill in a group	I	What is your ability to integrate in a physical activity group?	O4
	Supportive relationship	Gain support	I; M	What is your ability to get the physical activity - related help that you need from other people, such as information or guidance?	O5
		Provide support	I	What is your ability to provide support to help others with physical activity?	O6
		Lead others	I	What is your ability to be the leader to bring others to do physical activity?	O7
Knowledge and understanding - the knowledge to evaluate, adjust, and enhance PA and	Knowing self	Suitable PA for me	I; M	How clear are you about what physical activities are the most beneficial for you?	K1
		Suitable amount for me	I; M	How clear are you about what the ideal amount of physical activity is for you?	K2
		Suitable adjustment	I	How clear are you about how to adjust or adapt your physical activity according to the conditions of your body?	K3

the understanding of the value of being physically active.	Knowing physical activity	Improvement	I	How clear are you about how to enhance your physical activity ability?	K4
		Benefits of PA	I; L; M	How clear are you about the benefits of regular physical activity for your well-being?	K5
		Health benefits of PA	L	Howe clear are you about the health benefits of regular physical activity?	K6
		Knowledge of PA	I; L; M	How much do you know about physical activity?	K7
		PA recommendation	M	How clear are you about the physical activity recommendations for people in your age?	K8

Note. I=Interview; L=Literature review; M=Existing measurement; PA=physical activity; M=Motivation; P=Physical competency; E=Interaction with environment; S=Sense of self; O=Interaction with others; K=Knowledge and understanding

Appendix 13

Summary of expert panel review (items with comments) (*N*=7)

Item	Original item statement	I-CVI	Expert panel comments	Decision/Item revision
M1	How much do you value the benefits brought by physical activity?	0.57	This is a conclusive question, which can be covered by question M2, M3, and M4	▪ Deleted.
M4	How much do you value the social health benefits brought by physical activity?	1	Use "social benefit" instead of "social health benefit"	▪ Kept ▪ Revised: How much do you value the social benefits brought by physical activity?
M6	How important do you think physical activity is for people in your age?	0.86	Question is similar to M5	▪ Kept. M5 is asking to what extent PA is important "for themselves"; M6 is asking to what extent PA is important for "people in their age".
M7	How much effort did you put in physical activity?	0.71	Not clear. Suggested to use "time and effort"	▪ Kept. According to the interview results, older adults talked about the time and effort they put in PA. ▪ Revised: How much time and effort did you put in physical activity?
M13	How much pleasure do you derive from participating in physical activity?	1	The meaning of "pleasurable" is similar to "joyful" and "enjoy".	▪ Kept. For further test among older adults.
M15	How much do you want to do physical activity?	0.86	This is a summary/ conclusive question, which is not at the same level with other questions	▪ Kept. For further testing.
M16	How important is physical activity in your daily life?	0.86	Similar to M5 and M6	▪ Kept. According to the interview, physically active older adults saw PA as an important part of their daily life because PA is a habit for them.
P1	How physically fit do you think you are?	0.86	Physically fit is not equal to physical competence	▪ Kept. For further testing. According to interview with older adults, some people used physically fit to describe their physical competence.

P2	How confident are you about your physical ability?	0.71	A conclusive question, which is not at the same level with other questions; The meaning is same to P1	▪ Deleted. Accepted expert's suggestion.
P7	How confident are you about your ability to grip an object, such as a stair rail, a hammer, or bag of groceries?	0.86	Not relevant to physical activity	▪ Kept. Grip is an important ability for people to do some PA, such as lifting.
P10	How confident are you about your ability to do high intensity physical activity for half an hour, such as running, basketball, soccer, jumping rope?	1	No everyone can do this kind of activity, e.g. people with heart diseases	▪ Kept
P12	How confident are you about your ability to do the resistance activities depends on your muscle strength, such as dumbbell lifting, squat, or wall push-up?	1	This question may be hard for some older adults to answer since they don't do this kind of activity	▪ Kept
E1	How confident are you about keeping up some amount of physical activity when your mood is low?	0.71	Low mood can be a motivation for PA participation	▪ Kept. For further testing. Low mood was seen as a significant barrier for PA participation in literature.
E2	How confident are you about keeping up some amount of physical activity when you experience great stress?	0.71	Stress can be a motivation for PA participation	▪ Kept. For further testing. Stress was seen as a significant barrier for PA participation in literature.
E3	How confident are you about keeping up some amount of physical activity when you experience joint problem?	1	This question can be covered by E5.	▪ Kept. For further testing. Joint problem is a significant health problem that influence older adults' PA.
E5	How confident are you about keeping up some amount of physical activity when you have function limitation?	0.86	Be specific about physical limitation; This question maybe hard for some people without physical limitation to answer.	▪ Kept. For further testing. ▪ Revised. How confident are you about keeping up some amount of physical activity when you have physical function limitation, such as having difficulties with mobility?

