DETERMINANTS OF HYPERTENSION-RELATED LIFESTYLE BEHAVIORS AMONG YOUNG AND MIDDLE-AGED THAI ADULTS

By

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ABSTRACT

Navigating optimal blood pressure (BP) management in young- and middle-aged Thai adults diagnosed with hypertension (HTN) presents a substantial challenge, particularly in contrast to the older population. The early adoption of lifestyle modifications emerges as a pivotal factor in achieving effective BP control, especially for those recently diagnosed with HTN. Although young- and middle-aged adults in Thailand may be physically fit and capable to embrace lifestyle changes following the diagnosis of a chronic illness, their compliance to recommended lifestyle modification is suboptimal as compared to older adults with HTN. Aggravatedly, there exists a notable scarcity of evidence regarding the influence of psychosocial factors, guided by Social Cognitive Theory (SCT)—commonly utilized to illuminate the impact of such factors on human behavior—on recommended lifestyle behaviors for BP management in this targeted population. Specifically, a knowledge gap persists in understanding how psychosocial factors may affect adherence to dietary guidelines, such as low-sodium or low-fat diets (DA), and regular engagement in physical activity (PA) among Thai young- and middle-aged adults diagnosed with HTN within the first five years. Therefore, this dissertation meticulously examines the intricate relationship between SCT psychosocial factors—perceived stress, self-efficacy, outcome expectancy, functional support, and workplace support—and the adoption of recommended lifestyle behaviors, specifically DA and PA, as well as their systolic and diastolic blood pressure (BP) status among young- and middle-aged Thai adults diagnosed with HTN. The study unfolds through three key aims:

Firstly, it conducts a comprehensive review of 24 studies to delve into the multifaceted associations between psychosocial factors and DA and PA. The influence of self-efficacy on both PA and DA, contingent upon different domains and countries of origin. Although social

support exhibited limited associations, outcome expectancy had modest links with PA. It's noteworthy that many of these studies primarily focused on older adults with HTN.

Secondly, the dissertation rigorously evaluates psychometric measures, ensuring their reliability and validity when adapted to the Thai context. This phase not only reaffirms the robustness and consistency of measures related to the DA domain but also uncovers the strength of the associations between self-efficacy, outcome expectancy, social support, workplace support, and DA. Similarly, within the realm of PA-related measures, the correlations among self-efficacy, moderate- and vigorous-intensity PA, social support, and workplace support were thoroughly explored. These psychometric evaluations had confirmed the validities and reliabilities of translated psychosocial measures (from English to Thai) within the context of DA and PA engagement in Thailand.

Finally, a comprehensive study involving 400 young- and middle-aged adults with HTN is conducted to shed lights on determinants of HTN-related lifestyle behaviors. Self-efficacy in PA emerges as a pivotal predictor of PA, with functional support significantly contributing to the reduction of systolic BP. Similarly, self-efficacy in DA plays a crucial role in shaping DA and its subsequent impact on systolic BP reduction. Notably, moderate-to-vigorous PA (MVPA) acts as a significant mediator between self-efficacy in PA or functional support in PA and systolic BP. There are also notable associations between self-efficacy in PA and MVPA, especially among those with shorter HTN duration (≤1 year). Moreover, both decreased systolic and diastolic BPs are observed among adults who have engaged in an increased MVPA and low-intensity PA, as well as for those who have more complied to a low-sodium and low-fat diet.

This dissertation is dedicated to my parents, who exemplify unwavering strength and remarkable patience, both essential qualities for embarking on such a scholarly journey.

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CHAPTER 1: INTRODUCTION

Purpose

The overall objective of this dissertation work was to investigate the relationship of various psychosocial factors (perceived stress, self-efficacy, outcome expectancy, social support [functional support and workplace support]) with adherence to lifestyle behaviors, including dietary recommendations (low-sodium and low-fat diet adherence [DA]) and physical activity (PA), and blood pressure (BP) in young- and middle-aged Thai adults with a diagnosis of hypertension (HTN) within the past five years. This objective was accomplished in three ways. First, an integrative literature review was performed to update the current state of the science by determining how psychosocial factors were related to DA and/or PA. Second, to ensure good psychometric properties, several psychosocial measurements with specific domain assessed to recommended lifestyle behaviors, including self-efficacy, outcome expectancy, social support (functional and workplace support), and DA were translated from English to Thai language and examined in two phases. In Phase 1, during translation process, content, face, and cross-cultural validities were established with the content experts and Thai hypertensive adults (ages 18–55). In Phase 2, additional psychometric evaluations (i.e., internal consistency [Cronbach alpha] reliability, test-retest reliability, structural construct validity and predictive validity were appraised with young- and middle-aged Thai adults with HTN. Third, the associations between various psychosocial factors, including perceived stress, self-efficacy, outcome expectancy, and social support (functional and workplace support), recommended lifestyle behaviors (DA and PA), and systolic BP and diastolic BP were examined in a sample of young- and middle-aged Thai adults with HTN (n = 400) using structural equational modeling. Furthermore, the exploration encompassed the identification of potential moderating effects inherent in HTN

medication adherence and HTN duration, as well as the mediating mechanisms facilitated by recommended lifestyle behaviors within the aforesaid nexus of relationships.

Dissertation Format

The dissertation's objectives are comprehensively explored and presented across Chapters 2, 3, 4, 5, and 6. The central emphasis lies in delving into factors potentially related to the adherence of young and middle-aged Thai adults to recommended lifestyle behaviors, as well as the management of BP. Each of these four chapters serves as the cornerstone for an individual manuscript, as depicted in Figure 1.

The distinct objectives of these chapters can be delineated as follows: Firstly, Chapter 2 embarks on an integrative literature review, aiming to enrich our contemporary comprehension. This review delves into the intricate correlations between psychosocial factors—namely self-efficacy, outcome expectancy, and social support (spanning functional and workplace dimensions)—and the adherence of hypertensive adults to lifestyle behaviors, specifically encompassing DA and/or PA.

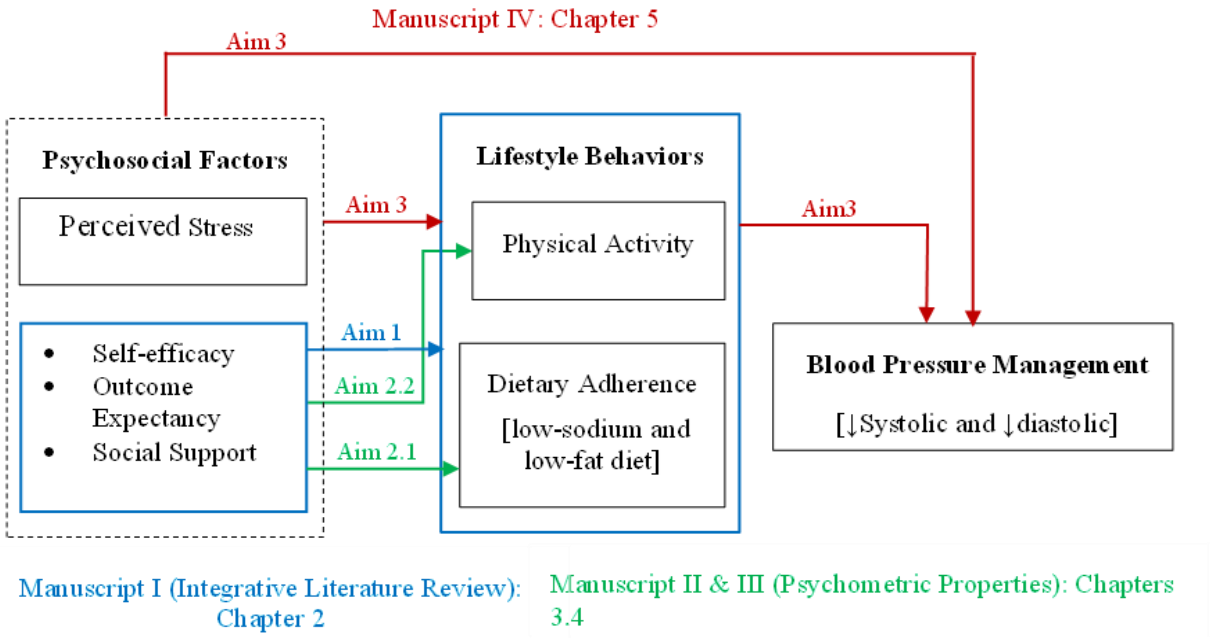
Chapters 3 and 4 then pivot to a meticulous scrutiny of the psychometric attributes of recently translated measurements, each directed at a specific domain. Chapter 3 focuses on DA, while Chapter 4 scrutinizes PA. These assessments transition from their English iterations to their Thai equivalents. The measurements encompass self-efficacy, outcome expectancy, and social support (functional and workplace support), individually tailored to the distinct realms of DA and PA.

Chapter 5 undertakes a comprehensive evaluation within the framework of the Social Cognitive Theory (SCT), unraveling the interplay of diverse psychosocial factors. This analysis spans perceived stress, self-efficacy, outcome expectancy, and social support (encompassing

both functional and workplace dimensions), collectively molding their impact on DA, PA, and the management of BP. This investigation enrolls a sample of 400 young and middle-aged Thai adults, all diagnosed with HTN. Moreover, this analysis extends beyond the confines of direct associations. It also probes the potential moderating effect of HTN medication adherence or HTN duration and the mediating effect of recommended lifestyle behaviors within these intricate relationships.

Finally, Chapter 6 stands as the nucleus for encapsulating the dissertation's findings and facilitating an exhaustive discourse surrounding its overarching aims and intentions.

Figure 1.1: Overview of conceptual framework with dissertation aims



Background and Significance

Significance of the Problem

Hypertension (HTN) is expected to affect more than 40% of the world's adult population by 2050 (World Health Organization, 2019), indicating the widespread seriousness of the problem. Moreover, the health care costs associated with HTN are anticipated to be greater than

$630 per year per person globally (Wierzejska et al., 2020). In fact, HTN-related comorbidity and disability are anticipated to total more than $100 million per year in national health care costs in Thailand, particularly for young- and middle-aged Thai adults (The National Statistical Office Thailand [NSO], 2020). Compared with high-income countries (e.g., 13.5% in the U.S.), low- and middle-income countries (LMICs) in Southeast Asia including Thailand have a greater prevalence of HTN (17.1%) (Baena et al., 2014). In fact, the prevalence of HTN among those aged over 18 in Thailand increased from 21.4% in 2016 to 25.4% in 2020 (Aekplakorn et al., 2022), whereas the incidence of newly diagnosed HTN cases in Thailand (LMIC) has nearly tripled from 2016 (4.6%) to 2020 (12.8%); many of these cases are in people younger than 55 years (NSO, 2020). In a 2019 survey with 65,667 hypertensive Thai adults (Sakboonyarat et al., 2019), approximately 40% were classified as young (18–35 years; 5%) and middle-aged adults (36–55 years; 35%).

World Health Organization (2019) has further estimated that in the next decade the mortality rate due to uncontrolled blood pressure (BP) is expected to increase by at least 20% in countries like Thailand if effective interventions are not implemented to address this life-threatening problem in a timely manner; the risk is particularly high for younger hypertensive adults. A major concern is that the mortality rate due to uncontrolled BP has already increased by 21% from 2016 (11.3%) to 2020 (13.7%) in Thailand (NSO, 2020). Many of these deaths are preventable, particularly for those who are diagnosed at younger ages (Hinton et al., 2020). Therefore, to reduce HTN-related mortality in Thailand, understanding how to effectively management BP in young- and middle-aged adults as soon as possible after an initial diagnosis of HTN is crucial.

Blood Pressure Management

Despite the importance of adequate BP management, poor BP management is more prevalent in young- and middle-aged adults compared to older adults. For example, a cross-sectional study with a representative sample of 1.1 million individuals from 44 LMICs indicated that young- and middle-aged adults with HTN had considerably poorer BP management than older adults with the same chronic condition (Geldsetzer et al., 2019). Similarly, in another cross-sectional study conducted in Thailand, about 64.6% of young- and middle-aged adults with HTN were unable to management their BP, compared with 52.3% of older adults (aged >60 years) (Meelab et al., 2019). Most importantly, early treatment is associated with more effective BP management, particularly for individuals newly diagnosed with HTN (Whelton et al., 2018). Moreover, behavioral health changes are more likely to be adopted within five years following the diagnosis of a chronic illness in young- and middle-aged adults (Newsom et al., 2012). For example, middle-aged hypertensive adults with well-managed BP reported significantly higher workplace productivity (i.e., hours of absence from work) than those with uncontrolled BP (0.72 vs. 1.35 hour; $p = .001$) (Unmuessig et al., 2016). In terms of HTN-related complications, early BP management of hypertensive treatment can significantly reduce cardiovascular complications due to uncontrolled BP such as hemorrhagic stroke, heart failure, and ischemic heart attack (O'Connor et al., 2013). A meta-analysis concluded that reducing systolic BP by 10 mmHg can reduce major adverse cardiovascular risks, including myocardial infarction, by 20% ($RR = 0.8$, 95% CI = 0.77–0.83) (Ettehad et al., 2016). Collectively, the above findings underscore the urgent need to promptly and effectively treat young- and middle-aged Thai adults with HTN within five years of diagnosis.

Lifestyle Behaviors for Blood Pressure Management

Helping individuals with HTN to successfully adhere to lifestyle modifications is a necessary step toward helping achieve BP management. According to the 2017 guidelines of the American Cardiology Association and American Heart Association for BP management, lifestyle behaviors (i.e., low-fat/or low-sodium DA, weight reduction, stress management, smoking cessation, and PA) are recommended as the first line of treatment for HTN (Whelton et al., 2018). In fact, engaging in regular PA and DA is highly recommended lifestyle behaviors for BP management for Asian adults with HTN (Chia et al., 2020). In a meta-analysis, the benefits of DA for BP management included a decrease in systolic and diastolic BP by 5.3–20.8 mmHg, and 3.7–7.9 mmHg, respectively (Juraschek et al., 2017). Regular PA (≥150 minutes/week) played a significant role in regulating BP and preventing premature death among hypertensive adults (Whelton et al., 2018). Although abundant evidence supports significant positive effects of healthy lifestyles on mitigating HTN-related comorbidity or mortality (Unger et al., 2020), young- and middle-aged adults with HTN are less likely to adopt DA and PA lifestyle modifications than older adults with HTN (Hinton et al., 2020; Johnson et al., 2017). For instance, in a qualitative study conducted in Nepal, most of the younger adults (aged <50 years) with a recent diagnosis of HTN perceived they were healthy because they had never experienced or anticipated HTN-related symptoms or complications such as severe headache, blurred vision, or chest pain (Shrestha et al., 2018).

In a cross-sectional Thai study with 65% of young- and middle-aged HTN adults (M_{age} = 54.1 years; n = 2,552), approximately 60% of them did not exercise at all, and about 50% of them consumed more than five grams of sodium daily (Apidechkul et al., 2022), which exceeds the recommended daily sodium consumption for hypertensive patients (World Health

Organization, 2012). In contrast, more than 60% of Thai older adults (aged >60 years) with HTN successfully engaged in regular PA (150 minutes a week) and adhered to dietary intake recommendations (i.e., low-sodium or low-fat) (Namwong et al., 2015). The study's results indicate that adherence to DA and PA in young- and middle-aged hypertensive Thai adults' remains suboptimal. The reasons for this finding are not clear because limited studies are available in Thai populations that examine the contributions of psychosocial factors to young- and middle-aged adults' adherence to the recommended lifestyle behaviors.

Existing Lifestyle Behavior Interventions for Blood Pressure Management in Thailand

Numerous lifestyle educational programs have exhibited varying degrees of effectiveness in enhancing BP management among Thai adults with HTN. However, most of these initiatives lacked theoretical guidance and predominantly targeted older adults aged over 60 years, who had been diagnosed with HTN for more than 5 years (Boonyathee et al., 2021; Ngowsiri et al., 2018; Woodham et al., 2020; Yokokawa et al., 2021). The primary focus of these interventions was to augment participants' understanding of DA and PA in general. It's noteworthy that concentrating solely on increasing HTN-related knowledge has been correlated with reduced sustainability of behavioral changes over time, as highlighted in a study involving younger Chinese adults (aged <60) with elevated BP (Gong et al., 2020). Similarly, a study by Shim et al. (2020) indicated that dietary knowledge tailored for BP management was not significantly associated with enhanced adherence to lifestyle behaviors such as DA (p >.05) among young and middle-aged adults (ages 18–55) with HTN. Consequently, lifestyle educational interventions may not exert a sustained effect on enhancing DA or PA over time among these young- and middle-aged adults with HTN.

