J-IAMSTEM
Journal of Innovation, Advancement, and Methodology in STEM Education
Vol. 3, No. 1, pp. 33-43, January-February 2026
https://so13.tci-thaijo.org/index.php/j_iamstem

Protocol for Promoting Exercise in the Elderly Regarding the Exercise Behaviors of the Elderly in Nakhon Sawan Province, Thailand

Wandee Chaweejan [1*], and Tanunchai Boonnuk [2]
[1]Nakhon Sawan Rajabhat University, Nakhon Sawan, Thailand
[2]Loei Rajabhat University, Loei, Thailand
*Corresponding author email: wandee.c@nsru.ac.th, wandee.phone19@gmail.com

Received: 14 Dec 2025 Revised: 15 Jan 2026 Accepted: 21 Jan 2026

Abstract

This study clarified the development of a comprehensive protocol for promoting exercise tailored to the specific environmental and social context of Nakhon Sawan Province, the study provided the following steps. A mixed-methods research design was used, combining qualitative and quantitative approaches including participatory action learning, interviews, and a questionnaire survey. Participants were 10 key informants, including public health officials and exercise specialists, who were selected through purposive sampling. Additionally, 450 samples from the elderly participating in exercise activities were involved under the multi-stage cluster sampling on residents aged 60 and over in Muang District, Nakhon Sawan Province, Thailand. The findings clarified a comprehensive protocol for promoting exercise through the following steps. First, provide key factors that influenced exercise behavior in older adults. Four key factors included knowledge and attitude, perceived benefits, perceived barriers, and social support. Second, the research identifies perceived barriers as the most significant predictor of exercise behavior. Consequently, the most effective way to increase activity levels is to prioritize safety, provide clear risk-management education, and ensure that exercise environments are accessible and age-friendly. Third, organizing the roles of knowledge, attitude, and social support remain crucial for long-term sustainability. Education that moves beyond "knowing" to "believing" (enhancing self-efficacy and goal-setting) allows seniors to internalize the benefits of movement. Finally, the Protocol for Promoting Exercise in the Elderly established in this study provides a targeted, four-phase roadmap for interventions. By sequentially addressing barrier mitigation, knowledge synthesis, benefit enhancement, and social integration, healthcare providers and community leaders can foster an environment conducive to active aging.

Keywords: Protocol, elderly, exercise behavior

1. Introduction

Over the past three to four decades, population structures have shifted rapidly both globally and in Thailand, with the proportion of older adults rising steadily—from about 10% in 2005 to roughly 11.7 million (17.8%) in 2018 (The Institute for Population and Social Research, 2019). The United Nations projects that people aged 60 and over in Thailand will constitute 28% of the population by 2031 and 37.1% by 2050, moving the country toward a super-aged society (Phromphakdee, 2013). Older adults face a higher risk and greater severity of chronic noncommunicable diseases due to lifelong health behaviors, the management of such conditions before old age, and age-related physical decline (Liangrueanrom et al., 2017). Physical inactivity is a major global mortality risk, responsible for about 3.2 million deaths annually, together with prolonged sedentary behavior, contributes to cardiovascular disease, diabetes, cancer, hypertension, obesity, osteoporosis, depression, and anxiety (Department of Health, 2017; Park et al., 2022). Behavioral risks such as poor diet, accumulated stress, environmental exposures, and particularly insufficient or poorly timed physical activity further increase these harms (Troiano et al., 2020), and inactive people have higher mortality than those who are sufficiently active (Strain et al., 2024). Thailand reflects this global trend: a decade-long survey found one in three Thais is insufficiently active, and only about 60% of school-age children, adolescents, and older adults meet recommended activity levels (Department of Health, 2017). Daily sedentary time among Thais approaches 14 hours and is rising, and Health Data Center reports from 2018–2020 show growing rates of NCDs and overnutrition among the elderly (Musikarat et al., 2021). The expanding elderly population thus brings increased risks and multifaceted age-related health challenges.