E7	How confident are you about keeping up some amount of physical activity when you feel tired?	0.43	Similar to E6. For older adults, if they feel tired, they need better rest rather than doing PA	▪ Deleted. Accepted expert's suggestion.
E8	How confident are you about keeping up some amount of physical activity when you have balance problem?	1	Not everyone has the balance problem.	▪ Kept
E10	How confident are you about keeping up some amount of physical activity when you are not healthy?	0.43	Not appropriate. If people get sick(acute), they need rest.	▪ Deleted. Accepted expert's suggestion.
E11	How confident are you about keeping up some amount of physical activity if you have chronic health issue, such as heart disease, cancer, or diabetes?	1	This question is better than the E10.	▪ Kept
E12	How confident are you to perform physical activity if you have past injury history?	0.86	Not clear. Fear of having injury again or the physical limitation caused by injury?; Change to "past injury history during physical activity" ; Those without injury history may not know how to answer this question.	▪ Kept. For further testing ▪ Revised: How confident are you to perform physical activity if you have past injury history during physical activity?
E13	How confident are you about keeping up some amount of physical activity when you don't have a regular routine?	/	Not clear. (2 experts did not rate this item because of the unclear question)	▪ Kept. For further testing. ▪ Revised. How confident are you about keeping up some amount of physical activity when some issues interrupt your regular routine?
E23	How confident are you about keeping up some amount of physical activity when you don't have transportation?	0.71	This situation is uncommon; older adults usually workout in their communities	▪ Kept. For further testing
E24	How confident are you about keeping up some amount of physical activity if the traffic is heavy in your community?	0.71	This situation is uncommon	▪ Kept. For further testing
E25	How confident are you about keeping up some amount of physical activity	0.86	Not clear, need to explain "convenient".	▪ Kept. ▪ Revised. How confident are you about keeping up some amount of physical activity

	when the physical activity is not convenient?			when the physical activity you usually do is not convenient to do?
S6	How confident are you to overcome the barriers during physical activity?	0.86	Should this question be put in the environment domain?	▪ Kept. This question aims to assess older adults' self-efficacy of overcoming barriers.
S9	How positive do you feel about yourself in general?	0.71	Not relevant to PA	▪ Kept. According to physical literacy, physically literate individuals have an overall positive attitude towards themselves
S10	How easy for you to perform physical activity regularly?	0.71	A conclusive question, which is not at the same level with the rest of questions; redundant question, this question can be covered by previous questions.	▪ Deleted. A summary question, accepted expert's suggestion.
O5	What is your ability to get the physical activity - related help that you need from other people, such as information or guidance?	0.86	This question need to be separated into two questions – help for information and help for guidance.	▪ Kept. Divvied the question into two questions based on the expert's suggestion. ▪ Revised. What is your ability to get the physical activity - related information that you need from other people? ▪ What is your ability to get the physical activity guidance that you need from other people?
O7	What is your ability to be the leader to bring others to do physical activity?	0.86	Not everyone have the ability to lead others, maybe hard for some people to answer	▪ Kept.
K6	Howe clear are you about the health benefits of regular physical activity?	0.71	This question can be replaced by K5.	▪ Deleted. This is a redundant item
K7	How much do you know about physical activity?	0.57	The question is not clear. A conclusive question, which is not at the same level with other questions.	▪ Deleted. Accepted experts' suggestion.
K9		/	Suggested to add a question to measure PA safety- if older adults can prevent injury during PA	▪ Question added. ▪ Added. How clear are you about how to prevent injury during physical activity?