In recent times, a multitude of psychoeducational interventions have garnered attention for their enduring impact on enhancing adherence to recommended lifestyle behaviors,

encompassing both PA and DA, leading to a reduction in BP among younger adults with HTN (M_{age} below 60). These promising outcomes have been documented not only in Western countries (Mensorio et al., 2019; Svetkey et al., 2005) but also within a Latin American context (Cornélio et al., 2016) during the 12 months post-intervention follow-up phase. These interventions have predominantly emphasized the augmentation of psychosocial factors, particularly self-efficacy and functional support from family, concurrently elevating participants' comprehension of recommended lifestyle behaviors vital for effective BP management. However, it is crucial to note that these interventions have primarily emphasized the enhancement of PA or DA, with limited exploration into manipulating other dimensions of psychosocial support such as workplace support or comprehensive functional support encompassing both peers and family, while also considering the potential influence of outcome expectancy. Furthermore, these two studies did not clearly outline their inclusion criteria regarding the duration of HTN for eligible participants, whether in the control or intervention group.

It is imperative to underscore that the above findings' applicability might not readily extend to the context of young- and middle-aged adults diagnosed with HTN in Thailand, particularly those receiving an early diagnosis in first five years. This distinction gains heightened significance due to the potential influence of HTN duration (Gwak & Lee, 2022) and the inherent presence of cultural variations (Kastanakis & Voyer, 2014) that can interact with this mechanism. As a result, the intricate ways in which the aforementioned psychosocial factors exert their influence on DA, PA, and BP management within this distinct demographic—encompassing individuals aged 18 to 55 in Thailand—remain significantly unexplored.

Furthermore, the outcomes of these investigations, particularly in the realm of DA, have predominantly centered on specific eating behaviors such as emotional eating, external eating, and restrictive eating (Mensorio et al., 2019), or adherence to comprehensive dietary plans like the DASH diet that integrates elements of low-sodium, low-fat, and other dietary components (Svetkey et al., 2005). However, a noticeable gap exists in comprehending how these interventions can positively influence the enhancement of dietary habits, specifically regarding adherence to either a low-fat or low-sodium dietary regimen. These void gains significance within the context of younger Thai adults who, despite the prominence of low-sodium dietary recommendations (Chailimpamontree et al., 2021), exhibit suboptimal adherence.

This knowledge gap poses a significant challenge in designing and reproducing interventions tailored to the needs of young- and middle-aged Thai adults with HTN. Addressing these gaps in understanding is essential for the effective development of interventions that resonate with the distinctive attributes and cultural contexts of this population. To foster sustainable recommended lifestyle behaviors, theoretically guided interventions are crucial (Bandura, 1987). The Social Cognitive Theory (SCT) is a widely used framework for guiding behavioral changes and has proven successful in deciphering the motives behind individuals adopting and sustaining health behaviors (Bandura, 1987). A prior systematic review encompassing 15 SCT-based interventions involving 3,388 hypertensive patients (ages ranging from 18 to 88; M_{age} = 55.2), aimed at promoting adherence to recommended lifestyle behaviors (DA and PA), found that two primary components, health education, and skill training (involving self-monitoring and goal setting), demonstrated a substantial effect size in enhancing PA (d = 0.93–0.99) 12 months after the intervention (Suriyawong & Sripethwandee, 2022). This

underscores the efficacy of SCT-based interventions in helping hypertensive patients navigate behavioral challenges to sustain lifestyle behaviors over time (Bandura, 1987).

However, it is pertinent to note that the applicability of these findings may not directly extend to the context of young- and middle-aged Thai adults with HTN. Additionally, it remains unclear whether these lifestyle behaviors (i.e., PA and DA) in young- and middle-aged Thai adults with HTN partially mediate the association between SCT's psychosocial factors and BP. Therefore, exploring how psychosocial factors of SCT influence lifestyle behaviors and subsequently enhance BP management among young- and middle-aged Thai adults diagnosed with HTN within the previous 5 years is essential. Without comprehensive insights into these areas, the development of effective theory-based interventions to mitigate HTN-related complications in Thailand will indeed be a formidable challenge.

The Need for Validated Measurements and Cultural Adaptations

Previous studies in Thailand have primarily focused on examining the relationship between psychosocial factors and lifestyle behaviors, such as PA or DA, among adults aged 60 and above with HTN (Chantakeeree et al., 2022; Jaiyungyuen & Wora-arun, 2018; Saminpanya et al., 2018). It's important to note that the measures used in these studies lacked sufficient theoretical validation. Notably, the psychosocial measurements, particularly self-efficacy and social support, were not tailored specifically to PA or DA behaviors but assessed a broader domain of general efficacy. Therefore, there is an urgent need to develop and validate domain-specific measures that accurately assess the psychosocial factors related to PA or DA for BP management in Thailand, including self-efficacy, social support, outcome expectancy, and workplace support.

To bridge these knowledge gaps, this dissertation has three aims.

Dissertation aims:

Aim 1: Evaluate the state of science on how psychosocial factors (i.e., self-efficacy, outcome expectancy, and social support) are related to adherence to lifestyle behaviors (DA and PA) in hypertensive patients.

Aim 2: The adaptation and validation of Dietary Adherence Scale and four SCT-based psychosocial measurements including the Self-Efficacy for Hypertension Treatment Adherence Scale with its DA self-efficacy and PA self-efficacy subscales, the Outcome Expectancies of Behavioral Change Scale with DA outcome expectancy and PA outcome expectancy subscales, the Social Support for Diet and Exercise Behavior Scale with DA functional support and PA functional support subscales, and the Workplace Support for Health Scale from English to Thai language.

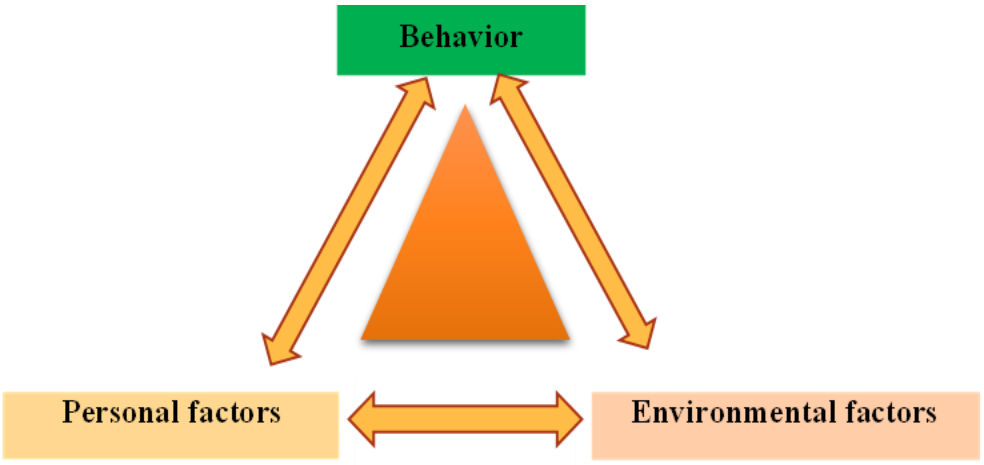
Aim 3: Examine: 1) the relationships of selected SCT-based psychosocial factors (perceived stress, self-efficacy, outcome expectancy, functional support, workplace support) with adherence to lifestyle behaviors (DA and PA) and systolic/diastolic BP; and 2) the potential mediators (DA and PA) and moderators (HTN medication adherence, and HTN duration) on these associations.

The findings of this dissertation may serve as a foundation to guide nurse researchers in developing effective theory-based interventions to promote healthy lifestyles in young- and middle-aged Thai adults with HTN so they can achieve an optimal BP level. Importantly, a nuanced understanding regarding the mechanism of psychosocial factors on lifestyle behaviors and BP management may facilitate policy changes needed to reduce the complications and health care burden and costs related to uncontrolled BP in Thailand.

Conceptual Framework

Theoretical approaches have been found to be more effective than nontheoretically approaches for explaining the mechanisms and factors that determine success or failure of behavioral changes (Glanz & Bishop, 2010). One theory commonly used to understand why individuals adopt and sustain health behaviors is SCT (Bandura, 1987). According to SCT (Bandura, 1987), personal factors (i.e., belief and thought), behavior, and environmental factors all serve as interacting factors that have a bidirectional impact on each other (see Figure 2).

Figure 1.2: Social Cognitive Theory (Bandura, 1987)



Accordingly, SCT is applicable for this study for several reasons. First, environmental factors (i.e., social support: functional or workplace support) are key factors that help individuals maintain their behavior changes over time (Institute of Medicine and National Research Council, 2013). Second, personal factors (i.e., self-efficacy, outcome expectancy, and perceived stress) have been identified as important factors in both initiation and maintenance behaviors (Bandura, 2004). However, most behavioral change theories (e.g., the Theory of Planned Behavior, the Transtheoretical Model) fail to consider the maintenance of behavioral change, focusing instead on initiation of the behavior (Conner, 2008). Finally, SCT provides the foundation for a testable

and predictive structural model for understanding the effects that each of the psychosocial variables may have on behaviors.

Description of Social Cognitive Theory (SCT)

SCT focuses on the relationship between personal (cognitive) and environmental factors and behavior: The personal and environmental factors directly influence behavior, while the environmental factors can indirectly improve behavior through personal (cognitive) factors (see Figure 2). In particular, personal factors (i.e., perceived stress, self-efficacy, and outcome expectancy) and environmental factors (structural and functional social support) are posited to be highly predictive of individuals' health behaviors (Bandura, 1987).

Personal Factors

Perceived Stress. Perceived stress is defined as the degree to which situations in the individual's life are evaluated as being stressful, unforeseen, and out of their management over time (Cohen & Wills, 1985). In a study with healthy young or older adults, a negative relationship occurred between perceived stress and lifestyle behaviors (Laugero et al., 2011; Richardson et al., 2015; Rod et al., 2009; Tariq et al., 2019). Elevated perceived stress was also positively associated with increased BP in 21,923 healthy young- and middle-aged adults living in the United States (Gordon & Mendes, 2021). In terms of adults with HTN, perceived stress was significantly related to poor BP management in older hypertensive adults (M_{age} = 58.41–58.62 years) (Bhelkar et al., 2018; Lu et al., 2019; Munakata, 2008). For young- and middle-aged adults, work-related stressors, such as working long hours, having a heavy workload, and job uncertainty, were associated with unhealthy lifestyle behaviors (Wu et al., 2016). More specifically, working long hours (>40 hours/week) was positively related to consumption of unhealthy fast foods (Pelletier & Laska, 2012) and having a sedentary lifestyle among young-

and middle-aged adults (Saidj et al., 2014). Of importance is that, on average, about 81% of young- and middle-aged adults (ages 18–55) in Thailand work longer than 40 hours per week (NSO, 2020). Many of these younger Thai adults also are responsible for raising their children and caring for aging parents simultaneously (Sanprakhon et al., 2022).

In a cross-sectional study comparing two representative adult samples from England and Thailand, the researchers found that more than half of young- and middle-aged Thai adults (ages 18–55) suffered from moderate-to-high stress, as compared to only about 20% of their English counterparts (Lazzarino et al., 2014). However, the association between perceived stress, lifestyle behaviors, and BP management has not been confirmed in younger Thai adults with HTN, particularly within the first five years after diagnosis. It is possible that increased stress in young- and middle-aged Thai adults may prevent them from making the needed lifestyle modifications (increased DA and increased PA). Thus, understanding how perceived stress in these younger adults (ages 18–55) may impact their lifestyle behaviors and BP management is an important first step to designing an effective intervention that can mitigate HTN-related health care burdens (Zhou et al., 2021).

Self-Efficacy. Self-efficacy is defined as an individual's beliefs about their confidence or capability in managing a behavior-specific that would bring about a desired outcome (Bandura, 1987). Bandura (1987) posited that individuals with higher personal self-efficacy are equipped with improved management skills to overcome psychosocial barriers (e.g., time constraints from work). Positive associations between self-efficacy and increased DA or increased PA (Daniali et al., 2017; Idowu et al., 2012; Kang et al., 2020; Mohammadi et al., 2021; Yan et al., 2012) have been identified among young adults (M_{age} <60 years) with HTN residing in Western or Middle Eastern countries. Although the associations between self-efficacy and health behaviors may be

expected similar across cultures (Bandura, 1987), a nonsignificant relationship between self-efficacy and increased DA was noted in young- to middle-aged Chinese adults (M_{age} = 48.37 years; Ma, 2018) and elderly Chinese (M_{age} = 63.72 years; Xie et al., 2020) with HTN. In several studies conducted in Thailand, although hypertensive adults' increased PA or increased DA was largely predicted by their general self-efficacy, it is important to note that the findings were mostly generated from older adults (>60 years) who had experienced HTN for more than 5 years (Jaiyungyuen & Wora-arun, 2018; Pinprapapan et al., 2013; Saminpanya et al., 2018; Sujamnong et al., 2013). Furthermore, given that self-efficacy is a domain-specific construct, it is critical to assess self-efficacy within the context of DA and PA to capture its associations with desired and relevant outcomes (improved DA and increased PA) (Resnick, 2013). In a study conducted in Sweden with 377 middle-aged men with HTN, improving exercise self-efficacy was associated with physiological advantages in lowering systolic BP (r = 0.17, p = 0.01; Bergström et al., 2015). Unfortunately, these assumptions have not yet been verified with young- and middle-aged Thai adults where cultural beliefs and social practices are distinct from Western, Middle Eastern, and other Asian countries. Collectively, it remains unclear how DA or PA self-efficacy may relate to DA, PA, and BP among young- and middle-aged Thai adults with HTN.

Outcome Expectancy. Outcome expectancy is defined as the positive (or negative) expected consequences that can result from maintaining a certain behavior (Bandura, 2004). The term is suggested to be related to the perseverance of coping and management efforts (Afifi & Tikkanen, 2021). Individuals are more likely to overcome stressful events and engage in a healthier lifestyle if they expect to benefit from such lifestyle changes (Latham, 2020). In a previous study conducted in a Western country, negative outcome expectancy was associated with decreased PA among young adults with HTN (M_{age} = 46.83 years; Wienert et al., 2017). In

another study conducted in Iran (a middle-income country), investigators found a positive relationship between positive outcome expectancy and increased PA among middle-aged adults with HTN (ages 40–60 years; M_{age} = 49.54 years) (Mohammadi et al., 2021). No studies have investigated the associations between outcome expectancy and DA, PA, and/or BP management among young- and middle-aged HTN adults in Thailand.

Environmental Factors

Environmental theoretical constructs to be operationalized in this proposed study are structural and functional social support. Social support is noted to help improve the emotional coping and management skills that hypertensive patients need to adhere to healthy lifestyles (Turan et al., 2019). There are two essential aspects of social support: (a) structural support, which consists of the number and types of connections within an individual's social network, and (b) functional support, which includes emotional and informational support from family, peers, or others (Cohen & McKay, 2020). Functional and structural support may be derived from an individual's home, workplace, and other social networks. Workplace structural support, in particular, refers to the degree to which employees believe their well-being is valued by their employers or coworkers, which can subsequently promote physical and emotional health in their workplaces (Laing & Jones, 2016). Currently, the relationship between functional support and adherence to a lifestyle behavior, such as PA, is well-supported among adults with HTN (Bahari et al., 2019; Daniali et al., 2017; Kang et al., 2020; Yan et al., 2012). Similarly in Thailand, functional support from peers or family is recognized as an important factor for lifestyle modifications in older Thai adults (M_{age} >60 years) with HTN (Chantakeeree et al., 2022; Leelacharas et al., 2015). In a study using National Health Interview Survey data, functional support was significantly associated with decreased systolic BP in older adults (Gorman &

Sivaganesan, 2007). In another cross-sectional study with middle-aged and older Chinese adults, functional support from family or community was significantly related to improving systolic BP and diastolic BP after controlling for sex and age (Lei et al., 2019). However, no studies thus far have examined the influences of workplace support on healthy lifestyles or BP management among younger adults with HTN. Structural workplace support would be important among young, hypertensive Thai adults because they encounter various stressors, including demands in the workplace. Enhanced understanding about structural workplace support can facilitate the development of a health promotion policy that may improve lifestyle modifications in younger adults with HTN and reduce HTN-related complications.