Elderly people often undergo psychological adjustments as they confront multiple life changes, worsening health, diminished social roles, and sometimes profound anxiety about mortality. They can lead to feelings of worthlessness, reduced motivation and enthusiasm, and lowered confidence and self-esteem. Physical decline and illness frequently limit participation in social activities and increase dependence on daily living routines, further undermining mental well-being; collectively, these physical, psychological, and social shifts can diminish quality of life (WHO, 1994). Consequently, promoting preparedness and behavioral health care for older people is essential to prevent further deterioration in their well-being. Exercise is defined as planned, repetitive, and systematic bodily movement. Exercise support strengthens muscles, supports growth, and enhances organ function; when undertaken regularly it can prevent disease, aid treatment, and assist rehabilitation (Barnett et al., 2017). Such activities, ranging from walking and running to skipping rope and body-weight exercises, also serve recreational and social functions that contribute to overall health.

Regular exercise plays a crucial role in maintaining health by enhancing circulation, stabilizing blood pressure, strengthening immune function, and reducing the risk of conditions such as cardiovascular disease, diabetes, obesity, and osteoarthritis; it also aids weight management, improves balance and mobility, supports digestive function, and alleviates stress while promoting better sleep (Milton et al., 2018; Yi et al., 2016). Physical activity behavior refers to planned, leisure-time movements that engage large muscle groups to build strength, prevent illness, and rehabilitate injuries or chronic conditions, while also serving as a constructive and enjoyable use of free time. Accordingly, this study concentrates on examining and analyzing the factors that influence exercise behaviors among older adults in Nakhon Sawan Province, Thailand, with the intention that findings will inform local planning and policy development to better promote elderly health and prepare for an aging society.

Health behavior is shaped by predisposing, enabling, and reinforcing factors (Green & Kreuter, 2005). Predisposing factors are individual characteristics such as knowledge, beliefs, attitudes, and values. These characteristics increase the likelihood of adopting

healthy behaviors; for instance, older adults with greater understanding and more positive attitudes toward exercise are more likely to engage in consistent, appropriate physical activity. Enabling factors refer to the practical supports that facilitate health actions, including access to resources, facilities, and information within a given social and cultural context, which significantly influence seniors' exercise routines. Reinforcing factors comprise external encouragement from family, peers, and the broader community that helps sustain activity. Drawing on this framework, the present study examines specific influence domains—knowledge and attitudes toward exercise, perceived benefits, perceived barriers, and social support—recognizing that enhancing knowledge and awareness about exercise can shift beliefs and attitudes and thereby promote healthier behaviors (Shiraly et al., 2017).

To help older adults maintain independence and prepare both physically and mentally for healthy aging, it is essential to promote sufficient levels of physical activity. Regular exercise builds muscle strength, enhances immune function, lowers harmful blood lipids such as LDL cholesterol and triglycerides while raising protective HDL, and reduces the risk of cardiovascular disease. Physical activity also revitalizes the body, relieves stress, improves sleep through endorphin release, and supports digestive and eliminative function (Kattanyutanon et al., 2019). Encouraging such activity is most effective when done within environments that facilitate exercise and are backed by family and community support. Key determinants that influence the adoption of physical activity among older adults include their knowledge and attitudes, perceived benefits, the presence of a supportive physical and social environment, and family/community encouragement—areas that must be strengthened to improve exercise behaviors in this population. Research questions therefore include: A. What exercise-behavior factors support the maintenance of good physical health in older adults? and B. How do the influence factors associated with exercise behaviors contribute to preserving physical health among the elderly?

Given the rapid demographic shift towards a super-aged society in Thailand and the escalating prevalence of chronic non-communicable diseases associated with physical inactivity, this research seeks to address the critical health challenges facing the aging population in Nakhon Sawan Province. Recognizing that one in three Thais, particularly the elderly, demonstrate insufficient physical activity and high sedentary behavior (nearly 14 hours per day), there is an urgent need for structured interventions to prevent physical and mental deterioration. Drawing upon the framework of predisposing, enabling, and reinforcing factors, the primary objectives of this study are to: 1) identify the key exercise behavior factors, including knowledge, attitudes, and perceived benefits and barriers, that maintain good physical health among the elderly; 2) analyze the influence of these factors and social support on actual exercise behaviors; and 3) develop a comprehensive protocol for promoting exercise tailored to the specific environmental and social context of Nakhon Sawan Province. Ultimately, this research aims to provide a strategic evidence-based framework to enhance the quality of life for the elderly and inform effective health policy planning for Thailand's aging society.