Note. PA= physical activity; M=motivation; P=physical competence; E=interaction with environment; S=sense of self; O=interaction with others; K=knowledge and understanding; I-CVI = Item-Content Validity Index.

Appendix 14

Summary of cognitive interviews (items with comments) (*N*=15)

Item	Statements	Codes	Quotes and comments	Decision/Amendment
M3	**How much do you value the mental benefits brought by physical activity?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued? 您有多重视运动给您心理健康带来的好处呢？	Technical terms	▪ "'mental benefits'… can you explain what is 'mental benefits' for me" (RC3) ▪ "I think these examples helped me to answer the question." (RC14) ▪ The rest interviewees agreed with the comment.	▪ Revised. Added examples. ▪ How much do you value the mental benefits brought by physical activity, such as making you feel good, less stress, or feel mind clearer? 您有多重视运动给您心理健康带来的好处呢, 比如帮助你感觉更好，降低压力，感觉思路更清晰等等？
M4	**How much do you value the social benefits brought by physical activity?** Not at all valued, A little valued, Somewhat valued, Very valued, or Extremely valued? 您有多重视运动给您社交方面带来的好处呢？	Technical terms	▪ "again, I don't much understand what you mean about 'social benefits'" (RC3) ▪ The rest interviewees agreed with the comment.	▪ Revised. Added examples. ▪ How much do you value the social benefits brought by physical activity, such as helping with your social networking and developing friendships? 您有多重视运动给您社交方面带来的好处呢, 比如帮助您社交交友之类的？
M7	**How much time and effort did you put in physical activity?** Not at all effortful, A little effortful, Somewhat effortful, Very effortful, or Extremely effortful? 您在运动中投入了多少时间精力呢？	Mismatch	▪ "You asked 'how much', so the options should be how much 'amount' not 'effortful'" (RC9) ▪ The rest of interviewees agreed with the comment.	▪ Revised. ▪ How much time and effort did you put in physical activity? Not at all, A little amount, Somewhat amount, Very amount, or Extremely amount? 您投入了多少时间精力在运动当中呢？没有，有点，比较多，很多，或者非常多？
M8	**How hard you tried to do physical activity well?** Not at all hard, A little hard, Somewhat hard, Very hard, or Extremely hard? 您有多努力的去做好运动呢？	Wording	▪ "I can understand what it mean, but … I feel the question sounds	▪ Revised. Reworded the questions by using 'their' language (the English statement was same, but Chinese

			awkward… how about …. ” (RC7) ▪ The rest interviewees agreed with the comment.	statement was revised) 您有多努力的去把运动做做好呢？
M9	**How much do you enjoy physical activity?** Not at all enjoyable, A little enjoyable, Somewhat enjoyable, Very enjoyable, or Extremely enjoyable? 您有多享受运动？	Vague	▪ “enjoy what? The process or the results?” (RC15)	▪ Revised. Made the question more specific. ▪ How much do you enjoy the process of doing physical activity?您有多享受运动的过程呢？
M13	**How much pleasure do you derive from participating in physical activity?** Not at all pleasurable, A little pleasurable, Somewhat pleasurable, Very pleasurable, or Extremely pleasurable? 运动有多令你感到愉快呢？	Other problem-Redundancy	▪ “I think this question is same to this one (M11)” (RC1) ▪ The rest of interviewees agreed with this comment.	▪ Deleted.
M16	**How important is physical activity in your daily life?** Not at all important, A little important, Somewhat important, Very important, or Extremely important? 运动在您的日常生活中有多重要呢？	Wording	▪ “how about the position of physical activity… ” (RC9)	▪ Revised. ▪ How important is the position of physical activity in your daily life? 运动在您生活当中占有多重要的地位呢？
M17	**How restless if you didn’t do physical activity?** Not at all restless, A little restless, Somewhat restless, Very restless, or Extremely restless? 如果不运动的话，您有多焦躁不安呢？	Technical terms	▪ “Restless…(a long silence).. what does restless mean? Can you explain this?” (RC1) ▪ 7 of 15 have difficulties in understanding the term “restless”.	▪ Revised. Used plain language to make the questions understandable ▪ How restless if you didn’t do physical activity for a period of time, a feeling of missing out on something? 如果一段时间不运动的话您有会有多少那种“少做了点什么的”不安感呢？
P1	**How physically fit do you think you are?** Not at all fit, A little fit, Somewhat fit, Very fit, or Extremely fit? 您认为您的身体有多强健？	Vague	▪ “it depends on compare to who…. I’m 70s, if compare with those in 60s, I’m not less fit than them” (RC7)	▪ Revised. Made the question more specific. ▪ Compared to majority of people in your age group and same sex, how physically fit do you think you are?