Behavior

According to the SCT, the health behavior outcome was operationalized to assess younger adults' adherence to lifestyle behaviors (DA and PA; see Figure 3). First, behavior was also operationalized as DA for consumption of a low-sodium and low-fat diet. The validated Dietary Adherence scale was adapted to assess DA (Folsom et al., 2007) to ensure that this DA measure fit with Thai participants' culture. A composite DA score was derived from the subscales of foods and nutrient components with equal weighting (i.e., grains; fruits; vegetables; nut, seeds, legumes; dairy; meat; fat; sweets; and sodium). Because there are differences in the dietary cultures of Western countries and Thailand, Thai people usually consume more white or brown rice than wheat or bread. Moreover, dairy products such as cheese and butter are rarely consumed as part of the Thai diet (National Bureau of Agricultural Commodity and Food Standards, 2022). Thus, this study adapted this DA measure with dietary considerations appropriate for the dietary preferences of the Thai culture.

Second, PA was assessed either for MVPA (i.e., labor tasks and carrying objects) or low-intensity PA (i.e., walking, cleaning, and gardening) using a validated self-report measure (Thai version of the International Physical Activity Questionnaire [IPAQ-SF]) over the previous seven days. MVPA or low-intensity PA was measured using the metabolic equivalent (MET) score, which refers to the total energy expenditure used when engaging in such PA (IPAQ, 2005). This instrument's score can be categorized into three levels of PA: 1) low level (MET-minutes/week <600), 2) moderate level (MET-minutes/week >600–3,000), and 3) high level (MET-minutes/week >3,000). The existing WHO guidelines on PA suggest that adults with HTN should perform PA for at least 600 MET-minutes/week to improve cardiovascular health such as BP (Bull et al., 2020). While the clinical outcome of BP management is not included in the SCT, lifestyle behaviors such as greater PA level or increased DA have demonstrated physiological benefits (Bandura, 1998). Thus, either PA or DA improvement can directly reduce high BP among Thai young- and middle-aged adults with HTN.

To date, no study was found that applied the SCT to examine the relationships among psychosocial factors, lifestyle behaviors, and BP management in young- or middle-aged adults with HTN in Thailand. Figure 3 illustrates how the SCT constructs were operationalized in this study. Also, the mediation effects of lifestyle behaviors on the relationship between SCT-based psychosocial factors and BP management remain largely unclear. The behavioral mediation model is illustrated in Figures 4 and 5, which shows the hypothesized structural equation modeling in which direct and indirect effects were examined.

Figure 1.3: Operational model guided by Social Cognitive Theory

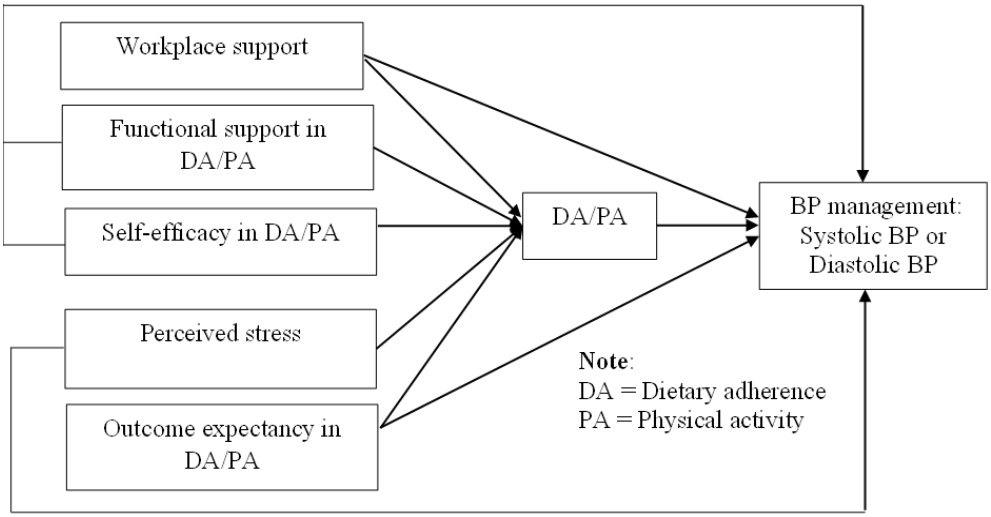
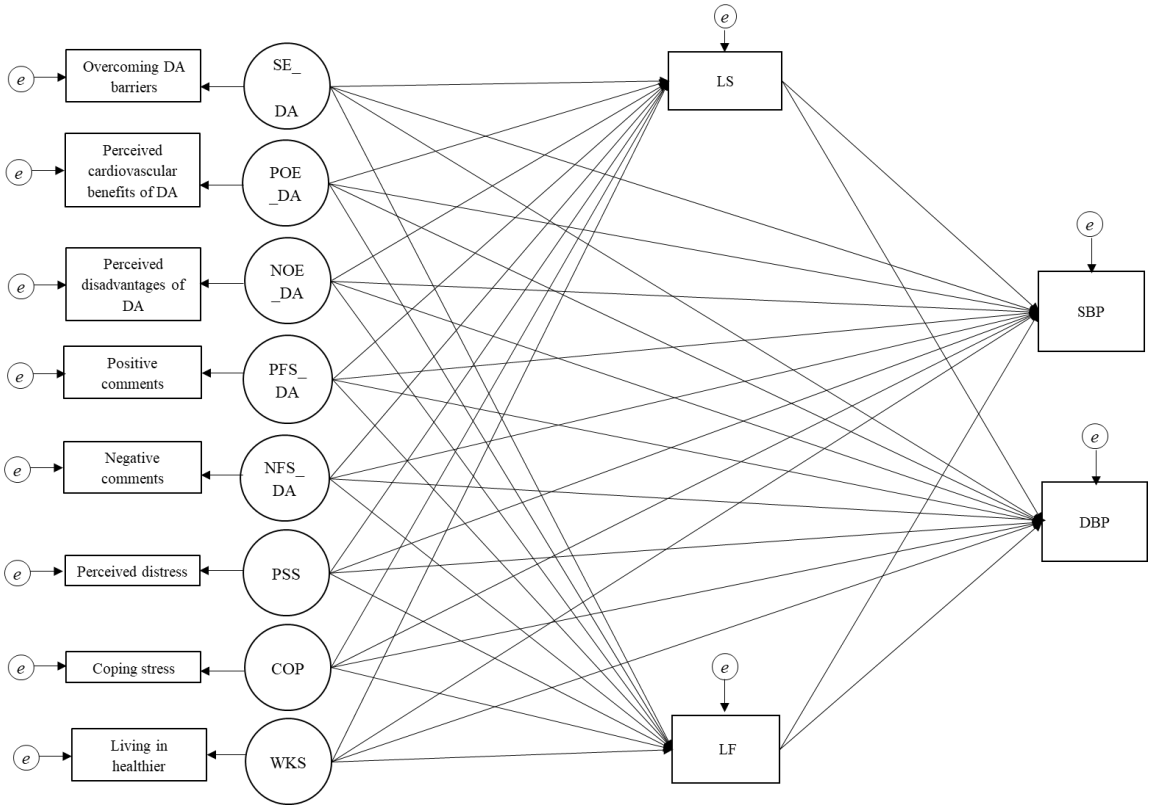
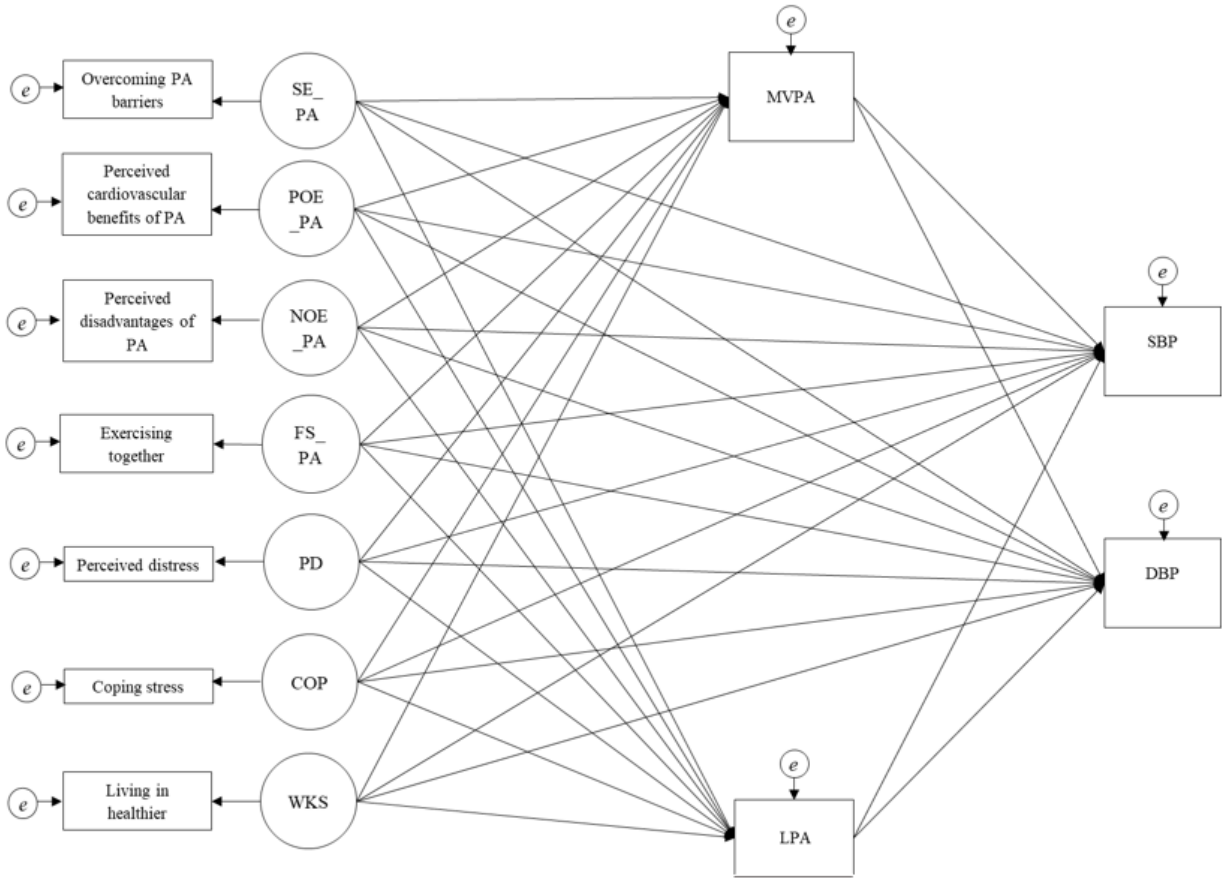


Figure 1.4: Structural equation modeling for dietary adherence



Note: e = measurement error, SE_DA = self-efficacy in dietary adherence; POE_DA = positive outcome expectancy in dietary adherence, NOE_PA = negative outcome expectancy in dietary adherence, PFS_DA = positive functional support in dietary adherence, NFS_PA = negative functional support in physical activity, PD = perceived distress, COP = coping ability, WKS = workplace support, LS = a low-sodium diet adherence, LF = a low-fat diet adherence, SBP = systolic blood pressure, DBP = diastolic blood pressure.

Figure 1.5: Structural equation modeling for physical activity



Note: e = measurement error, SE_PA = self-efficacy in physical activity, POE_PA = positive outcome expectancy in physical activity, NOE_PA = negative outcome expectancy in physical activity, FS_PA = functional support in physical activity, PD = perceived distress, COP = coping, WKS = workplace support, MVPA = moderate-to-vigorous physical activity, LPA = low-intensity physical activity, SBP = systolic blood pressure, DBP = diastolic blood pressure.

Factors Associated with Blood Pressure Level

In this study, we focus on behavioral factors contributing to both systolic and diastolic BP among young- and middle-aged Thai adults with HTN. We aim to identify potential covariates that may directly or indirectly impact DA and PA behaviors, and subsequently influence systolic and diastolic BP levels. These additional analyses will provide a clearer understanding of the factors contributing to systolic and diastolic BP, either directly or indirectly through medication or moderation effects.

Sociodemographic Factors

Age. The age factor plays a significant role in BP management among adults with HTN. Younger adults with HTN tend to face higher rates of uncontrolled BP compared to their older counterparts, particularly those aged over 60 years. This observation underscores a noteworthy issue among younger adults, which has also been identified in previous studies (Geldsetzer et al., 2019; Meelab et al., 2019). Furthermore, it's crucial to recognize that BP management varies across different age categories. For example, adults with HTN between the ages of 45 and 54 tend to exhibit poorer BP control, with approximately 30% experiencing BP levels exceeding 140/90 mmHg. In contrast, those aged between 20 and 44 have a lower prevalence, just above 10%, of BP levels exceeding this threshold (Whelton et al., 2018). This disparity underscores the importance of considering age-specific approaches in HTN management.

Biological Sex. Biological sex emerges as a crucial factor in BP management. A cross-sectional study involving 152,561 adults with HTN, with 55% being female, provides compelling evidence that males with HTN struggle more to control their BP (≥140/90 mmHg) compared to females with HTN (approximately 60% vs. 50%, p <0.01), especially when considering individuals of similar ages (18–49 years) (Daugherty et al., 2011). One possible explanation for this difference lies in hormonal disparities. Endogenous estrogen, a female hormone, appears to have a protective effect on blood vessels and a capacity to reduce peripheral resistance, potentially contributing to lower BP levels in females compared to males of similar age (Colafella & Denton, 2018).

Income. Individuals of lower socioeconomic status often face a higher prevalence of HTN and encounter difficulties in managing their BP (Coulon et al., 2016). These challenges are closely tied to factors such as household income, which limit their opportunities for adopting

healthy lifestyles, including access to nutritious foods (Suarez et al., 2015). Research utilizing data from the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) project has provided insights into the impact of socioeconomic factors (Shahu et al., 2019). The study specifically examined county-level median household income, where quintile 1 represents the lowest income group and quintile 5 represents the highest. The findings found that participants with household incomes falling below the lowest quartile (indicating the lowest socioeconomic status) were less likely to achieve the recommended BP management threshold (<140/90 mmHg) with an odds ratio of 0.48 and a 95% confidence interval of 0.37–0.63 (Shahu et al., 2019).

Educational Level. Individuals with higher levels of education tend to prioritize their health, resulting in a significantly lower prevalence of HTN as observed in the study by Martin et al. (2021). In a cohort study involving 101,959 Chinese participants with HTN aged 40 years and older, those with an educational attainment level at or above middle school demonstrated better BP management (<140/90 mmHg) during a 3.8-year follow-up period when compared to participants with an elementary school education or lower (Sun et al., 2022). Specifically, the odds ratio for achieving BP control was 1.11 (95% CI = 1.09–1.15) for those with a middle school education and 1.18 (95% CI = 1.14–1.22) for those with an education level above middle school.

Marital Status. Marital status was examined in relation to overall health outcomes, particularly in the context of HTN control. Previous studies have consistently shown a positive association between marital status and BP. Specifically, individuals who are married or have a spouse tend to report better BP control compared to their single counterparts, even after accounting for age and sex among adults with HTN. For instance, a study conducted in Poland

found that married adults with HTN had significantly lower systolic and diastolic BP levels than their unmarried counterparts (p <.001; Lipowicz & Lopuszanska, 2005). Similarly, a cross-sectional national survey in China, involving 15,384 adults with HTN aged over 25 years, revealed that both younger (<40 years) and older (≥60 years) married adults tended to have lower systolic and diastolic BP levels compared to their unmarried counterparts (p = 0.039; Li et al., 2022).

Occupation and Working Hour. Various occupations expose individuals to distinct stressors, often arising from demanding work conditions, particularly the prolonged working hours. The psychological stress stemming from occupational demands can have tangible repercussions on physical health, potentially leading to conditions such as HTN or uncontrolled BP among the working population. For instance, a 2.5-year longitudinal study conducted in Japan revealed that individuals engaged in 2,000 white-collar professions, including office workers, technicians, professionals, and managers, who worked more than 40 hours per week, exhibited notably higher systolic (+2.5 mmHg) and diastolic (+2.3 mmHg) BP levels compared to those with regular working hours (35–40 hours/week) among males (Gilbert-Ouimet et al., 2022). Among females, those with extended working hours (over 40 hours per week) demonstrated a considerable increase in diastolic BP (+1.8 mm Hg) compared to females working regular hours (Gilbert-Ouimet et al., 2022).