2. Methodology

A mixed-methods research design was used, combining qualitative and quantitative approaches including participatory action learning, interviews, and a questionnaire survey. The study aims to examine the factors of exercise behavior that support good physical health and to analyze the influence of related determinants on elderly exercise habits, and to develop a comprehensive protocol for promoting exercise tailored to the specific environmental and social context of Nakhon Sawan Province. The study focused on residents aged 60 and over in Muang District, Nakhon Sawan Province, Thailand.

2.1 Participants

Participants were 10 key informants, including public health officials and exercise specialists, who were selected through purposive sampling. Additionally, 450 samples from the elderly participating in exercise activities were involved under the multi-stage cluster sampling, together with the sample size calculation from the table opening by Yamane, in the 95% confidence interval on the selection technique in the methods.

2.2 Research instruments

Research instruments consist of a structured interview and a semi-structured questionnaire.

A structured interview guide for organizational informants focused on exercise behavior factors and comprised four topics: (1) knowledge and attitude toward exercise, (2) perceived benefits of exercise, (3) perceived barriers to exercise, and (4) social support. The guide included open-ended questions such as "What are the exercise behavior factors that support good physical health in the elderly?" The interview instrument demonstrated perfect content alignment, with an item-objective congruence (IOC) score of 1.00.

A semi-structured questionnaire for organizational respondents assessed influence factors associated with exercise behaviors that support good physical health in the elderly. The instrument comprised three parts: (1) respondents' general information; (2) items across five domains, and (3) open-ended items for additional suggestions. Items across five domains included (a) knowledge and attitude toward exercise, (b) perceived benefits of exercise, (c) perceived barriers to exercise, (d) social support, and (e) support for exercise behavior. Responses used a 5-point Likert scale, with mean-score interpretations as follows: 4.51–5.00 = Highest, 3.51–4.50 = High, 2.51–3.50 = Moderate, 1.51–2.50 = Low, and 1.00–1.50 = Lowest. The questionnaire demonstrated acceptable internal consistency (Cronbach's alpha = 0.82).

2.3 Data collection

Data was collected through a document review and synthesis, participatory action learning, and interviews with 10 purposively selected key informants (public health officials and exercise specialists). Interview notes and audio recordings were analyzed to identify exercise behavior factors and indicators. In addition, exercise activities were conducted with older adults, and a questionnaire survey was conducted to 450 participants to examine influence factors associated with exercise behaviors that support good physical health. The procedure of collecting data involving human participants complied with the Ethical Standards of the Nakhon Sawan Province Ethics Committee in Human Research, Thailand. Ethical reference number is NSWPHO-034/68.

2.4 Data analysis

Data analysis on exercise behavior factors toward indicators was analyzed using three main stages, i.e., data reduction, data organization, and data interpretation to the conclusion. The influence factors associated with exercise behaviors were analyzed by descriptive statistical analysis, including mean, standard deviation, and multiple regression analysis using a computer.

3. Findings and Discussion

3.1 Factors of Exercise Behavior That Support Good Physical Health in Elderly

The exercise behavior comprised four factors and their indicators including knowledge and attitude toward exercise, perceived benefits of exercise, perceived barriers to exercise, and social support. Knowledge and attitude toward exercise consists of 6 indicators. These included 1) knowledge and understanding of the benefits of exercise; 2) awareness of the risks of not exercising; 3) a positive attitude toward exercise; 4) self-

confidence in performing exercise; 5) setting clear exercise goals; and 6) motivation and intention to maintain good health. Perceived benefits of exercise consist of 3 indicators. These included 1) perceived benefits of exercising; 2) perceived personal health status; and 3) self-efficacy. Perceived barriers to exercise consist of 3 indicators. These included 1) recognition of potential obstacles; 2) openness to information on how to manage those obstacles; and 3) demonstration of behavioral change to overcome barriers. Social support consists of 3 indicators. These included 1) family and community support; 2) social interaction and participation in activities; and 3) exchange of knowledge and information.

The findings show that exercise behavior comprises four main domains. Knowledge and attitude include understanding the benefits and risks of inactivity, holding a positive outlook, having confidence, setting clear exercise goals, and being motivated and committed to health. Perceived benefits cover beliefs about exercise advantages, personal health status, and self-efficacy. Perceived barriers involve recognizing potential obstacles, being receptive to information on how to overcome them, and demonstrating behavioral changes to address those barriers. Social support encompasses family and community backing, peer interaction and activities, and exchanging information and advice.