			▪ Interviewees answered this question by comparing with those people that in same age group and same sex with them.	和大多数和您同年龄段同性别的人相比，您认为您的身体有多强健？
P3	**How confident are you about your ability to walk continuously for half an hour at your normal pace?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己用您平常走路速度不间断的走上半小时的能力有多少信心？	Wording	▪ "the wording of the question is awkward… how about – What is your ability to walk for half an hour…" (RC5) ▪ The rest 10 interviewees agreed that the revised statement is better.	▪ Revised. Reworded the question. ▪ What is your ability to walk continuously for half an hour at your normal pace? Not at all capable, A little capable, Somewhat capable, Very capable, or Extremely capable? 您用您平常走路速度不间断的走上半小时的能力如何？完全没有能力，有点能力，比较有能力，很有能力，还是非常有能力?
P4	**How confident are you about your ability to climb two floors without stopping?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己连续爬两层楼的能力有多少信心？	Vague Wording	▪ Interviewees have different interpretations of "two floors"	▪ Revised. Added example make clear. ▪ What is your ability to climb two floors without stopping, such as from first floor to third floor? 您连续爬两层楼的能力如何, 比如从一层到三层？
P5	**How confident are you about your ability to squat fully?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己完全蹲下来的能力有多少信心？	Wording		▪ Revised. Reworded the question. ▪ What is your ability to squat fully? 您完全蹲下来的能力如何？
P6	**How confident are you about your ability to carrying five kilograms, which is about your 10 bottles of water, with**	Wording	▪ "why not use 'a bottle of cooking oil', that is 5 kilograms" (RC3)	▪ Revised. Reworded the question. ▪ What is your ability to carrying ten JIN, which is about the weight of one bottle of cooking oil, with your

	your hands nonstop for five minutes? Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己用手提五公斤的东西提上五分钟的能力有多少能力, 大概是十瓶矿泉水的重量？		▪ All rest interviewees agreed with that “bottle of cooking oil” is better than “10 bottles”.	hands nonstop for five minutes? 您用手提十斤的东西提上五分钟的能力如何, 十斤大概是一桶食用油的重量？
P7	**How confident are you about your ability to grip an object, such as a stair rail, a hammer, or other things?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少对自己用手握东西的能力有多少信心，比如握扶手，锤子，或者其他物品等等？	Wording		▪ Revised. Reworded the question. ▪ What is your ability to grip an object, such as a stair rail, a hammer, or other things? 您用手握东西的能力如何，比如握扶手，锤子, 或者其他物品等等？
P8	**How confident are you about your ability to do light physical activity for half an hour, such as casual walking, biking, dancing slowly, or stretching?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己连续做半小时低强度运动的能力有多少信心，比如慢走，慢舞，或者伸展运动等等？	Wording		▪ Revised. Reworded the question. ▪ What is your ability to do light physical activity for half an hour, such as casual walking, biking, dancing slowly, or stretching? 您连续做半小时低强度运动的能力如何，比如慢走，慢舞，或者伸展运动等等？
P9	**How confident are you about your ability to do moderate physical activity for half an hour, such as brisk walking, swimming, jogging, or badminton?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己连续做半	Wording		▪ Revised. Reworded the question. ▪ What is your ability to do moderate physical activity for half an hour, such as brisk walking, swimming, jogging, or badminton? 您连续做半小时中等强度运动 的能力如何，