Hypertension Duration

The duration of HTN has a substantial impact on BP management. A qualitative study conducted in Nepal observed that individuals diagnosed with HTN during the early stages of their condition tend to face challenges in BP control, often exhibiting BP levels exceeding 140/90 mmHg (Shrestha et al., 2018). This contrasts with those with a longer history of HTN

(greater than one year) because individuals newly diagnosed with HTN may not have previously experienced severe complications associated with high BP, such as headaches or blurred vision (Shrestha et al., 2018). Moreover, a comprehensive cross-sectional study involving 31,089 patients diagnosed with HTN from 103 community health centers in the US provided valuable insights (Huguet et al., 2023). This study revealed that the odds of uncontrolled BP were higher in the group recently diagnosed with HTN (less than one year) compared to individuals who had been managing HTN for over 5 years (*OR* = 1.19; 95% CI = 1.00, 1.42). Interestingly, those with a HTN duration of 1–3 years showed a greater proportion of controlled BP compared to those with a HTN duration exceeding 5 years, with odds 1.15 times higher (*OR* = 0.87; 95% CI = 0.77, 0.99) (Huguet et al., 2023).

Body Mass Index

The Body Mass Index (BMI) is a quantitative measure obtained by dividing an individual's weight in kilograms by the square of their height in meters. An elevated BMI value is indicative of a greater proportion of body fat (Zierle-Ghosh & Jan, 2022). However, it is essential to recognize that relying solely on BMI categorizations for weight assessment may potentially engender health-related issues (Zierle-Ghosh & Jan, 2022). It's widely recognized that BMI can directly impact BP, with high BP often found in individuals with elevated BMI, as demonstrated in meta-analyses of included 57 observational studies (Jayedi et al., 2018). A previous study investigated the relationship between various BMI levels and HTN risk, particularly high BP, in a sample of 7,907 community-living adults participating in Italy's Longevity Check-up 7+ project (Jayedi et al., 2018). The findings indicated a significant association between higher BMI levels and consistently elevated BP across BMI categories, suggesting that BMI may independently contribute to heightened BP. Furthermore, international

guidelines, such as those provided by the American Heart Association, recommend that individuals with HTN can enhance their BP management by reducing their weight (Whelton et al., 2018). In accordance with the criteria set by the Thai Health Promotion Foundation (2012), individuals falling below 18.50 kg/m^2 on the BMI scale are categorized as underweight. Those with a BMI ranging from 23.0 to 24.9 kg/m^2 are classified as overweight. In the range of 18.5 to 22.9 kg/m^2, individuals are considered to have a normal weight, reflecting a healthy balance between weight and height and a lower risk of weight-related health issues. On the other hand, those with a BMI exceeding 25.0 kg/m^2 fall into the obese category, signifying a significantly higher body weight that may pose health risks such as high BP.

Other Lifestyles Factors

Both alcohol drinking and smoking have the potential to impact BP levels (Whelton et al., 2018). An influential study known as the Framingham study, which meticulously evaluated and followed over 5,000 middle-aged men and women initially aged 30–59 years, sheds light on this issue (Franklin & Wong, 2013). According to the study's findings, adults who consume a high level of alcohol (exceeding 1,800 milliliters per month) tend to exhibit higher systolic and diastolic BP readings compared to those who consume less than 900 milliliters per month. Similarly, smoking can also lead to elevated BP levels due to the release of catecholamines, which in turn increase vascular resistance (Haass & Kübler, 1997).

Hypertension Medication Adherence

In adults with HTN, poor adherence to antihypertensive therapy stands out as a significant contributor to the challenge of achieving BP management (Poulter et al., 2020). A well-established clinical trial underscores the substantial impact of varying levels of adherence to HTN medication on systolic and diastolic BP among adults with HTN (Matsumura et al., 2013).

The study reveals that follow-up BPs, adjusted for age, sex, baseline BP, and randomized treatment, exhibited a significant difference among the adherence groups over the 6-month treatment period. Specifically, the low-adherence group showed higher BPs (135/78 mmHg) at follow-ups in contrast to the high-adherence group (130/74 mmHg; $p = 0.02$) and the moderate-adherence group (128/74 mmHg; $p = 0.003$).

In summary, understanding the role of these psychosocial factors in adherence to recommended lifestyle behaviors and BP in young- and middle-aged Thai adults with HTN can help nurse researchers develop effective theory-based interventions to promote adherence to lifestyle behaviors and prevent serious cardiovascular complications resulting from uncontrolled BP occurring at younger ages. This dissertation is organized in a multiple-paper format, and the comprehensive coverage of these papers will be presented in the following chapters.

Chapter 2 (Manuscript 1) was an integrative review of how psychosocial factors influenced hypertensive patients' adherence to lifestyle behaviors, including DA and/or PA. This manuscript has been published in the *Western Journal of Nursing Research* (Suriyawong et al., 2023). The methodology of this integrative review was guided by recommendations of Whittemore and Knafl (2005). The review integrated qualitative and quantitative studies to increase a broad understanding of how these psychosocial factors, including self-efficacy, outcome expectancy, and social support (guided by the SCT), were associated with DA and/or PA in individuals with HTN.

In summary, the findings showed that DA or PA was moderately to largely associated with self-efficacy, functional social support, and outcome expectations. In addition, a few knowledge gaps that will direct future research were identified in the manuscript. For example, cultural variation, age, and duration of HTN might play as the confounders in the relationship

between these psychosocial factors and hypertensive patients' adherence to lifestyle behaviors such as DA or PA. Also, evidence was lacking to support the relationship between social support, when operationalized as structural social support, and adherence to lifestyle behaviors in younger adults with HTN.

Chapters 3 and 4 (Manuscripts 2 and 3) encompassed two distinct phases. In the initial phase, we adhered to the rigorous guidelines set forth by the World Health Organization (2006) to meticulously translate and back-translate various SCT-based psychosocial measurements. These included self-efficacy in DA, self-efficacy in PA, outcome expectancy in DA, outcome expectancy in PA, functional support in DA, functional support in PA, workplace support, and DA. The aim was to establish content validity, cross-cultural validity, and face validity, with input from three content experts and feedback from five young- and middle-aged Thai adults with HTN. In the subsequent phase, we conducted a comprehensive psychometric assessment of the translated Thai measurements specifically tailored to the DA domain, involving 110 Thai hypertensive adults (ages 18–55) with two-time data collection. For measurements pertaining to the PA domain, their psychometric properties were evaluated in a sample of 250 participants through a single time data collection approach. The evaluation encompassed both reliability (internal reliability and external reliability) and validity (including construct validity such as content, face, structural, convergent, and discriminant validity, as well as criterion validity involving concurrent and predictive validity).

Chapter 5 (Manuscript 4) scrutinized the intricate relationships among various psychosocial factors, namely perceived stress, self-efficacy, outcome expectancy, and social support (functional and workplace support), and their respective associations with recommended lifestyle behavior (DA and PA), and BP management (systolic and diastolic BP) in a cohort of

400 Thai young- and middle-aged adults with HTN. The investigation also encompassed an exploration of the potential mediating role of recommended lifestyle behaviors (DA or PA) on the relationship between these psychosocial factors and BP. Additionally, the study delved into the potential moderating influence of HTN medication adherence and the duration of HTN diagnosis on these intricate associations.

Chapter 6 (Conclusion) provides a summary of the dissertation across all four manuscripts and synthesizes the contributions made towards advancing the science related to BP, recommended lifestyle behaviors, and various psychosocial factors in Thai young and middle-aged adults with HTN. This chapter discusses this study's implementation and how nursing researchers or policymakers can utilize the findings of this study to develop or design an effective intervention to help Thai younger adults with HTN achieve improved BP management early on.

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CHAPTER 2: PSYCHOSOCIAL DETERMINANTS OF RECOMMENDED LIFESTYLE BEHAVIORS AMONG HYPERTENSIVE PATIENTS: AN INTEGRATIVE LITERATURE REVIEW

Abstract

Dietary adherence (DA) to a low-sodium and/or low-fat diet and physical activity (PA), is recommended and recognized as first-line treatments for hypertensive patients' blood pressure control, but little is known about how they are influenced by psychosocial determinants. This integrative review examined the relationships of three psychosocial factors (self-efficacy, outcome expectancy, and social support) with hypertensive patients' diet adherence and physical activity. The search was limited to studies published between 1997 and 2021. Twenty-four; then 24 peer-reviewed studies were assessed. Nearly half of the studies (k = 10; 42%) targeted older hypertensive adults (aged >60 years).

Results showed of these three psychosocial factors, self-efficacy had small-to-large relationships with PA (r = 0.02–0.46) and DA (r = 0.06–0.79), with the strength of the associations varying by the assessed domain and country of origin. However, a few studies reported a small-to-large relationship between social support and PA (k = 3; r = 0.21–0.83) or DA (k = 2; r = 0.009–0.271), while the remaining psychosocial factors (positive [k = 1; r = 0.25] and negative [k = 1; r = -0.23] outcome expectancy) had a small association with PA. When designing an intervention that focuses on improving PA or DA among hypertensive patients, these three psychosocial factors should be manipulated. However, these relationships could be confounded by factors such as age, duration of hypertension, and race/ethnicity. Thus, continued research is more efforts are needed to more comprehensively delineate the contributions of these psychosocial factors to improving on DA or PA, particularly among younger hypertensive adults.

Introduction

Uncontrolled blood pressure is a significant chronic condition. It is estimated that it will affect almost 40% of the world population older than 18 years by 2050 (World Health Organization [WHO], 2020). This condition remains the primary cause of death globally, responsible for more than 7 million deaths per year (WHO, 2020). Fewer than one in five hypertensive patients have their blood pressure under control (WHO, 2020).

Uncontrolled blood pressure can lead to increased likelihood of ischemic heart disease and stroke (Virani et al., 2021), poor quality of life, disability, and premature mortality among hypertensive patients (Zhu et al., 2021). Helping patients with hypertension (HTN) to successfully adhere to healthy lifestyles (e.g., physical activity, low-sodium diet, and alcohol/smoking cessation) is important for blood pressure control (Bruno et al., 2018). Joint National Committee-8 guidelines recommend a low-sodium and/or low-fat diet, along with physical activity, as first-line treatments for hypertensive patients' blood pressure control (James et al., 2014). In addition, adherence to dietary and physical activity recommendations have been shown to decrease the demand for pharmacological therapy (Unger et al., 2020), enhance the efficacy of antihypertensive drugs (Mahmood et al., 2019), and prevent the development of cardiovascular diseases (Betageri et al., 2021). A systematic review with meta-analysis reported that dietary adherence alone can decrease systolic blood pressure (-3.2 mmHg) among adults with HTN (Filippou et al., 2020). When dietary adherence is combined with moderate-to-vigorous physical activity (>30 min/time, 3 times/week), a greater reduction in systolic blood pressure (-5.44 mmHg) is noted, compared to dietary adherence alone (-0.57 mmHg) (Lee et al., 2015). Moreover, adherence to dietary and/or physical activity behaviors are strongly associated with greater health-related quality of life in hypertensive patients. For instance, hypertensive

patients who regularly engaged in moderate physical activity three times/week (Zhu et al., 2021), or consistently consumed a healthy diet (Li et al., 2018) experienced greater health-related quality of life than those who did not.

Despite the obvious benefits of healthy eating and physical activity on blood pressure control, hypertensive patients' adherence to dietary and physical activity guidelines remains inadequate. Kim & Kong (2015) found that only about 15% of hypertensive Korean patients adhered to a recommended diet and only approximately 40% of them engaged in regular physical activity (Kim & Kong, 2015). In a qualitative study conducted in Nepal (Shrestha et al., 2018), hypertensive patients reported having difficulties engaging in or maintaining recommended physical activity, generally because they experienced fewer symptoms and thus perceived a lower risk of cardiovascular disease. Moreover, lacking support from family, a physician, workplace, or other social networks was identified as one of the significant barriers in managing and sustaining a healthy lifestyle (Gebrezgi et al., 2017). Finally, hypertensive patients' lack of belief in themselves to engage and sustain lifestyle change behaviors when faced with difficulties (i.e., time constraints) is also an important psychosocial barrier (Bhandari et al., 2021). Thus, to improve hypertensive patients' blood pressure control, a comprehensive understanding of the psychosocial influences on adherence to dietary and physical activity recommendations is crucial.

One theory that highlights the significant role of psychosocial factors on behavior is Social Cognitive Theory (Bandura, 1987). Within Social Cognitive Theory, self-efficacy and outcome expectancies are the major constructs and have been found to significantly contribute both directly and indirectly to maintaining healthy behaviors (Bandura, 1987). In addition to self-efficacy, Social Cognitive Theory identifies considers social support as an important determinant

in sustaining behavioral change that can, which is highly predictive of individuals' health behaviors (Bandura, 1987). Therefore, this integrative review selected and explored these three plausible psychosocial factors to understand how they may be related to hypertensive patients' adherence to dietary and physical activity recommendations in hypertensive patients.

Self-efficacy refers to an individual's beliefs about their capacity to execute necessary steps to produce desired health outcomes (Bandura, 1987). Individuals with higher self-efficacy have a greater capability to engage in targeted behavior when facing barriers than those with lower self-efficacy. Further, self-efficacy is hypothesized to be reciprocally associated with health behaviors, such as physical activity, through environmental factors and social support (Bandura, 1987). For instance, a qualitative study revealed that emotional and structural support from family were essential factors that helped hypertensive patients gain confidence to overcome HTN self-management behavior barriers, such as physical activity and dietary adherence (Rimando, 2015). Thus, when faced with behavioral barriers, the individuals' perceived social support may help them to engage in and sustain beneficial lifestyle behaviors (i.e., physical activity) with increased confidence or conviction in their abilities (Bandura, 1987).

Social support refers to the assistance or information that individuals receive from others, such as family or peers (Uchino et al., 2018). Social support has two dimensions: (a) structural social support, which consists of the number and types of connections within an individual's social network, and (b) functional social support, which includes emotional, informational, and instrumental support from family, peers, or others (Cohen & McKay, 2020). Functional and structural support may derive from an individual's home, workplace, and other social networks. Workplace structural social support, for example, refers to the degree to which employees believe their well-being is valued by their employers or coworkers, which can subsequently

promote physical and emotional health in their workplaces (Laing & Jones, 2016). Moreover, Bahari et al. (2019) confirmed that self-efficacy mediates the relationship between familial social support and self-care behavior, including physical activity, among 158 Saudi Arabian men with HTN (Bahari et al., 2019). According to Bandura (2004), social support is an external factor that provides opportunities for friends, family, and/or community members (or organizations) to support individuals' behavior (Bandura, 2004).

Outcome expectancy is another cognitive factor that can directly influence lifestyle behaviors (Bandura, 1987). Outcome expectancy refers to a persons' belief in the likelihood that a behavior (e.g., low-sodium/low-fat diet and regular physical activity) would lead to a desired outcome, such as controlled blood pressure and/or fewer adverse effects (Bandura, 2004). For instance, individuals' desire to sustain healthy lifestyles can be rooted in their visualization of positive outcomes, such as improving blood pressure control or reducing cardiovascular risks (Liu et al., 2020). Conversely, expectations of negative burdens associated with behavioral changes, such as increased expenses, inconvenience, or effort, may have an adverse effect on adherence to healthy lifestyles (Bandura, 2004; Resnick et al., 2000).

Although many existing literature reviews have investigated dietary adherence and/or physical activity in hypertensive patients (Filippou et al., 2020; Lee et al., 2015; Nissensohn et al., 2016; Pescatello et al., 2019; Rossi et al., 2012; Semlitsch et al., 2013; Siervo et al., 2015), most of these reviews focused on the effect of dietary adherence or physical activity on blood pressure control (Filippou et al., 2020; Lee et al., 2015; Nissensohn et al., 2016; Semlitsch et al., 2013; Siervo et al., 2015) or other cardiovascular health outcomes (Pescatello et al., 2019; Rossi et al., 2012). To the best of our knowledge, no comprehensive review has been conducted to understand whether these three psychosocial factors are associated with hypertensive patients'

adherence to dietary and/or physical activity recommendations. Given the established importance of dietary adherence and physical activity in controlling blood pressure and improving cardiovascular health, understanding psychological factors related to dietary adherence and physical activity is necessary for promoting and/or sustaining lifestyle behavioral changes.