Developing knowledge and positive attitudes in older adults therefore means increasing awareness of exercise benefits and the consequences of inactivity, promoting self-assessment of readiness, building confidence and goal-setting skills, and fostering a positive disposition toward physical activity (Khantabudr, 2021). Raising awareness of exercise benefits also requires assessing exercise-related confidence, such as the ability to choose suitable activities and perform pre-exercise checks, and evaluating perceived health gains (for example, reduced fall risk) and one's current health status (Sandi, 2011; Sukhonan et al., 2014). These elements are essential for encouraging older adults to adopt regular, appropriate physical activity.

Common perceived barriers among older adults include fear of injury, time constraints, and poor health; readiness to overcome these barriers depends on access to accurate information, supportive resources, and personal commitment to change (Thiranuch et al., 2017; Kristi et al., 2018). These barriers and facilitators are reflected in both exercise attitudes and behaviors. Meanwhile, social support (i.e. family and community encouragement, peer engagement, knowledge sharing, enjoyable group activities, and community networks) helps promote and sustain exercise among older people.

Overall, promoting exercise in older adults can yield broad health benefits: lowering cardiovascular mortality, reducing cancer risk factors, improving circulatory, pulmonary, and cardiac function, preventing conditions such as heart disease, hypertension, and osteoporosis, enhancing balance and appearance, strengthening immunity and muscles, and supporting mental well-being.

3.2 Influence Factors Associated with Exercise Behaviors in the Elderly.

Influence factors associated with exercise behaviors that contribute to maintaining good physical health in the elderly consist of four factors. These included (1) knowledge and attitude toward exercise, (2) perceived benefits of exercise, (3) perceived barriers to exercise, and (4) social support. Each factor had a statistically significant positive effect on exercise behaviors that contribute to maintaining good physical health in older adults. The regression model explained 58.7% of the variance in exercise behaviors ($R^2 = 0.587$), with a good overall fit ($F = 157.421$, $p < .001$) (see Table 1). Ranked by standardized beta coefficients (Table 2), perceived barriers to exercise exerted the strongest influence ($\beta = 0.342$), followed by knowledge and attitude toward exercise ($\beta = 0.198$), perceived benefits ($\beta = 0.187$), and social support ($\beta = 0.142$). The prominent effect of perceived barriers highlights the importance of addressing environmental and personal obstacles to physical activity, while the significant contributions of knowledge, perceived benefits, and

social support indicate that education, perceived health gains, and family/community encouragement also play meaningful roles in promoting exercise among older adults.

Table 1. Mean, standard deviation, and relationship between variables (n of 450).

Variables.	Mean.	Std.	1	2	3	4	5
1. Knowledge and attitude towards exercise.	3.68	0.72	1	-			
2. Perceived benefits of exercise.	3.52	0.78	0.612**	1	-		
3. Perceived barriers to exercise.	3.71	0.69	0.587**	0.623**	1	-	
4. Social support.	3.45	0.82	0.534**	0.598**	0.612**	1	-
5. Exercise behaviors.	3.56	0.77	.612**	0.634**	0.698**	0.578**	1

Note. ** $p < 0.01$.

Table 2. Multiple regression of influence factors on exercise behaviors (n of 450).

Independent variables.	β	t	Sig.	Test results.
1. Knowledge and attitude towards exercise.	0.198**	4.752	.000	H1: Accepted
2. Perceived benefits of exercise.	0.187**	4.231	.000	H2: Accepted
3. Perceived barriers to exercise.	0.342**	7.896	.000	H3: Accepted
4. Social support.	0.142**	3.187	.000	H4: Accepted

Note. * $p < 0.05$, ** $p < 0.01$, R^2 of 0.587, Adjusted R^2 of 0.583, F of 157.421, $p < .001$.

Meanwhile, comparison of influence factors of exercise behaviors includes the environment conducive to physical activity, and support from family and community was a statistically significant positive influence on exercise behaviors in the environment conducive to physical activity, and support from family and community. Perceived barriers to exercise had the highest impact on an environment conducive to physical activity (β of 0.378, $p < 0.01$), followed by support from family and community (β of .201, $p < 0.01$), knowledge and attitude towards exercise (β of 0.189, $p < 0.01$), and social support. (β of 0.156, $p < 0.05$), respectively. All independent variables could explain the variance of the environment conducive to physical activity by 61.2% (R^2 of 0.612) and support from family and community by 48.7% (R^2 of 0.487). The model had a statistically significant fit to the empirical data (F of 172.345 and 103.251, $p < 0.01$), as shown in Table 3.