	小时中等强度运动 的能力有多少信心，比如快走，慢跑，游泳，或者打羽毛球等等？			比如快走，慢跑，游泳，或者打羽毛球等等？
P10	**How confident are you about your ability to do high intensity physical activity for half an hour, such as running, basketball, soccer, jumping rope?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己连续做半小时高强度运动的能力有多少信心，比如跑步，打篮球，踢足球，或者跳绳等等？	Attitude Wording	▪ “I have heart problem, I don’t think I can do intense activity” (PC6) ▪ 7 of 15 said that they did not do this kind of PA, so they were not sure about the answer.	▪ Revised. High intensity PA is recommended for healthy older adults. ▪ What is your ability to do high intensity physical activity for half an hour, such as running, basketball, soccer, jumping rope? 您连续做半小时高强度运动的能力如何，比如跑步，打篮球，踢足球，或者跳绳等等？
P11	**How confident are you about your ability to do the aerobic exercise, such as walking, radio calisthenics, cycling, or jogging?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己做有氧活动的能力有多少信心，比如说走路，广播体操，骑自行车，或者慢跑等等？	Technical terms Wording	▪ “What is aerobic exercise? I have never been to school… Is playing badminton (an aerobic exercise)?” (RC2) ▪ 5 of 15 did not know the term “aerobic exercise”.	▪ Revised. Used substituted plain language. Reworded the question. ▪ What is your ability to do the physical activities that are not high-intensity but require endurance, such as walking, radio calisthenics, cycling, or jogging? 您做那些不是很激烈但是需耐力的运动的能力如何，比如说走路，广播体操，骑自行车，或者慢跑等等？
P12	**How confident are you about your ability to do the resistance activities, such as dumbbell lifting, squat, or wall push-up?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident?	Attitude Technical terms Wording	▪ “What does resistance activity include?” (RC1) ▪ “I don’t know how to answer this question… I can guess but I’m not sure, I don’t do these activities very often… so I would say my ability is not good.” (RC1)	▪ Revised. Resistance training is recommended for older adults. Used substituted plain language. Reworded the question. ▪ What is your ability to do the physical activities that depends on your muscle strength, such as dumbbell lifting, squat, or wall push-up? 您做那些需要肌肉力量

	您对自己做力量性运动的能力有多少信心，比如举哑铃，深蹲，或者墙式俯卧撑等等？		▪ 10 of 15 did not know the term “resistance activity”. ▪ 6 of 15 said that they did not do this kind of PA, so they were not sure about the answer.	的运动的能力如何，比如举哑铃，深蹲，或者墙式俯卧撑等等？
P13	**How confident are you about your ability to do the physical activity depends on your balance, such as walking alone straight line, standing on one leg, or walk heel to toe?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您对自己做需要平衡能力的运动的能力有多少信心，比如走直线，单脚站立，或者脚尖脚跟连续走等等？	Attitude Wording	▪ “eh… I’m not sure… I don’t know… may be somewhat competent?” (RC8) ▪ 6 of 15 said that they did not do this kind of PA, so they were not sure about the answer.	▪ Kept. Balance training is recommended for older adults. Reworded the question. ▪ What is your ability to do the physical activity depends on your balance, such as walking alone straight line, standing on one leg, or walk heel to toe? 您做那些需要平衡能力的运动的能力如何，比如走直线，单脚站立，或者脚尖脚跟连续走等等？
E1	**How confident are you to perform physical activity regularly when your mood is low?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您感到心情低落的情况下坚持一定的运动量？	Inappropriate assumptions	▪ “This is not a problem …. I think I would do more physical activity if I have bad mood to make my mood better.. so … (bad mood) is more like a motivation for me.” (RC8) ▪ 12 of 15 did not feel low mood is a barrier for their PA participation.	▪ Deleted. For the targeted Chinese older adults, low mood may not a challenging situation for them.
E3	**How confident are you about keeping up some amount of physical activity when you experience joint problem?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您有关节问题的情况下坚持一定的运动量？	Attitude	▪ “I don’t have joint problem.” (PC11) ▪ 5 of 15 did not have joint problem and did not know how to answer this question.	▪ Revised. Combined E3 and E5. Joint problem is common among older adults, so the item was kept for further testing.