The purpose of this integrative review was to examine the relationships of three psychosocial factors (self-efficacy, outcome expectancies, and social support) with adherence to dietary recommendations and physical activity in hypertensive patients. The potential confounders (age, sex, racial background, country of origin, and socioeconomic status) were also evaluated. The findings of this integrative review can be utilized to design an effective intervention program for hypertensive patients. A future intervention may target relevant psychosocial factors to improve adherence to dietary and physical activity recommendations, which would have a positive impact on patients' blood pressure control.

Methods

Study Design

This integrative review was guided by the Whittemore & Knafl (2005) methodology, which includes five stages: 1) defining the target population and problem; 2) literature search; 3) data evaluation; 4) data analysis; and 5) data presentation. This methodology allows for the inclusion of a variety of study designs (quantitative and qualitative) and increases the generalizability of findings (Whittemore & Knafl, 2005). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was used to report guide steer this review.

Search Strategies

Four electronic databases recommended by a university health science librarian — Scopus, CINAHL, Web of Science, and PubMed—were recommended by a university health science librarian to search for relevant published studies. The following keywords (developed by the first author with professional guidance from the university health science librarian) were used for the search: (a) "healthy lifestyle," "healthy behavior," "healthy behaviors," "lifestyle modifications," "healthy diet," "exercise," "physical activity," "physical fitness," AND (b) "self-efficacy," "social support," "outcome expectation," "outcome expectations," "outcomes expectancy," "outcomes expectancies," AND (c) "high blood pressure," "elevated blood pressure," "hypertens*." The search was restricted to articles published between 1997 and 2021 because the first guidelines emphasizing the importance of lifestyle modification to prevent high blood pressure were published in 1997 (The sixth report of the Joint National Committee prevention detection evaluation and treatment of high blood pressure, 1997). We also performed handsearching from reference lists to maximize our capability to obtain additional relevant articles.

Study Selection and Inclusion/Exclusion Criteria

The first author (WS) began by exporting all references from the four electronic databases to EndNote in order to remove duplicates. Then, the first and second author independently screened the titles and abstracts identified from the search based on the inclusion and exclusion criteria; they then performed in-depth full-text reviews. Published articles were included in this review if: (a) the article primarily targeted hypertensive patients above age 18 years; (b) the article examined the relationship between psychosocial factors (i.e., self-efficacy, outcome expectancies, or social support) and physical activity and/or dietary adherence; (c) the

article was a peer-reviewed paper; and (d) the article was original research. Articles were excluded if they were not in English [due to the excessive cost associated with translation (Arksey & O'Malley, 2005)], were review studies, or focused on other chronic illnesses (i.e., diabetes or other cardiovascular diseases). The screening disagreements were discussed until consensus was reached.

Data Extraction

The first author developed a data extraction form based on the study purpose and then extracted the data. The form was employed to present each study's data in a table as follows: (a) author(s) and year of publication; (b) study design and country; (c) theory guiding study; (d) study population: sample size and characteristics of subjects; (e) psychosocial factors examined; (f) outcome variable(s); (g) key findings; and (h) quality score. The second author independently verified the accuracy of the extracted data. Discrepancies were discussed until mutual agreement was reached.

Quality Appraisal

The quality of each eligible study was evaluated using the Alberta Heritage Foundation of Medical Research's standard quality-assessment criteria (Kmet et al., 2004). This tool comprised of 14 quantitative and 10 qualitative study evaluation criteria was used. Each criterion was scored from 0 points (no) to 2 (yes), with Total Sum ranging from 0 to 20 points for qualitative studies and 28 points for quantitative studies. A quality score was obtained by dividing the Total Sum by Total Possible Sum and is recommended to be higher than 0.55 to ensure adequate quality in reviewed articles. The first and second authors independently rated the quality of each eligible study and then discussed their scores until consensus was reached. If consensus could not be reached between the two authors, then two of the authors rated a study

with different quality scores, the third author would be contacted also required to evaluate the quality of those studies and resolve the discrepancies. However, no significant differences in the quality scores of the included studies occurred between the first two authors in the quality scores of included studies were observed between the first two authors.

Synthesis of Findings

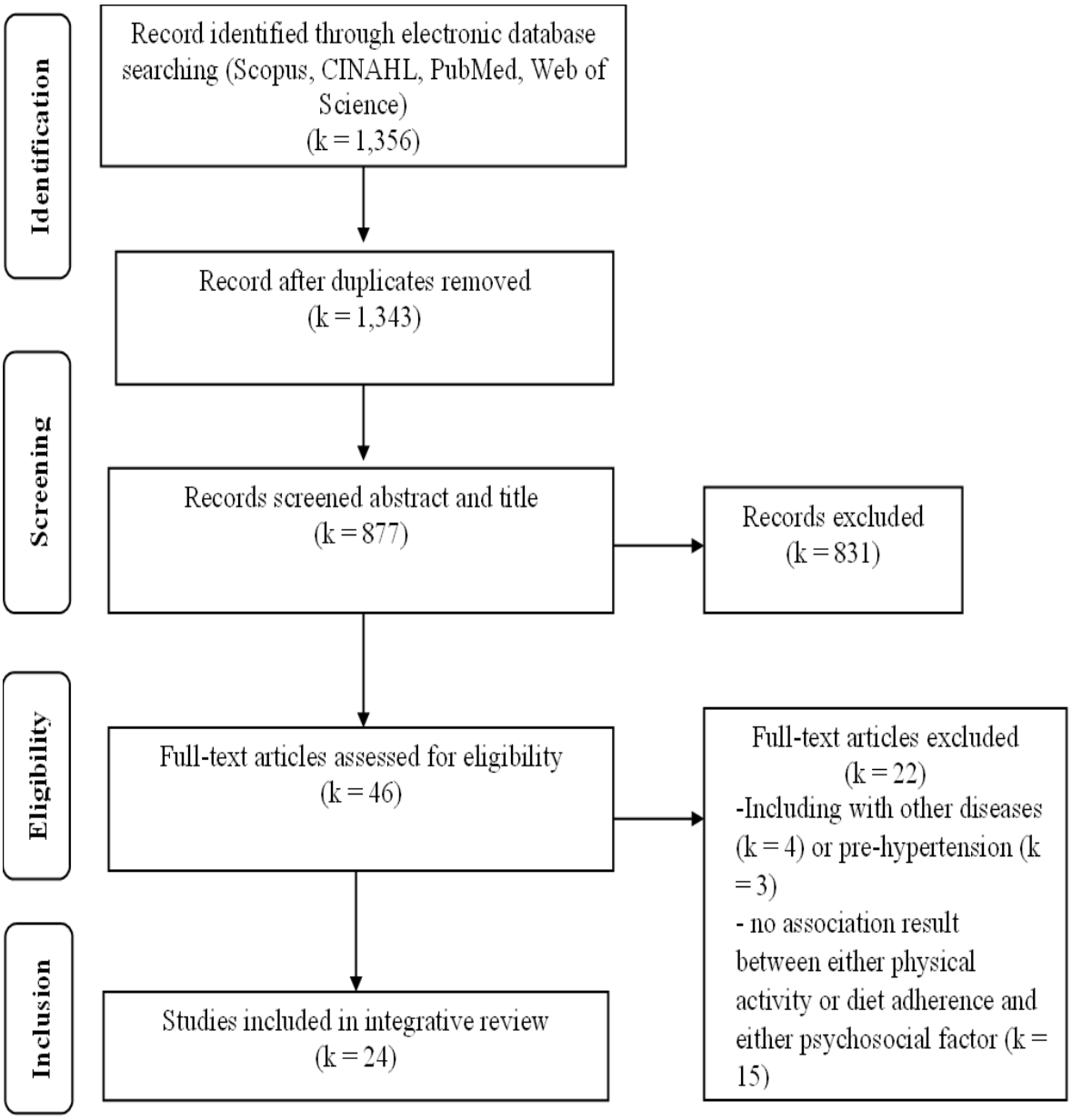
All outcomes were synthesized in a narrative format. Two reviewers (W. S. and T. A. K.) performed the synthesis of the findings and then discussed the results to achieve consensus. Further, we grouped the strength association between the three psychosocial factors and outcomes into three groups representing specific effect sizes. The *Psychometrica* online effect size calculator (https://www.psychometrica.de/effect size.html) was used to transform the different effect sizes such as Cohen's d and Odds Ratio into *r* correlation coefficients (*r*) for easy comparison (Lenhard, 2016). A correlation coefficient (*r*) of 0.10 is considered small, 0.30 is considered moderate, and 0.50 is considered large (Cohen, 1988).

Results

Figure 2.1 illustrates the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. A total of 1,356 studies were identified. After removing duplicates, 1,343 remained for title and abstract screening. After applying inclusion criteria, 46 articles were retrieved for in-depth review. The full-text appraisal focused on exploring the association between the psychosocial factors (i.e., self-efficacy, social support, outcome expectancies) and the recommended lifestyle behaviors (i.e., regular physical activity and/or dietary adherence) of hypertensive patients. An additional 22 studies were excluded for not addressing variables associated with the objective of this review. A total of 24 studies were included in this integrative review. The quality scores of the included 24 articles ranged from

0.63 to 1.00 (see Table 2.1). No study was excluded due to having a low-quality score (<0.55) (Kmet et al., 2004).

Figure 2.1: PRISMA flow diagram of the article selection process



Study Characteristics

Of the 24 reviewed articles, about 25% were conducted in the United States (k = 6); followed by Iran (*k* = 4, 16%); China (*k* = 4, 16%); Korea (*k* = 2, 8%); and Ethiopia, Germany,

Indonesia, the Netherlands, Nigeria, Saudi Arabia, South Africa, and Taiwan (k = 1 per country). Most of the studies were quantitative (k = 22, 92%), with 19 cross-sectional (79%), two longitudinal (8%), one randomized controlled trial, and two qualitative studies (8%). The sample sizes ranged from 11 (Kirkendoll et al., 2010) to 671 (Kamran et al., 2015). The hypertensive patients' ages ranged from 18 to 88 years, with a mean age of 55.64; about 67.97% of participants were female. Nearly half of the studies (k = 10; 42%) focused on older adults (M_{age} >60 year) (Adiyasa & Cruz, 2020; Gee, 2005; Hu et al., 2015; Kim et al., 2020; Larki et al., 2018; Lee et al., 2007; Lee & Laffrey, 2006; Sol et al., 2011; Xie et al., 2020; Yan et al., 2012). About 21% of the selected studies (k = 5) recruited included African Americans (Gee, 2005; Kang et al., 2020; Kirkendoll et al., 2010; Mansyur et al., 2013; Warren-Findlow et al., 2012). The duration of HTN diagnosis ranged from 1 month (Xie et al., 2020) to 16 years (Ma, 2018). The most utilized theoretical framework was Self-Efficacy Theory (k = 6, 26%). The most examined psychosocial construct was self-efficacy (k = 22, 92%), followed by social support (k = 9, 36%) and outcome expectancies (k = 3, 16%). About 39% of the studies (k = 9) did not disclose any theoretical framework. Study outcomes included regular physical activity only (k = 17, 71%), dietary adherence alone (k = 10, 42%), and adherence to both dietary and PA recommendations together (k = 5, 21%).

Assessed Domains of Psychosocial Factors

The individuals' adherence to dietary or physical activity recommendations was influenced by various aspects of self-efficacy, social support, and outcome expectancies (see Table 2.2). In this review, the following six domains of self-efficacy were found to be relevant to hypertensive patients' adherence to dietary or physical activity general self-efficacy, dietary adherence self-efficacy, managing hypertension self-efficacy, self-management self-efficacy,

physical activity self-efficacy, and self-care behaviors self-efficacy. Among 22 studies exploring the relationship of self-efficacy, the most frequently examined domain was physical activity self-efficacy (k = 8, 36%), followed by self-management self-efficacy (k = 5, 23%), and general self-efficacy (k = 4, 18%).

Two domains of social support were operationalized, including functional and structural support. Of the nine studies investigating the contribution of social support, about 78% (k = 7) operationalized it as functional support from family alone (k = 3) or family and peer support together (k = 4), while two studies defined it as structural support from the family structure, such as marital status and the number of family members (Andualem et al., 2020; Hu et al., 2015). No study investigated structural support derived from the individuals' workplaces, communities, or other social networks.

Positive outcome expectancy was examined in three cross-sectional studies (Gee, 2005; Mohammadi et al., 2021; Wienert et al., 2017); one of them also investigated the potential influence of negative outcome expectancy (Wienert et al., 2017). No qualitative study was found that provided an in-depth understanding about how hypertensive patients' adherence to dietary and physical activity recommendations may be influenced by their perceived positive or negative outcome expectancies.

Dietary Adherence Outcome

Hypertensive patients' dietary adherence was operationalized as a low-sodium/low-fat diet (k = 5, 50%) and a low-sodium diet alone (k = 5, 50%).

Low-Sodium/Low-Fat Diet

Of the five studies that examined a low-sodium/low-fat diet, four were cross-sectional studies and one was a longitudinal study. Among the four cross-sectional studies, self-efficacy

was found to have a moderate- (r = 0.36; conducted in Korea) (Shim et al., 2020) to-strong (r = 0.79; conducted in the United States) (Kang et al., 2020) relationship with a low-sodium/low-fat diet. However, in two cross-sectional studies that were conducted in China (Ma, 2018; Xie et al., 2020), the contribution of self-management and general self-efficacy was not significant. On the other hand, in a longitudinal study conducted in the Netherlands, self-management self-efficacy was moderately associated with a low-sodium/low-fat diet (r = 0.46) (Sol et al., 2011).

It is probable that younger hypertensive patients may have different psychosocial needs. In a cross-sectional study with relatively younger U.S. hypertensive patients (M_{age} = 47.62; n = 571), increased functional support from their family was only weakly related to adherence to a low-sodium/low-fat diet (r = 0.27) (Kang et al., 2020). To our knowledge, no study has examined the contribution of other types of network/structural support or outcome expectancies to adherence to a low-sodium/low-fat diet.

Low-Sodium Diet

Of the five studies investigating adherence to a low-sodium diet, four were cross-sectional and one had a longitudinal design. Among the four cross-sectional studies, two studies reported a weak relationship with self-care self-efficacy [r = 0.06; conducted in Iran] (Larki et al., 2018) and self-management self-efficacy [r = 0.14; conducted in the United States] (Warren-Findlow et al., 2012). However, another cross-sectional study conducted in Iran found a strong correlation with general self-efficacy (r = 0.76) (Kamran et al., 2015).

In a cross-sectional study conducted in China (n = 318), no significant association was noted between self-management self-efficacy and a low-sodium dietary adherence (Hu et al., 2015). Similarly, in a four-year longitudinal study conducted in the United States, although the association between physical activity self-efficacy and low-sodium dietary adherence was

clinically significant, it did not reach the level of statistical significance ($p = 0.06$, $n = 185$) (Mansyur et al., 2013).

Hu et al. (2015) found that the number of supportive family numbers (as a proxy for structural support) was not significantly associated with low-sodium dietary adherence among Chinese hypertensive patients (Hu et al., 2015). No studies, thus far, have examined the contribution of outcome expectancies to low-sodium dietary adherence in hypertensive adults.

Physical Activity Outcome

Among 17 studies assessing hypertensive patients' regular physical activity, moderate-to-vigorous physical activity ($k = 9$, 53%) and light-intensity physical activity ($k = 6$, 35%) were the most frequently selected outcomes.

Moderate-to-Vigorous Physical Activity

Seven of nine studies (78%) showed a significant relationship between self-efficacy and moderate-to-vigorous physical activity, the latter of which was self-reported in all studies. Six of the seven were cross-sectional and found a weak-to-moderate relationship with self-efficacy (r = 0.07–0.46) (Daniali et al., 2017; Idowu et al., 2012; Lee & Laffrey, 2006; Mohammadi et al., 2021; Wienert et al., 2017; Yan et al., 2012). Physical activity self-efficacy had a stronger association with moderate-to-vigorous physical activity (r = 0.384–0.46) (Idowu et al., 2012; Lee & Laffrey, 2006; Mohammadi et al., 2021) when compared to self-management self-efficacy (r = 0.07 to .33) (Daniali et al., 2017; Sol et al., 2011; Warren-Findlow et al., 2012). Also, in a longitudinal study conducted in the Netherlands, self-reported moderate-to-vigorous physical activity was moderately predicted by self-management self-efficacy in 125 hypertensive patients aged 50 to 70 years ($r = 0.33$) (Sol et al., 2011).