The factors (i.e. knowledge and attitude toward exercise, perceived benefits, perceived barriers, and social support) were all positively associated with exercise behavior, with effects reaching statistical significance at the 0.01 level in models for both an activity-conducive environment and family and community support. Moreover, environments that facilitate physical activity are crucial for older adults because they enhance physical and mental health, reduce fall risk, and improve quality of life. Such supportive environments can be created by providing safe, accessible spaces (Bull et al., 2020; Notthoff et al., 2017).

Table 3. Influence factors of exercise behaviors in the environment conducive to physical activity, and support from family and community (n of 450).

Independent variables.	Exercise behaviors.		An environment conducive to physical activity, and support from family and community.	
	β	Sig.	β	Sig.
Knowledge and attitude towards exercise.	0.189**	.000	0.156**	.001
Perceived benefits of exercise.	0.201**	.000	0.178**	.000
Perceived barriers to exercise.	0.378**	.000	0.284**	.000
Social support.	0.156*	.003	0.134*	.012
R^2	**0.612**		**0.487**	
F	**172.345**		**103.251**	

Note. * $p < 0.05$., ** $p < 0.01$.

Provide a range of activities and choices, such as different sports, informational resources, and motivational programs. These activities and choices can encourage older adults to be more active (Milton et al., 2018; Purakom et al., 2021; Strout et al., 2016). Community and societal support are vital for promoting physical activity by offering education on the benefits and safe methods of exercise and by implementing policies and initiatives that make cities and neighborhoods more age-friendly (Pho-am & Samkarn, 2022). In this way, family and community support boost motivation and confidence and help establish lasting, supportive environments that improve physical and mental health, reduce disease risk, and enhance quality of life for the elderly.

3.3 Protocol for Promoting Exercise in the Elderly

Based on the research findings of exercise behavior factors provided, the following Protocol for Promoting Exercise in the Elderly has been developed. This protocol prioritizes interventions based on their statistical influence, with a primary focus on overcoming barriers, followed by enhancing knowledge, perceived benefits, and social support.

Protocol was developed for promoting exercise for active aging. The objective is to increase exercise behavior among the elderly to improve cardiovascular health, reduce fall risks, and enhance overall quality of life. The protocol consists of four phases including 1) barrier mitigation and environmental adaptation, 2) knowledge synthesis and attitude shaping, 3) perceived benefit & self-efficacy enhancement, and 4) social integration and community support

3.3.1 Phase 1: Barrier Mitigation and Environmental Adaptation

This phase addresses factor of perceived barriers, which were identified as the most significant factor influencing exercise behavior.

Safety & Risk Management

Organize safety and risk management through injury prevention education and pre-exercise screening. Injury prevention education, provide clear, evidence-based information to address the "fear of injury." Teach proper warm-up, cool-down, and low-impact techniques. Organize pre-exercise screening. Conduct self-assessments of physical readiness to ensure seniors feel "health-ready" to participate.

Environmental Accessibility

Environmental accessibility should be organized by conducive spaces and time management. Conducive spaces could be provided through the following ensure exercise areas are safe, well-lit, and accessible (e.g., non-slip floors, grab bars, proximity to restrooms).

Time management could be provided through the following offer flexible, short-duration sessions to accommodate those who perceive "lack of time" as a hurdle.

Resource Navigation

Information Hubs: Provide a "barrier-management" toolkit containing contact info for local support resources and transport options.

3.3.2 Phase 2: Knowledge Synthesis & Attitude Shaping

Targeting the second highest influence factor - Knowledge and Attitude. To provide knowledge and attitude, the activities should be provided as follows: educational workshops, and goal setting and motivation.

Educational Workshops

Educational workshops should be organized to construct meaning of the “why” factor. Explain the specific benefits (reduced heart disease, cancer prevention, improved lung function). Explain risk literacy. This could be provided by organize learning activities of the tangible risks of a sedentary lifestyle (osteoporosis, high blood pressure, muscle atrophy).

Goal Setting and Motivation

Set the SMART Goals. The goal assists elderly participants in setting clear, achievable exercise goals. Provide self-confidence building by use verbal persuasion and mastery experiences to boost self-confidence and the "intention to maintain health."