E5	**How confident are you about keeping up some amount of physical activity when you have physical function limitation, such as having difficulties with mobility?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您有一些活动受限的时候坚持一定的运动量, 比如腿脚不便的情况下？	Other problem-Redundancy	▪ "for me, this is the same question with the joint problem question… I am thinking about my join problem when I answer this question" (RC3) ▪ The rest 10 interviewees agreed that E3 and E5 can be combined.	▪ Deleted. Combined E3 and E5 ▪ How confident are you about keeping up some amount of physical activity when you have physical function limitation, such as having joint problem that affects your mobility? 您有多少信心在您有身体功能受到限制的时候坚持一定的运动量呢, 比如有关节问题导致活动吃力的时候？
E8	**How confident are you about keeping up some amount of physical activity when you have balance problem?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您平衡力不太好的情况下坚持一定的运动量？	Attitude	▪ "My balance is good….. My husband has stroke, it is difficult for him to do some activity… but for me I don't know how to answer this question." (RC12) ▪ 6 of 15 did not have related experience and did not know how to answer this question.	▪ Kept. Balance is a common problem for older adults, especially for oldest old, so this question was kept for further testing.
E12	**How confident are you to perform physical activity if you have past injury history during physical activity?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您有过往受伤经历的情况下坚持一定的运动量？	Attitude	▪ "I never get injured during physical activity… I don't know." (RC10) ▪ All interviewees did not have injury history during physical activity.	▪ Deleted. For the targeted Chinese older adults, injury history is not a common challenging situation for them.
E14	**How confident are you about keeping up some amount of physical activity when you don't have a workout companion?** Not at all confident, A little confident, Somewhat confident, Very confident, or	Wording	▪ "The word companion is … too formal, how about to say "someone to do physical activity with" ? (PC8)	▪ Revised. Used more plain language. ▪ How confident are you about keeping up some amount of physical activity when you don't have a someone to workout wit? 您有多少

	Extremely confident? 您有多少信心在您没有一起运动的同伴的情况下坚持一定的运动量？		▪ Interviewee suggested to use lay language instead of "companion".	信心在没有人和您一起结伴做运动的情况下坚持一定的运动量？
E15	**How confident are you about keeping up some amount of physical activity when you need to provide care to others, such as your grandchild, your spouse, or family member?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您需要照顾他人的情况下坚持一定的运动量，比如照顾小孩，伴侣，或者家人等等？	Double-barreled	▪ "Well, that depends on who I look after. Looking after grandchild is different from looking after older or sick people… the mood is different. If I needed to look after a sick person, I don't have the mood to do exercise." (RC9) ▪ 11 of 15 agreed that taking care of children is different from taking care of dependent family members.	▪ Revised. Divided into two questions. ▪ How confident are you about keeping up some amount of physical activity when you have childcare duty? 您有多少信心在您需要照顾小孩的情况下坚持一定的运动量？ ▪ How confident are you about keeping up some amount of physical activity when you need to take care of someone who lacks the ability to maintain independent living, such as sick family members? 您有多少信心在您需要照顾缺少自理的人的情况下坚持一定的运动量，比如说在您需要照顾生病家人之类的情况下？
E16	**How confident are you about keeping up some amount of physical activity when no one encourage you to do physical activity?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在没有人鼓励你的情况下坚持一定的运动量？	Inappropriate assumptions	▪ "I don't need anyone to encourage me.. so it doesn't matter have someone encourage me." (RC1) "My husband always told me to do, but I still don't do." (RC15) ▪ 12 of 15 found this item confusing because they felt no encouragement is not a challenging situation for them.	▪ Deleted. For the targeted Chinese older adults, no encouragement may not a challenging situation for them.