Regarding the association with functional social support, small-to-large associations were noted in three cross-sectional studies regardless of age, sex, or country of origin (Daniali et al., 2017; Idowu et al., 2012; Yan et al., 2012). It is important to note that having functional support from both family and peers was associated with greater moderate-to-vigorous physical activity (r = 0.83, p <0.01) (Idowu et al., 2012), compared to having functional support from family alone (r = 0.09–0.213) (Daniali et al., 2017; Yan et al., 2012). No study examined the contribution of structural support to moderate-to-vigorous physical activity.

Concerning patients' beliefs about the beneficial outcomes an individual would derive from physical activity, positive outcome expectancy was significantly correlated with moderate-to-vigorous physical activity (r = 0.25) (Mohammadi et al., 2021), particularly for hypertensive patients younger than 55 years. On the other hand, for those who endorsed negative consequences, their moderate-to-vigorous physical activity was relatively low (r = -0.23) (Wienert et al., 2017). In a U.S. study with older adults (aged >60 years, n = 99), the association between positive outcome expectancies and moderate-to-vigorous physical activity was not significant (p = 0.256) (Gee, 2005).

Light-Intensity Physical Activity

Three of six studies (50%) found a positive relationship between self-efficacy and light-intensity physical activity. In one cross-sectional study involving older hypertensive patients (M_{age} >55 years), a weak relationship between self-efficacy and light-intensity physical activity (r = 0.02; p <0.05) (Larki et al., 2018) was reported; whereas in another cross-sectional study with young hypertensive adults (M_{age} <50 years), the association was at a moderate level (r = 0.31; p <0.01) (Ma, 2018). In contrast, a nonsignificant association between older hypertensive patients' general self-efficacy and light-intensity physical activity was reported in cross-sectional studies

conducted in the United States (n = 99, M_{age} = 70.9 years) (Gee, 2005) and in China (n = 318, M_{age} = 62.9 years) (Hu et al., 2015). However, in a 24-week intervention program designed to improve older U.S. hypertensive patients' physical activity self-efficacy (M_{age} = 71.3 years), patients in the experimental group had significant increases in physical activity self-efficacy and light-intensity physical activity, compared to those in the control group (p <0.001) (Lee et al., 2007).

Interestingly, in a U.S. longitudinal study with relatively younger hypertensive patients (M_{age} = 53.9 years), increased physical activity self-efficacy predicted increased light-intensity physical activity, but the association was not statistically significant (p = 0.06) (Mansyur et al., 2013). Regarding functional support, two cross-sectional studies demonstrated that light-intensity physical activity was not significantly associated with family or peer support ([r = 0.01; p >0.05] (Gee, 2005), [r = 0.06; p >0.05] (Hu et al., 2015)). Finally, no study examined the relationship between structural support (or outcome expectancies) and light-intensity physical activity.

Adherence to Dietary and Physical Activity Recommendations

Of the studies reviewed, five used hypertensive adults' adherence to physical activity and dietary recommendations together as the outcome. Four of these studies were cross-sectional (Adiyasa & Cruz, 2020; Andualem et al., 2020; Bahari et al., 2019; Kim et al., 2020), and one was qualitative (Kirkendoll et al., 2010). In the four cross-sectional studies, physical activity/dietary adherence had a moderate-to-high correlation with self-efficacy regardless of the domain assessed (r = 0.34–0.681) (Adiyasa & Cruz, 2020; Andualem et al., 2020; Bahari et al., 2019; Kim et al., 2020). Moreover, physical activity/dietary adherence was moderately associated with family and peers' functional support (r = 0.353, p <0.05) (Bahari et al., 2019).

Similarly, in a focus group study conducted in the United States (Kirkendoll et al., 2010), about 20% of hypertensive participants attributed their success in making healthier lifestyle changes to the significant functional support (positive encouragement) they had received from their family members and peers.

Finally, structural support derived from the family system (using marital status as proxy) was significantly correlated to physical activity/dietary adherence in a study conducted in Ethiopia (r = 0.35) (Andualem et al., 2020). None of the studies investigated the contribution of outcome expectancies to physical activity/dietary adherence.

Discussion

To the best of our knowledge, this integrative review is the first to examine the relationship between each of these three psychosocial factors and hypertensive adults' diet and/or physical activity. The primary results of this review verified the significant role of self-efficacy in helping patients adhere to dietary and physical activity recommendations. However, the contributions of social support and outcome expectancies remained obscure or inconsistent, particularly for younger hypertensive adults. With the increased prevalence of obesity in the US, many young and middle-aged adults were diagnosed with HTN at younger ages. Currently, the prevalence of HTN in U.S. adults aged 18 to 39 years and 40 to 59 years was estimated to be 22.4% and 54.5%, respectively (Ostchega et al., 2020). For those with HTN diagnosis at younger ages, their risks for cardiovascular disease and all-cause mortality are significantly higher (Chen et al., 2019). For this reason, enhancing understanding about psychosocial influences on younger hypertensive adults' adherence to physical activity and dietary recommendations is essential to minimize hypertensive-related comorbidities and mortality.

Consistent with clinical guidelines, dietary adherence was operationalized in this review as adherence to a low-sodium/low-fat diet or a low-sodium diet alone. However, in the context of a healthy diet, different types of dietary regimens may play different roles in health outcomes, especially blood pressure control. For example, a low-sodium/low-fat diet for hypertensive patients has often resulted in much lower systolic and/or diastolic blood pressure (National Institutes of Health, 2021), compared to adherence to a low-sodium diet alone (mean decreases 5.3–20.8 mmHg vs. 3.20–7.04 mmHg, respectively) (Juraschek et al., 2017).

Following the recommended guidelines, regular physical activity in this review was assessed either by moderate-to-vigorous or low-intensity physical activity. The existing global physical activity guidelines suggest that adults with HTN should perform at least 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity physical activity per week to achieve blood pressure control (James et al., 2014; Whelton et al., 2018). Only one study conducted in Iran reported that adults with HTN were achieving this recommended amount by engaging in 253.25 minutes and 305.95 minutes per week of moderate and vigorous-intensity physical activity, respectively (Mohammadi et al., 2021). A recent systematic review and meta-analysis suggested that consistently engaging in moderate-intensity physical activity interventions (≥150 minutes/week) could lower hypertensive adults' resting systolic and diastolic blood pressure by 5.8 and 3.5 mmHg, respectively (Costa et al., 2018). It is important to note that blood pressure was not significantly different from engaging in either moderate- or vigorous-intensity physical activity (Costa et al., 2018).

In a systematic review and meta-analysis targeting middle-aged non-hypertensive women, light-intensity physical activity did lower their systolic blood pressure, but the changes were not statistically significant (pooled mean difference = -1.15; $p = 0.19$) (Park & Kim, 2021).

Although the benefit of light-intensity physical activity for hypertensive adults is not yet clear, it is important to note that light-intensity physical activity is consistently associated with a decrease in all-cause mortality by 29% in healthy adults when compared to those who did not engage in this behavior (pooled *HR* = 0.71; 95% *CI* = 0.62–0.83) (Chastin et al., 2019). For this reason, future studies should aim to understand psychosocial influences on hypertensive adults' light-intensity physical activity, since it might serve as a gateway to engaging in moderate- or vigorous-intensity physical activity.

Our integrative review findings clearly support the contribution of self-efficacy to moderate-to-vigorous physical activity or light-intensity physical activity, regardless of age or race. This contribution is not surprising because according to Social Cognitive Theory, self-efficacy is a cognitive factor that can directly influence physical activity behavior (Bandura, 1998) and indirectly affect physical activity change through goal setting and attainment (Schunk, 1984). For example, perceived self-efficacy and outcome expectancies could be operationalized through cognitive processes (setting/achieving/sustaining their goals in physical activity) and help hypertensive patients improve their blood pressure control (Mbambo et al., 2019). A positive contribution of self-efficacy to the adherence to a low-sodium/low-fat diet was well-supported (Kang et al., 2020; Shim et al., 2020; Sol et al., 2011), but the magnitude of the association varied depending on hypertensive patients' cultural background, as noted by results reported in which general self-efficacy or self-management self-efficacy were not significantly associated with Chinese patients' dietary adherence (Ma, 2018; Xie et al., 2020).

Although this review confirms a small-to-moderate effect on the relationship between self-efficacy and adherence to dietary or physical activity recommendations, the effects of outcome expectancies and social support on dietary adherence are still limited, particularly

among younger hypertensive adults. This knowledge gap may lead to a missed opportunity to effectively implement goal setting/attainment strategies with younger hypertensive adults. Understanding the mechanism by which these psychosocial factors influence young hypertensive adults' adherence to a low-sodium/low-fat diet is critical, given the established importance of dietary behaviors for blood pressure control.

It is important to note that there are limited studies available to verify longitudinal associations or establish causal relationships, particularly for low-income, racial and ethnic minority hypertensive adults. Several studies have demonstrated that the high cost of healthy food limits access to healthier food choices for low-income families in the United States (Dave et al., 2017; Jones et al., 2014 ; Wolfson et al., 2019). Therefore, it is possible that socioeconomic status may present a critical barrier/confounder for hypertensive patients to engage in or sustain healthy lifestyles over time. To improve blood pressure control among hypertensive patients who are racial and ethnic minorities, more studies are needed to explore how their unique psychosocial factors could play an important role on their lifestyle behaviors.

In terms of the influence of social support on hypertensive patients' physical activity, a substantial relationship with a large effect was observed. However, a small percentage of studies (k = 9), found it challenging to comprehensively understand the association between social support and adherence to physical activity and dietary recommendations. The literature suggested two essential dimensions of social support (Cohen & McKay, 2020). In this integrative review, functional support was shown to have a positive impact on hypertensive patients' recommended behaviors. In fact, functional support from multiple sources in patients' social network, including family and peers, had a greater relationship with physical activity (particularly for moderate-to-vigorous physical activity) than from familial relationships alone.

This finding is consistent with the findings of a systematic review with 20 prospective studies, in which various sources of social support were noted to promote healthy adults' physical activity (Scarapicchia et al., 2017).

In this review, a beneficial relationship between functional social support and adherence to a physical activity and/or dietary recommendation was supported. The contribution of social support to physical activity, however, appeared to depend on the type of physical activity investigated. Moderate-to-vigorous physical activity (but not light-intensity physical activity) was strongly correlated with functional support derived from family and peers, regardless of age, sex, or race. A possible explanation for the nonsignificant finding for light-intensity physical activity may be due to the study's relatively small sample size (n = 99) (Gee, 2005). The power of a study is its capacity to detect an effect when it exists; therefore, a low study power may diminish the possibility that a statistically significant discovery represents a true effect (Faber & Fonseca, 2014). Furthermore, a self-reported measure may have limited validity because respondents may have difficulties recalling trivial daily activities (e.g., housekeeping chores or movements) that should be counted as light-intensity physical activity (Khare & Vedel, 2019).

The potential contribution of structural support on young hypertensive adults' healthy lifestyle is clearly understudied. This problem underscores an important knowledge gap. Young hypertensive adults may perceive positive outcomes and a sufficient ability to implement recommended behaviors but may fail to do so as a result of excessive time- or role-related constraints (Pelletier & Laska, 2012). In order for younger adults to adhere to dietary and physical activity recommendations, it is important to consider their unique psychosocial needs and provide necessary structural support. Young hypertensive adults may struggle with various role-related obligations and simultaneously serve as a breadwinner, parent, and/or caregiver to

elderly parents. In fact, literature has suggested that working long hours (>40 hours/week) is related to increased consumption of fast foods (Pelletier & Laska, 2012) and a sedentary lifestyle (Saidj et al., 2014). To this end, it is possible that structural and functional support from multiple social networks, such as family, peers, communities, and workplaces, may enable younger hypertensive patients to engage in healthier lifestyles and cope with immense role-related challenges and stress. For instance, the literature has suggested that different social support sources have different influences on stress and coping strategies in youth (Watson et al., 2019) and adults (Li et al., 2021).

Although there were relatively few studies examining the effect of positive outcome expectancies on hypertensive patients' lifestyle behaviors, a positive association with moderate-to-vigorous physical activity was observed, particularly in hypertensive patients younger than 55 years. Although this association was not observed in older hypertensive patients (>60 years), the above finding is promising for understanding younger hypertensive adults' psychosocial needs. It is possible that hypertensive patients' age may be a confounding factor for their physical activity, particularly through the lens of outcome expectancies. In fact, Spiteri et al. (2019) found that it was difficult to persuade older adults to participate in physical activity because of increased concerns about safety from age-related frailty (Spiteri et al., 2019). Furthermore, because of the increasing likelihood of chronic health problems, older hypertensive patients face greater hurdles for engaging in physical activity (compared to younger hypertensive adults) because their concerns may be different (Schutzer & Graves, 2004). An in-depth understanding of young hypertensive adults' needs for structural and functional support is needed given the high demands of their employment.

Some methodological issues limit the findings of this integrative review. First, the majority of included studies were cross-sectional, which limited the ability to draw a causal relationship. Second, most of the outcomes were evaluated using self-report measures, which have low measurement validity compared to objective measures (Baker et al., 2004). Third, variations in study sample size, as well as a very wide age range of participants, may have an impact on the validity of study findings. In addition, only English language articles published after 1997 were included, about 21% of studies were conducted with a racial minority population (African American), and nearly half of the studies focused on older hypertensive participants (>60 years). As a result, the findings may not be generalizable to younger hypertensive adults or other racial and ethnic minority populations. Moreover, compared to older adults with HTN, young- and middle-aged adults with high blood pressure are less aware of their chronic conditions and less likely to adhere to healthy lifestyle recommendations (Zhang & Moran, 2017). Thus, it is critical to gain sufficient understanding about psychosocial influences on these young adults' lifestyle behaviors as a means of mitigating HTN-related comorbidities and mortality.

By manipulating these three psychosocial factors, health care professionals could assist hypertensive patients in maintaining and sustaining healthy lifestyle behaviors. Health care providers may need to target, develop and implement lifestyle interventions that integrate the four sources used to build self-efficacy skills, as described by Bandura (1987). For example, a cognitive-behavioral intervention that integrates education, social modeling, verbal persuasion, and skill building may lead to improvements in patients' lifestyle behaviors and ultimately help them to achieve blood pressure control. Health care providers can also encourage their hypertensive patients to identify the goals and objectives that will assist them in achieving

healthy lifestyle behaviors that can result in blood pressure control. Further, health care providers should provide informational support to hypertensive patients on healthy lifestyle behaviors that can achieve blood pressure control during clinical visits or identify a caregiver, or key persons, to assist them in sustaining their healthy lifestyle behaviors at home over time.

In conclusion, it is evident that hypertensive patients' self-efficacy in various domains plays a significant role in their adherence to physical activity and dietary recommendations. Although the influence of outcome expectancies and social support on adherence to physical activity and dietary recommendations is promising, studies of various aspects of outcome expectancies and social support are still limited. Further research is needed to identify and expand the findings of this integrative review to continue to reduce the of these gaps in knowledge. For example, more effort is needed to on investigating how outcome expectancies and social support can be further operationalized to sustain hypertensive patients' adherence to dietary and physical activity recommendations over time, particularly for younger hypertensive adults. In particular, additional work is needed to delineate the effect of structural and functional support on sustainability of lifestyle behaviors in hypertensive patients. Despite the promising effects of a low-sodium/low-fat diet and moderate-to-vigorous physical activity on blood pressure control, further studies are warranted to understand how to utilize these psychosocial factors and promote adherence to these behavioral recommendations over time. Finally, understanding the contributions of structural supports in workplaces may result in workplace health policy changes and subsequently promote healthier lifestyles among younger hypertensive adults.