3.3.3 Phase 3: Perceived Benefit & Self-Efficacy Enhancement

Targeting perceived benefits should be organized through health status awareness and boosting self-efficacy.

Health Status Awareness

To enhance health status awareness, the self-assessment tools and fall prevention focus should be provided. Self-assessment tools could be provided by implementing periodic self-tracking of health status (e.g., balance tests, flexibility markers) so participants can "perceive" their own improvement. Fall prevention focus could be provided by explicitly demonstrating how specific exercises reduce the risk of falls and improve physical appearance.

Boosting Self-Efficacy

Method choice of boosting self-efficacy, we should allow seniors to choose from a variety of exercise methods to increase their sense of control and competence.

3.4 Phase 4: Social Integration & Community Support

Targeting social support should be organized through family and peer engagement, and community networking.

Family and Peer Engagement

Family and peer engagement should be provided by family inclusion and peer-to-peer networks. Family inclusion could encourage family members to serve as motivators and

occasional exercise partners. Peer-to-Peer Networks could be organized by creating "Exercise Buddy" systems to facilitate social interaction and the exchange of health knowledge.

Community Networking

Community networking could be organized by social activities and community policy support. Social activities could be provided by organizing group exercises that are "fun" and social (e.g., dance, group walks), moving beyond purely clinical physical activity. Community policy support should be provided by working with local leaders to create a "Community Support Team" dedicated to elderly physical activity.

Conclusion, this protocol recognizes that managing barriers is the most critical step in promoting exercise. By combining a safe, conducive environment with structured social support and targeted education, the program aims to explain and influence the 58.7% of variance in exercise behavior found in the research, leading to a significant reduction in chronic disease and an improvement in the mental and physical health of the elderly population.

4. Conclusion

This study provides a comprehensive understanding of the factors that drive exercise behavior in the elderly, offering both statistical evidence and a practical framework for intervention. To develop a comprehensive protocol for promoting exercise tailored to the specific environmental and social context of Nakhon Sawan Province, the study provided the following steps.

First, exercise behavior in older adults is a multi-dimensional construct influenced by four key factors: knowledge and attitude, perceived benefits, perceived barriers, and social support. Together, these factors explain a significant portion (58.7%) of the variance in exercise habits, confirming their collective importance in promoting physical health.

Second, the research identifies perceived barriers as the most significant predictor of exercise behavior. While older adults may understand the benefits of physical activity, their actual participation is heavily dictated by their ability to overcome obstacles such as fear of injury, poor health, and environmental accessibility. Consequently, the most effective way to increase activity levels is to prioritize safety, provide clear risk-management education, and ensure that exercise environments are accessible and age-friendly.

Third, while barrier mitigation is primary, the roles of knowledge, attitude, and social support remain crucial for long-term sustainability. Education that moves beyond "knowing" to "believing" (enhancing self-efficacy and goal-setting) allows seniors to internalize the benefits of movement. Furthermore, the findings highlight that social interaction—specifically family encouragement and community-based activities—serves as a vital motivator that transforms exercise from a clinical task into an enjoyable social event.

Finally, the Protocol for Promoting Exercise in the Elderly established in this study provides a targeted, four-phase roadmap for interventions. By sequentially addressing barrier mitigation, knowledge synthesis, benefit enhancement, and social integration, healthcare providers and community leaders can foster an environment conducive to Active Aging.

In conclusion, promoting exercise in the elderly requires more than just encouragement; it demands a strategic approach that removes physical and psychological hurdles while fostering a supportive social network. Implementing these findings will not only improve cardiovascular and musculoskeletal health but also enhance the overall mental well-being and quality of life for the aging population.

4. References

Barnett DW, Barnett A, Nathan A, Van Cauwenberg J, Cerin E. (2017). Built environmental correlates of older adults' total physical activity and walking: a systematic review and meta-analysis. International Journal of Behavioral Nutrition and Physical Activity, 14(1), 1-14.

Bull FC, Al-Ansari SS, Biddle S, et al. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behavior. Br J Sports Med, 54: 1451–62.

Green, L., & Kreuter, M. (2005). Health program planning: An educational and ecological approach (4th ed.). McGraw-Hill.

Kattanyutanon, T., Pansomboon, T., Jindamanee, C., Rungruang, P., Kliangklao, M., Homchan, P. et al. (2019). Factors related to physical activity in the elderly. Academic Journal, 23(1), 1 – 14.