E19	**How confident are you about keeping up some amount of physical activity when there are no physical activity facilities near your residence?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您家附近没有运动设施的情况下坚持一定的运动量？	Technical term	▪ "What is physical activity facilities? " (RC5) ▪ 6 of 15 did not understand the term "facilities".	▪ Revised. Added examples to explain the term. ▪ How confident are you about keeping up some amount of physical activity when there are no physical activity facilities near your residence, such as no available parks, gyms, or public squares? 您有多少信心在您家附近没有运动设施的情况下坚持一定的运动量，比如说附近没有公园，健身房，或者广场之类的地方？
E21	**How confident are you about keeping up some amount of physical activity when the temperature is too hot or too cold?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在天气太冷或者太热的情况下坚持一定的运动量？	Double-barreled	▪ "Too hot is problem but too cold is not…" (RC7) ▪ 8 of 15 noted that this item includes two questions.	▪ Revised. Divided the question into two. ▪ How confident are you about keeping up some amount of physical activity when the temperature is too hot? 您有多少信心在天气太热的情况下坚持一定的运动量？ ▪ How confident are you about keeping up some amount of physical activity when the temperature is too cold? 您有多少信心在天气太冷的情况下坚持一定的运动量？
E23	**How confident are you about keeping up some amount of physical activity when you don't have transportation?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在缺少交通工具的情况下坚持一定的运动量？	Inappropriate assumptions	▪ "I don't go far to do physical activity; I don't need the transportation" (RC 2) ▪ "My legs are my transportation… I don't know how to answer this question." (RC10) ▪ All interviewees found this question is not relevant to their PA.	▪ Deleted. For the targeted Chinese older adults, heavy traffic may not a challenging situation for them.

E24	**How confident are you about keeping up some amount of physical activity if the traffic is heavy in your community?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您家附近交通拥堵的情况下坚持一定的运动量？	Inappropriate assumptions	▪ "I don't do exercise on the street, so it is not matter whether the community traffic is heavy or not" (RC13) ▪ All interviewees found this question is not relevant to their PA.	▪ Deleted. For the targeted Chinese older adults, heavy traffic may not a challenging situation for them.
E26	**How confident are you to perform physical activity if your community is not safe, such as no streetlights, unattended dogs, or feeling unsafe?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心在您小区不太安全的情况下坚持一定的运动量，比如小区没有路灯，有野狗，或者感觉不安全等等情况下？	Inappropriate assumptions	▪ "I don't know, our community is quite safe…" (RC1) ▪ 13 of 15 found this question is difficult to answer because they did not have such experience before.	▪ Deleted. For the targeted Chinese older adults, community safety may not a challenging situation for them.
S1	**How confident are you in doing physical activity as good as other people in your age group?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心能够和大多数您这个年龄段的人运动的一样好？	Vague	▪ "I am comparing with the old ladies at my age" (RC2) ▪ Same age and same sex.	▪ Revised. Made the question more specific. ▪ How confident are you in doing physical activity as good as other people in your age group and same sex? 您有多少信心能够和大多数您这个年龄段同性别的人运动的一样好？
S2	**How confident are you in doing physical activity as much as other people in your age group?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多	Vague	▪ "same… with the old ladies at my age" (RC2) ▪ Same age and same sex.	▪ Revised. Made the question more specific. ▪ How confident are you in doing physical activity as much as other people in your age group and same

	少信心能够和大多数您这个年龄段的人运动量一样多？			sex? 您有多少信心能够和大多数您这个年龄段同性别的人运动量一样多呢？
S3	**How confident are you to keep doing physical activity regularly for a short period of time?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心能够在短时间保持一定的规律运动？	Vague	▪ "…about 1 year" (RC6) ▪ "short-term, about 3 months… " (RC7) ▪ Interviewees had different opinions about "long-term", from one month to 1 year.	▪ Revised. Made the question more specific. ▪ How confident are you to keep doing physical activity regularly for the next 3 months? 您有多少信心能够接下来的 3 个月保持规律的运动？
S4	**How confident are you to keep doing physical activity regularly for a long period of time?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心能够长期的保持一定的规律运动？	Vague	▪ "it means always … at least 10 years…" (RC3) "I'm thinking about 5 years or more" (RC11) ▪ Interviewees had different opinions about "long-term", from 3 years to over 10 years.	▪ Revised. Made the question more specific. ▪ How confident are you to keep doing physical activity regularly for the next 3 years?您有多少信心能够在接下来的 3 年保持规律的运动？ ▪ How confident are you to keep doing physical activity regularly for the next 10 years?您有多少信心能够在接下来的 10 年保持规律的运动？
S7	**How confident are you to achieve your physical activity goals?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心能够完成您的运动目标？	Attitude	▪ "I don't have a goal… I just what I can" (RC1) ▪ 11 of 15 said usually they did not have a PA goal.	▪ Revised. Added a scenario. ▪ When you set a physical activity goal, how confident are you to achieve that goal? 当您定下了运动目标后，您有多少信心去完成这个目标?