Table 2.1: Detail of studies characteristic in this review (n = 24)

Study	Design/ Country	Theory	Population	Outcome Variable (s)	Quality Score
Adiyasa et al. (2020)	Cross-sectional, Indonesia	Self-Efficacy	n = 120, age 40 – > 60 years (M_{age} = 61.3), 23.3% male, Dx > 3 months	DA+PA	0.63
Andualem et al. (2020)	Cross-sectional, Ethiopia	No theory guided (SE and FS)	n = 301, age >18 years (M_{age} = 51.1), 51.2% male, Dx > 6 months	↓Na/↓Fat diet +PA	0.92
Bahari et al. (2019)	Cross-sectional, Saudi Arabia	Self-Efficacy	n = 158, age 24–86 years (M_{age} = 54.3), 100 % male, 12.0% Dx < 1 year	↓Na diet +PA	0.71
Daniali et al. (2017)	Cross-sectional, Iran	No theory guided (SE and SS)	n = 359, age 30–76 years (M_{age} = 55.15), 14.7% male, Dx > 6 months	MVPA	0.72
Gee (2005)	Cross-sectional, U.S.	Social Cognitive Theory	n = 99, age 60–85 years (M_{age} = 70.19), 16.7% male, 94.9% Caucasian; 5.1% African American	LPA	0.92
Hu et al. (2015)	Cross-sectional, China	Not theory-guided (SE, FS, depression, anxiety)	n = 318, age > 35 years (M_{age} = 62.9), 29.3% male, Dx > 1 year (M = 8.2)	↓Na diet LPA	0.90
Idowu et al. (2012)	Cross-sectional, Nigeria	No theory guided (SE, SS and perceived barriers)	n = 212, 81.13% age < 60 years, 40.1% male, Dx > 6 months (M = 7.65 years)	MVPA	0.80
Kamran et al. (2015)	Cross-sectional, Iran	Health Belief Model	n = 671, age 30–80 years (M_{age} = 50.2), 25.2% male, Dx > 1 year (M = 5.9)	↓Na diet	0.90
Kang et al. (2020)	Cross-sectional, U.S.	Social Cognitive Theory	n = 571, age 35–60 years (M_{age} = 47.62), 100% female, 67% African American	↓Na+↓Fat diet MVPA	0.91

Table 2.1 (cont'd)

Study	Design/ Country	Theory	Population	Outcome Variable (s)	Quality Score
Kim et al. (2020)	Cross-sectional, Korea	No theory guided (SE, emotional states)	*n* = 208, 100% female, age 65–85 years (M_{age}= 75.7)	↓Na diet+ PA	0.74
Kirkendoll et al. (2010)	Qualitative study, U.S.	No theory guided	*n* = 11, age 26–64 years (M_{age} = 51), 27% male, 100% African American, 18.18% *Dx* ≤ 6 months	DA + PA	0.93
Larki et al. (2018)	Cross-sectional, Iran	Health Belief Model	*n* =152, age 35–80 years (M_{age} = 56.87), 27.6% male, *Dx* > 6 months (*M* = 9.46)	↓Na diet LPA	0.86
Lee et al. (2006)	Cross-sectional, U.S.	Cox's Interaction Model of Client Health Behavior	*n* = 316, age 60–75 years (M_{age} = 69.04), 31.5% male	MVPA	0.92
Lee et al. (2007)	RCT, Taiwan	Self-Efficacy	<u>intervention gr.</u> *n* = 102 (M_{age} = 71.3; 62.7% male) <u>control gr.</u> *n* = 100 (M_{age}= 71.3; 54.0% male)	LPA	1.00
Ma (2018)	Cross-sectional, China	Health Belief Model	*n* = 382, age 23–59 years (M_{age} = 48.37), 57.8% male, *Dx* 4 months–16 years (*M* = 3.78)	↓Na+↓Fat diet LPA	0.77
Magobe et al. (2017)	Qualitative study, South Africa	No theory guided (SE)	*n* = 44, age 41–80 years, *Dx* 1–10 years	PA	0.68
Mansyur et al. (2013)	Longitudinal, U.S.	Self-Efficacy	*n* = 185, age 45–65 years (M_{age} = 53.9), 35.14% male, 100% African American	↓Na diet LPA	1.00
Mohammadi et al. (2021)	Cross-sectional, Iran	The Health Action Process Approach (HAPA) model.	*n* =176, age 40–60 years (M_{age} = 49.54), 46.02% male, *Dx* >1 years	MVPA	0.73

Table 2.1 (cont'd)

Study	Design/ Country	Theory	Population	Outcome Variable (s)	Quality Score
Sol et al. (2011)	Longitudinal, Netherlands	Self-Efficacy	*n* = 125, age 50–70 years (M_{age} = 61.01), 72% male	↓Na +↓Fat diet MVPA	0.93
Shim et al. (2020)	Cross-sectional, Korea	No theory guided (Knowledge, SE, perceived benefits and barriers)	*n* = 138, age 60-62 years (M_{age} = 60.7), 33.3% male, *Dx* > 1 year (*M* = 8.4)	↓Na +↓Fat diet	0.91
Warren-Findlow et al. (2012)	Cross-sectional, U.S.	Self-Efficacy	*n* = 188, age 22–88 years (M_{age} = 53.0), 28.7% male, 100% African American, *Dx* > 6 months	↓Na diet MVPA	0.95
Wienert et al. (2017)	Cross-sectional, Germany	The Health Action Process Approach (HAPA) model.	*n* = 512, age 18–86 years (M_{age} = 46.83), 28.1% male, 15.82% *Dx* < 12 months	MVPA	1.00
Xie et al. (2020)	Cross-sectional, China	No theory guided (Health attitudes and SE)	*n* = 148, age 18–64 years (M_{age} = 63.72), 59.5% male, *Dx* > 1 month (*M* = 16.60)	↓Na +↓Fat diet PA	0.72
Yan et al. (2012)	Cross-sectional, China	No theory guided (SE, FS)	*n* = 559, age 45–68 years (M_{age} = 54.6), 31.2% male, *Dx* > 1 year	MVPA	0.70

Note: SE = self-efficacy, SS = social support, FS = family support, Dx = duration of Hypertension, PA= physical activity, LPA = light-intensity physical activity, MVPA = moderate-to-vigorous physical activity, DA = diet adherence or healthy eating behavior, ↓Na = low-sodium diet, ↓Fat = low-fat diet

Table 2.2: The association between psychosocial factors and outcomes (n = 24)

Study	Outcomes			Other Findings
	DA	PA	DA+PA	
Adiyasa et al. (2020)	-	-	Moderate effect (SBSE; r = 0.397*).	-
Andualem et al. (2020)	-	-	Small effect (SMSE; r = 0.34*).	• 51.8% performed PA. • Structural support (marital status) was associated with DA + PA (r = 0.35**).
Bahari et al. (2019)	-	-	• Large effect (SBSE; r = 0.68*). • Moderate effect (FS&PS; r = 0.40*).	SBSE was correlated to FS&PS (r = 0.43*).
Daniali et al. (2017)	-	• Small effect (FS; r = 0.09*) • Moderate effect (SMSE; r = 0.33**)	-	-
Gee (2005)	-	*ns*Small effect (ESE [r = 0.18]; FS [r = -0.01]; PS [r = 0.01]; POE [r = 0.13]).	-	-
Hu et al. (2015)	*ns*Small effect (MHSE [r = 0.03]; SS [r = 0.09]).	*ns*Small effect (MHSE [r = 0.06]; FS [r = 0.06]).	-	-
Idowu et al. (2012)	-	• Moderate effect (ESE; r = 0.44**); Large effect (FS&PS; r = 0.83**).	-	-

Table 2.2 (cont'd)

Study	Outcomes			Other Findings
	DA	PA	DA+PA	
Kamran et al. (2015)	Large effect (GSE; *r* = 0.76**).	-	-	-
Kang et al. (2020)	• Small effect (FS; *r* = 0.271*). • Large effect (DASE; *r* = 0.791**).	*ns*ESE.		45% and 25% adhered DA and PA respectively.
Kim et al. (2020)	-	-	Moderate effect (SBSE; *r* = 0.514**).	• 73.1% engaged PA. • ↑Depression was associated with ↓DA+PA (*r* = -0.439**).
Kirkendoll et al. (2010)	-	-	Emotional support from family+ peers is needed.	-
Larki et al. (2018)	Small effect (SBSE; *r* = 0.06*).	Small effect (SBSE; *r* = 0.02*).	-	• 5.3% adhered DA. • 19.1% performed PA.
Lee et al. (2006)	-	Moderate effect (ESE; *r* = 0.418**).	-	-
Lee et al. (2007)	-	Intervention gr. (↑ESE) was > report LPA**.	-	-
Ma (2018)	*ns*Small effect (GSE; *r* = 0.14).	Moderate effect (GSE; *r* = 0.31**).	-	-

Table 2.2 (cont'd)

Study	Outcomes			Other Findings
	DA	PA	DA+PA	
Magobe et al. (2017)	-	• ↓PA due to ↓PA self-efficacy. • ↑PA education is needed. • ↑verbal encouragement is important to ↑PA.	-	-
Mansyur et al. (2013)	*ns*Small effect (DASE; r = -0.217)	*ns*Moderate effect (ESE; r = 0.486).	-	BMI was related to ↓LPA*.
Mohammadi et al. (2021)	-	• Small effect (POE; r = 0.25*). • Moderate effect (ESE; r = 0.46*).	-	PA intention was associated with PA (r = 0.57*).
Sol et al. (2011)	Moderate effect (SMSE; r = 0.46*).	Moderate effect (SMSE; r = 0.33*).	-	-
Shim et al. (2020)	Moderate effect (DASE; r = 0.36*).	-	-	Perceived DA barriers were associated with DA (r = -0.17*).
Warren-Findlow et al. (2012)	Small effect (SMSE; r = 0.14*).	Small effect (SMSE; r = 0.07*).	-	Age was not related with DA or PA.
Wienert et al. (2017)	-	• Small effect (NOE; r = -0.23**). • Moderate effect (GSE; r = 0.41**).	-	• ~ 60% engaged in PA. • POE was correlated with PA intention (r = 0.14**).
Xie et al. (2020)	*ns*Small effect (SMSE; r = 0.01).	Small effect (SMSE; r = 0.22*).	-	Males adhere to PA > females (*OR* = 2.04; 95% *CI* = 1.06–3.84).

Table 2.2 (cont'd)

Study	Outcomes			Other Findings
	DA	PA	DA+PA	
Yan et al. (2012)	-	• Small effect (FS; r = 0.213**). • Moderate effect (ESE; r = 0.429*).	-	-

Note: GSE = general self-efficacy, DASE = diet adherence self-efficacy, MHSE = managing hypertension self-efficacy, SESM = self-management self-efficacy, ESE = exercise/physical self-efficacy, SESB = self-care behaviors self-efficacy, FS = family support, PS = peer support**,** PA = physical activity, LPA = light-intensity physical activity, MVPA = moderate-to-vigorous physical activity, DA = diet adherence or healthy eating behavior, ↓Na = low-sodium diet, ↓Fat = low-fat diet, *p <0.05, **p <0.01, *ns* = nonsignificant

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CHAPTER 3: ADAPTATION AND PSYCHOMETRIC VALIDATION OF DIETARY ADHERENCE-RELATED PSYCHOSOCIAL MEASURES: A PILOT STUDY WITH THAI ADULTS WITH HYPERTENSION

Abstract

The association between psychosocial factors and dietary adherence in Thai young- and middle-aged adults with hypertension remains unclear due to the lack of validated assessment measures. Therefore, this cross-sectional and observational study was conducted in two stages with the following aims: 1) To adapt four psychosocial measures, including self-efficacy, outcome expectancy, social support, and workplace support, along with the Dietary Adherence Scale into Thai using the World Health Organization (2016) recommended procedures (Adaptation Stage); and 2) To evaluate the psychometric properties of the translated measures, including face validity, content validity, and various aspects of validity and reliability (Psychometric Validation Stage).

Content validity was conducted with an expert panel (n = 3) while face validity was established through cognitive interviews with five hypertensive adults. Exploratory factor analysis (Time 1 data) and confirmatory factor analysis (Time 2 data) were performed to evaluate structural, convergent, discriminant, concurrent, predictive with 110 Thai adults (aged 18–55 years) with hypertension. Structural equation model was also applied to test concurrent and predictive validity. The convergent and discriminant validity was determined by average variance and the diagonal value, respectively. In structural equation model, increased self-efficacy in dietary adherence and positive outcome expectancy in dietary adherence at Time 1 significantly predicted workplace support (β = 0.54, p <.001) and functional support in dietary adherence (β = 0.40, p <.001) at Time 2, respectively. The test-retest procedure (ICC = 0.93–

0.98) at 2 weeks and McDonald's Omega coefficient (ω = 0.62–0.88) tests were performed and demonstrated acceptable internal consistency.

Keywords: Dietary adherence, Young adults, Middle-aged adults, Hypertension, Validation, Psychometric properties, Self-efficacy, Outcome expectancy, Social support, Workplace support

Introduction

Young- and middle-aged Thai adults with hypertension (HTN) have less than optimal adherence to the dietary recommendations for blood pressure (BP) management compared with older Thai adults (Apidechkul et al., 2022). Existing integrative literature, guided by the Social Cognitive Theory (SCT), highlights the significant impact of psychosocial factors on lifestyle behaviors, particularly adherence to low-sodium and/or low-fat diet recommendations among hypertensive patients (Suriyawong et al., 2023). Several constructs of SCT—self-efficacy, outcome expectancy, and social support—have been recognized as key determinants of dietary adherence behavior (Suriyawong et al., 2023). However, it is crucial to acknowledge that the associations between these factors differ according to various behavioral domains, constructs, and relevant variables, such as ethnicity and age (Suriyawong et al., 2023). Thus, translating and validating psychosocial measures within the context of dietary adherence to a low-sodium and low-fat diet into the Thai language is a critical first step for minimizing cardiovascular risks and health care burdens for young- and middle-aged Thai adults with HTN.

The incidence of HTN has been increasing globally. The World Health Organization [WHO] estimates that by 2050, almost 40% of the world's adult population will be diagnosed with HTN (WHO, 2020). It is concerning that many of the new cases of HTN were diagnosed in younger adults (Zhou et al., 2019). Similarly, the National Statistical Office of Thailand [NSO] reported that the total number of adults with HTN increased from 5% to 13% over a recent 4-

year period (2016–2020), indicating the severity of the problem; nearly 50% of them were young- and middle-aged adults (ages 18 to 55 years) (NSO, 2020).

Helping these young- and middle-aged adults with HTN improve their BP control is critical to reducing cardiovascular-related comorbidities and health care costs later in their lives. The NSO (2020) reported that the cost related to complications of high BP, such as hemorrhagic stroke, heart failure, and myocardial infarction, was anticipated to be more than $130 million per person per year for young- and middle-aged adults if they don't receive effective and timely interventions. Adherence to dietary recommendations (i.e., a low-sodium and low-fat diet) is one of several important actions to improve BP management (Whelton et al., 2018). A systematic review with meta-analysis confirmed that adherence to a low-sodium and low-fat diet was associated with decreased systolic and diastolic BP of 8.9 mmHg and 4.5 mmHg, respectively (Filippou et al., 2020).

Using theory-guided and validated Thai measures to understand the influence of psychosocial factors on lifestyle behaviors is essential for helping young- and middle-aged adults with HTN improve their BP management. One theory commonly used to understand why individuals adopt and sustain health behaviors is Social Cognitive Theory (SCT) (Bandura, 1987). The SCT-based psychosocial constructs, including self-efficacy, social support (functional support from peers or family), and outcome expectancy, have been commonly utilized to significantly predict healthy lifestyle adherence among Western and Middle Eastern younger adults (M_{age} <60 years) with HTN (Suriyawong et al., 2023). However, similar knowledge in Thai populations is lacking because of a lack of validated Thai measures. To address this gap, we have selected several promising measurements for scale adaptations and psychometric validations. The Self-Efficacy for Hypertension Treatment Adherence Scale (Zhao

et al., 2021), the Outcome Expectancies of Behavioral Change Scale (Renner & Schwarzer, 2005), the Social Support for Diet Behavior Scale (Sallis et al., 1987), the Workplace Support for Health Scale (Kava et al., 2021), and the Dietary Adherence Scale (Folsom et al., 2007) have been chosen for scale adaptations because they are SCT-based, domain-specific constructs with established validity and reliability data in studies involving other cultural adults with HTN.