Khantabudr, C. (2021). Physical Exercise Behavior of the Elderly in Chiang Mai. Journal of Health, Physical Education and Recreation, 47(1), 232-242.

Kristi, K., CHES, Gonzalez, Gina B. (2018). Increasing Physical Activity Using An Ecological Model. ACSM's Health & Fitness Journal, 22(4), 29-32.

Liangrueanrom C. et al. (2017). Do Thai people have sufficient physical activity according to the criteria? Journal of Health Systems Research, 11(2), 205 -220

Milton K, Varela AR, Strain T, Cavill N, Foster C, Mutrie N. (2018). A review of global surveillance on the muscle strengthening and balance elements of physical activity recommendations. J Frailty Sarcopenia Falls, 3, 114–24.

Musikarat, P., Sriburi, C., Bunyarom, O., Srisuphakonkul, K. (2021). Physical activity level and factors related to physical activity level in elderly people living in communities in Health Region 2. Royal Thai Army Medical Journal, 74 (2), 67 – 84.

Notthoff, N., Reisch, P., & Gerstorf, D. (2017). Individual Characteristics and Physical Activity in Older Adults: A Systematic Review. Gerontology, 63(5), 43-59.

Park AH, Zhong S, Yang H, Jeong J, Lee C. (2022). Impact of COVID-19 on physical activity: A rapid review. J Glob Health,12: 05003.

Pho-am, A. and Samkarn, N. (2022). Health perception related to the quality of life of the elderly. Journal of Public Health and Health Sciences, 5(1), 146 – 155

Phromphakdee, C. (2013). An aging society in Thailand. Journal of the Academic Office, Secretariat of the Senate, 3(16), 1 – 17.

Purakom, A., Poonsri, W., Kanlueng, T., and Sukolpuk, M. (2021). Increase Physical Activity Power up Thailand in the Elderly. Journal of Health, Physical Education and Recreation, 47(1), 1-13

Sandi, C. (2011). Risk assessment and intervention for vulnerable older adults. Medical Journal, 53(8), 421-425.

Shiraly R, Shayan, Z., Keshtkar, V., & Hamed, M. (2017). Self-reported Factors Associated with Engagement in Moderate to Vigorous Physical Activity among Elderly People: A Population-based Study. Int J Prev Med, 8(1), 26.

Strain, T., Flaxman, S., Guthold, R., Semenova, E, Cowan, M., Riley, L.M., Bull, F.C., Stevens, G. A. (2024). National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022. The Lancet Global Health, Volume 12, Issue 8, e1232-e1243. https://doi.org/10.1016/S2214-109x(24)00150-5.

Strout, E. H., L. Fox, A. Castro, P. Haroun, B. Leavitt, C. Ross, M. Sayan, et al. (2016). Access to Transportation for Chittenden County, Vermont Older Adults. Aging Clinical and Experimental Research, 28(4), 769-74.

Sukhonan, T., Sapprasert, C., Chariyasin, S., and Wongsala, A. (2014). Factors affecting exercise behavior of the elderly in Ban Suan Municipality, Chonburi Province. Burapha University Journal of Public Health, 9(2), 66-75.

Thiranuch, C., Lilaknaweera, Y., Homsin, P. (2017). Factors related to physical activity in the elderly. Journal of Nursing Education, 10(2), 19-32.

The Division of Physical Activity for Health, Department of Health. (2017). Recommendations for promoting physical activity, reducing sedentary behavior, and sleeping. Bangkok: NC Concept Co., Ltd.

The Institute for Population and Social Research. (2019). Population Bulletin, Mahidol University. Nakhon Pathom: Institute for Population and Social Research, Mahidol University.

Troiano RP, Stamatakis E, Bull FC. (2020). How can global physical activity surveillance adapt to evolving physical activity guidelines? Needs, challenges, and future directions. Br J Sports Med, 54, 1468–73.

World Health Organization: WHO. (1994). Quality of Life Assessment: An Annotated Bibliography. https://apps.who.int/iris/handle/10665/61629.

Yi X, Pope, Z., Gao, Z., Wang, S., Pan, F., Yan, J., Wang, R. (2016). Associations between individual and environmental factors and habitual physical activity among older Chinese adults: A social-ecological perspective. J Sport Health Sci., 5(3), 15-21.