S8	**How confident are you in your ability to do more physical activity?** Not at all confident, A little confident, Somewhat confident, Very confident, or Extremely confident? 您有多少信心能够做更多的运动？	Vague	▪ “more amount of physical activity” (RC5) “… other kinds of physical activities” (RC6) ▪ 4 of 15 interpreted the question as “more types of physical activities”.	▪ Revised. Made the question more specific. ▪ How confident are you in your ability to do more amount of physical activity? 您有多少信心能够做更多量的运动？
O3	**What is your ability to join in a new physical activity group?** Not good at all, A little good, Somewhat good, Very good, or Extremely? 您能够多好地加入到一个新的运动团体中呢？	Attitude	▪ “This… I’m not sure. I usually do physical activity by myself or with my wife.” (RC7) ▪ 3 of 15 did not do group PA and needed to make an assumption to answer the question.	▪ Revised. Added a scenario. ▪ If you were asked to participate in group physical activity, what is your ability to join in a new physical activity group? 如果您被邀请参加团体运动，您能够多好地加入到一个新的运动团体中呢？
O4	**What is your ability to integrate in a physical activity group?** Not good at all, A little good, Somewhat good, Very good, or Extremely? 您能够多好地融入到一个运动团体当中呢？	Wording Attitude	▪ “I would say… being accepted by others, and build bond relationships with others, become friends.” (RC8) ▪ “I don’t do group exercise a lot… so I feel I would be somewhat confident…” (RC6) ▪ 10 of 15 found the item confusing. Confusing about the term “integrated in”. ▪ 3 of 15 did not do group PA and needed to make an assumption to answer the question.	▪ Revised. Reworded the statement using interviewee’s language; added a scenario. ▪ If you were asked to participate in group physical activity, what is your ability to build good relationships with others in the group? 如果您被邀请参加团体运动，您有多少信心能和团队中的其他人建立良好的关系呢？
O5	**What is your ability to get the physical activity - related information that you need from other people?** Not good at all,	Vague	▪ “Can you give me some examples? What information.” (RC2)	▪ Revised. Giving examples to explain the “information”.

	A little good, Somewhat good, Very good, or Extremely? 您有多少能力能从他人那里得到你所需要的有关运动的信息呢？		▪ "I'm thinking about the information… like last week I asked my neighbor if there is dancing groups near our community." (RC11) ▪ All rest 10 agreed with that the example is helpful.	▪ What is your ability to get the physical activity – related information that you need form other people, such us when you have questions about where to find a venue for your workout or where offers more physical activity programs? 您有多少能力能从他人那里得到您所需要的运动信息呢，比如当你需要在那里有运动场所或者哪里的运动项目比较多之类的信息时？
O8	**What is your ability to get the physical activity guidance that you need from other people?** Not good at all, A little good, Somewhat good, Very good, or Extremely? 您有多少能力能从他人那里得到您所需要的运动指导呢？	Vague	▪ "Guidance…. do you mean find someone to teach me? Or something else?" (RC4) ▪ All rest 10 agreed with that the example is helpful.	▪ Revised. Giving examples to explain the "guidance". ▪ What is your ability to get the physical activity guidance that you need form other people, such us when you need someone to provide instructions or to lead the workout? 您有多少能力能从他人那里得到您所需要的运动指导呢，比如当你需要人指导动作或者带领你进行运动的时候？
K8	**How clear are you about the physical activity recommendations for people in your age?** Not at all clear, A little clear, Somewhat clear, Very clear, or Extremely clear? 您有多清楚的了解合适您年龄人群的运动指南呢？	Technical terms	▪ "What is physical activity recommendation?" (RC2) ▪ 13 of 15 did not know the term "physical activity recommendation".	▪ Revised. Added the description of PA recommendation. ▪ How clear are you about the recommended weekly minimal physical activity amount for older adults? 您有多清楚的知道对老年人推荐的最小运动量是多少呢？

Note. PA= physical activity; M=motivation; P=physical competence; E=interaction with environment; S=sense of self; O=interaction with others; K=knowledge and understanding.