Utilization of the Self-Efficacy for Hypertension Treatment Adherence Scale in our study allowed us to assess participants' confidence in adhering to HTN treatment, specifically in relation to dietary recommendations such as a low-sodium and low-fat diet. This measure was selected based on its well-documented importance in evaluating self-efficacy in dietary adherence to a low-sodium and low-fat diet (Suriyawong et al., 2023). Previous research, as indicated by Shim et al. (2020), has demonstrated a stronger association between self-efficacy in dietary adherence and adherence to a low-sodium and low-fat diet (r = 0.36) (Shim et al., 2020) compared with general self-efficacy, which was measured using the General Self-Efficacy Scale (Xie et al., 2020) and exhibited a weaker association (r = 0.01). These findings emphasize the importance of considering the specific aspects of self-efficacy when examining dietary adherence within the context of BP management.

The literature on assessing outcome expectancy related to dietary adherence for blood pressure (BP) management in hypertensive individuals is currently limited. The Outcome Expectancies of Behavioral Change Scale has emerged as a suitable measure for evaluating individuals' perceived outcomes associated with adopting a healthy diet, such as a low-sodium and low-fat diet. Originally developed as part of the "Berlin Risk Appraisal and Health Motivation Study" (BRAHMS) in 1994, the scale aims to provide psychometric scale to an international audience and foster cross-cultural studies on health cognitions and behavior

(Renner & Schwarzer, 2005). Previous studies have demonstrated its good reliability, particularly when applied to young, healthy adults in Germany and South Korea, providing a solid foundation for cross-cultural comparisons (Renner & Schwarzer, 2005).

To comprehensively assess social support relevant to dietary adherence among young and middle-aged adults, two specific measures were selected. Firstly, the Social Support for Diet Behavior Scale (Sallis et al., 1987) was initially employed to evaluate perceived support from family or peers in relation to dietary adherence. Although there is limited evidence on its validation in hypertensive adults (Suriyawong et al., 2023), an original study reported high reliability (α >0.80) and concurrent validity (r = 0.27) when compared to self-reported adherence to a low-sodium and low-fat diet in young healthy adults (Sallis et al., 1987). Secondly, the construct of workplace support, reflecting the value placed on employees' well-being by employers or coworkers, has been acknowledged for its positive impact on physical and emotional health in work settings (Laing & Jones, 2016). The validated Workplace Support for Health Scale was chosen to assess workplace support, since it is essential to consider young and middle-aged adults' perceived support in their workplace when investigating lifestyle behaviors (Kava et al., 2021). By evaluating these two aspects of social support, the study can effectively capture the support required for adhering to a low-fat and low-sodium diet, which is beneficial for BP management.

Although several studies in Thailand have examined relevant psychosocial factors, particularly self-efficacy and healthy lifestyle behaviors, including dietary adherence to a healthy diet in older hypertensive adults with a mean age over 60 years (Chantakeeree et al., 2022; Jaiyungyuen & Wora-arun, 2018; Saminpanya et al., 2018), the measures used were not adequately validated or domain-specific to a low-fat or low-sodium dietary adherence behavior.

For instance, the self-efficacy measure employed in previous studies was a general self-efficacy measure, which failed to assess an individual's confidence in overcoming barriers specific to dietary adherence in the context of HTN. It is worth noting that previous studies had limited psychometric validation data to support the use with young and middle-aged adults. For example, although a high content validity index (CVI >0.80) and internal consistency (α >0.80) were reported for these self-efficacy measures, there were no construct validity data available. Furthermore, the specific outcomes of interest were not clearly defined in terms of how the measures assessed adherence to a low-sodium or low-fat diet, because they predominantly focused on general adherence to a healthy diet without specific consideration of the dietary requirements for hypertensive patients, such as a low-sodium or low-fat diet. Bandura (1987) emphasized that assessing a psychosocial factor, such as self-efficacy related to a specific behavior with an assessed outcome, was important. Currently, there are no existing psychosocial measures in Thai that can measure domain-specific self-efficacy in dietary adherence to a low-sodium or low-fat diet or functional social support specifically within the context of dietary adherence recommendations. Moreover, given the cultural differences in dietary patterns between Thai, other Asian, and Western cultures, it is essential to cross-culturally adapt and validate psychosocial measures within the context of Thai dietary habits.

Without psychometrically sound measures, it is difficult to utilize theories to develop effective interventions to proactively prevent HTN-related comorbidities. This knowledge gap may be especially impactful to the health outcomes of young- and middle-aged Thai adults with HTN. Overall, evaluating the content validity, construct validity (structural, convergent, and discriminant validity), criterion validity (concurrent and predictive validity), and reliability (test-retest, internal reliability) of translated measures would be beneficial for researchers and health

care providers in Thailand for assessing the perception of psychosocial factors and dietary adherence for BP management among young- and middle-aged adults with HTN. Therefore, the purpose of this pilot study was to translate four psychosocial and dietary adherence measures from English into Thai and examine their psychometric properties in young- and middle-aged Thai adults with HTN.

Methods

Ethical Considerations

The study was approved by the Michigan State University Institutional Review Board (ID: STUDY00008308) prior to subject recruitment. To ensure that participants provided informed consent, the study used an online consent process as mentioned in the data collection process. They were explicitly informed about the voluntary nature of their participation, emphasizing their right to refuse participation or withdraw from the study at any time without penalty.

Study Design

This pilot study follows a cross-sectional and observational design, conducted in two stages. The initial stage involved the translation of selected measures, followed by a rigorous evaluation of their content and face validities. In Stage 2, we comprehensively analyzed the psychometric properties of four selected psychosocial measures within the context of dietary adherence. These psychosocial measures were hypothesized to serve as reliable predictors of enhanced adherence to low-sodium and low-fat diet recommendations, which may, in turn, contribute to more effective management of BP.

Study Setting and Subjects

The first stage of the study involved recruiting eight participants who contributed significantly to the assessment of face and content validity. These eight participants comprised five young and middle-aged adults with HTN who were employed at least 20 hours per week, and three content experts who have expertise in chronic disease management, instrument development, and scale adaptation procedures.

In Stage 2, we recruited 110 eligible participants adults aged 18–55 years with primary HTN who visited a primary care setting in a Thailand province, were proficient in Thai, and worked at least 20 hours per week. Individuals diagnosed with coronary heart disease (such as heart failure or ischemic heart disease) were excluded. Existing statistical studies have suggested different minimum sample sizes for psychometric studies, ranging from 30 to 400 subjects (Bonett & Wright, 2015; Kline, 2016; Rea & Parker, 1992). Factor analysis has typically been viewed as a method requiring a large sample size; however, a minimum sample size of 50 subjects has been deemed acceptable (Kyriazos, 2018). Therefore, a sample size of 110 subjects was considered adequate to perform factor analyses (exploratory and confirmatory analysis) and the test-retest procedure.

Selected Instruments

Self-Efficacy

The Self-Efficacy for Hypertension Treatment Adherence Scale, which is a 6-item dietary adherence subscale, was selected to assess self-efficacy in dietary adherence in this pilot study (Zhao et al., 2021). This original measure focused on how much confidence adults with HTN had in adhering to healthy dietary recommendations (a low-sodium and low-fat diet) when faced with barriers in various situations. With the five possible responses (from 1 = not confident to 5 =

very confident), the total score ranged from 6 to 30. A higher score indicated greater self-efficacy in adhering to healthy diet (such as a low-sodium and low-fat diet) recommendations. This subscale, as used in a previous study in adults with HTN, has demonstrated good internal consistency as evidenced by Cronbach's alpha coefficients greater than 0.80 (Zhao et al., 2021). Moreover, it has been noted that self-efficacy in dietary adherence had small correlation coefficients: 0.17 (with the Dietary Approach to Stop Hypertension score) (Zhao et al., 2021).

Outcome Expectancy

The two domains of the Outcome Expectancies of Behavioral Change Scale were developed to assess how adults with chronic diseases, including HTN, perceived the negative or positive consequences of adhering to healthy diet recommendations such as a low-sodium and low-fat diet (Renner & Schwarzer, 2005). The 6-item scale uses a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The total possible score of outcome expectancy in dietary adherence ranges from 6 to 42. A higher sum score reflects the higher level of perceived outcome expectancy in dietary adherence. This measure has been validated in chronic disease patients, including those with HTN, to establish reliability (α = 0.82) (Renner & Schwarzer, 2005). Furthermore, the two domains of outcome expectancy include positive and negative subscales to reflect participants' perceptions of the positive or negative consequences derived from their engagement in dietary adherence. A higher score represents a higher perception of positive or negative outcome expectancy.

Functional Support

The 10-item Social Support for Diet Behavior Scale developed by Sallis et al. (1987) was selected to determine participants' perceptions of functional support from family or peers for dietary adherence. On a scale ranging from 1 (never) to 5 (very often), subjects were asked to

indicate how accurately each item characterized the support they have received from their family or peers to adhere to a recommended dietary regimen. The total score was determined by summing the scores for each item after reverse coding the negative items. Higher scores indicate a greater perception of functional support for dietary adherence. This original measure has been validated with good internal consistency reliability (α = 0.87) and concurrent validity (r = 0.25–0.46; with self-report lifestyle behaviors such as improved healthy eating [a low-sodium and low-fat diet]) in younger adults (Sallis et al., 1987). There are two subscales in this measure, including perceived positive or negative functional support.

Workplace Support

The 5-item Workplace Support for Health Scale was used to measure participants' perceptions of coworker and supervisor support for living a healthier lifestyle (Kava et al., 2021). Participants were asked to score their responses on a 5-point Likert scale. The possible responses were 1 (totally disagree) to 5 (totally agree). The range for the total sum score was from 5 to 25. Higher ratings indicate stronger workplace support for a healthy lifestyle. A previous study in young healthy adults found that this measure has good reliability (α = 0.82) and concurrent validity (r = 0.74; with an increase in employer evidence-based intervention implementation in the workplace) (Kava et al., 2021).

Dietary Adherence

The Dietary Adherence Scale was originally developed to measure how well adults with HTN follow the recommended Dietary Approaches to Stop Hypertension (DASH) guideline, including a low-fat and low-sodium diet (National Institutes of Health, 2021). This measure focused on nine food groups on which the DASH diet focuses, including: 1) grains; 2) meat, poultry, and fish; 3) vegetables; 4) fruits; 5) fat-free or low-fat dairy products; 6) fats and oils; 7)

nuts, seeds, dry beans, and peas; 8) sweets; and 9) sodium. The Dietary Adherence Scale was scored by a scheme adopted from Folsom et al. (2007) and the Department of Health, Thailand (2020). A composite dietary adherence score was derived from a summed score of nine foods and nutrient groups with equal weighting. Each dietary component was assigned a score of 0 to 1 as follows: 1 to individuals whose intake was at or above the recommended amount for a food group; 0.5 to those who were close; and 0 to those who were below the suggested minimum dietary intake recommendation. Three food items were negatively phrased and required reverse coding (i.e., fat and oils, sweets, and sodium).

Stage I: Adaptation and Translation Process

We followed World Health Organization guidelines (2016) to complete the four steps of translation and back-translation, which included: 1) forward translation from English into Thai; 2) back-translation and checking consistency between the back-translated and English versions by three content experts; 3) pretesting the translated Thai version with five young- and middle-aged Thai adults with HTN by assessing their subjective understanding and capability to answer the translated measures (face validity) via a virtual focus group; and 4) revising or adapting the final version as necessary. The forward-translation, back-translation, and adaptation process took about four months (October 2022 to January 2023).

The PI and a nursing PhD candidate (bilingual in English and Thai) independently performed the forward translation. The resulting Thai versions were compared and discussed for consistency and variation. This step was repeated twice until the two translators reached agreement.

Once translated, an expert panel comprised of three PhD-prepared bilingual nursing professors was involved with the content validity verification process. To establish cross-cultural

validity of translated items, the expert panel members were asked to review and ensure those items were culturally relevant to Thai people's dietary habits. The expert panel and PI met virtually three times to identify and resolve insufficient expressions, translation concepts, and other discrepancies throughout the entirety of the translation and adaptation process. The expert panel was asked to rate the level of agreement on each item based on the validated criteria using a content validity index (CVI) which had four possible responses: 1) do not agree; 2) somewhat agree; 3) quite in agreement; and 4) totally agree. Once the expert panel and PI reached agreement, the Thai measure version was sent to two bilingual raters for backward translation. The expert panel was then asked to rate their agreement on the consistency of the Thai measure and the original English version, which had a high level of agreement.

Once content validity was established, the PI conducted a virtual focus group via Zoom with five young- and middle-aged adults with HTN recruited from the same clinic to further assess the translated version's face validity. In this virtual focus group, the PI asked them to review and describe what the survey questions were asking and to identify any unclear questions, confusing words or phrases, and whether there was a need for modification. We brought any concern back to the expert panel for further clarification and modification to ensure consistency in terminology. Finally, the PI met with the same five participants again to ensure there were no additional concerns with the final versions.

Stage II: Psychometric Validation

In Stage 2, we evaluated the construct validity (i.e., structural, concurrent, convergent, discriminant, and predictive validity) and reliability of the Thai version of all translated measures among 110 eligible participants using data collected at two time points (Time 1 and Time 2, with a 2-week interval between the assessments). The primary investigator (PI) delivered flyers with

the eligibility criteria and PI's contact information (email) to registered nurses at a noncommunicable disease unit in a primary care setting of a Thailand province. The flyers were distributed by the nurses to potential participants who visited this unit. The eligible participants could scan the QR-code on the flyer to access the eligibility screening survey. Once eligibility was determined, interested participants were required to read the online consent form and click "proceed" to indicate their voluntary agreement to participate in this two-time research survey. A QR-code was given at the end of the first survey to allow participants access to the second survey after two weeks. No personal contact information was collected for this stage of the investigation. However, we requested that participants provide the last four digits of their cell phone number to verify that both responses were coming from the same participant. Recruitment and data collection from a primary care setting spanned the period between February and March 2023.

Data Analysis

IBM SPSS Statistics version 28 (IBM, US, 2022) and MPlus Version 8.8 software were used for the data analyses. Initially, 120 young- and middle-aged adults with HTN had agreed to participate in this pilot in both Times 1 and 2. However, after examining missing data patterns, we saw that 10 participants (8.33%) had missed the majority of questions (≥50%) of both the Time 1 and Time 2 surveys. To avoid bias, a decision was made to remove these 10 cases from further analysis. After removal, only 0.13% of missing values remained. The Missing Completely at Random (MCAR) test was used to check for missing patterns (Little & Rubin, 2019). This test revealed that the missing pattern was random ($\chi^2 = 206.312$, $df = 218$, $p = .705$). To maximize the use of all collected data, we used MPlus to perform multiple imputations with the recommended 10 datasets (Jakobsen et al., 2017). In addition, since most of the study

variables were not normally distributed according to the Kolmogorov–Smirnov test (p <.05), the maximum likelihood parameter estimates with standard errors (MLR) was selected as the final estimator.

Content Validity

Each scale item was rated by a panel of three content experts in terms of its relevance to the underlying construct and Thai culture. These items were typically scored on a 4-point Likert scale (1 = not agreement; 4 = total agreement). The Content Validity Index (CVI) of each item was then calculated by dividing the number of experts who gave a rating of either quite agreement (3) or total agreement (4) by the total number of experts. The mean CVI was accepted as representing content validity of the measures.

Exploratory Factor Analysis

Factor analysis was used to evaluate each instrument's structural validity. We first explored the factorial structure using exploratory factor analysis on data gathered at Time 1 with Oblimin and Kaiser normalization rotation because we assumed there would be a correlation between the factors (Howard, 2016). To determine the number of factors within a set of variables in the measures, a factor loading of greater than 0.60 and Kaiser's criterion of eigenvalues greater than 1.00 was considered adequate (Howard, 2016). We also examined individual Kaiser-Meyer-Olkin (KMO) values and communalities to ensure their adequacy, considering values above 0.60 and 0.50 as satisfactory, respectively (Hair et al., 2019).

Confirmatory Factor Analysis

We used confirmatory factor analysis to verify the factor structure of a set of observed variables collected from Time 2. Using MPlus, confirmatory factor analysis with robust maximum likelihood (MLR) was then performed to assess the fitness of the original factorial

structure from exploratory factor analysis against the potential violation of multivariate normal distribution (Muthen & Muthen, 2017). Chi-square/degree of freedom ratio (χ^2/df ratio ≤ 3) (Hair et al., 2019), root mean square error of approximate (RMSEA; <0.08) (Hu & Bentler, 1999), comparative fit index (CFI) and Tucker-Lewis index (TLI) ≥0.95 were applied to examine the fit between the data and proposed model (Hair et al., 2019; Hu & Bentler, 1999). To improve model fit, minimum value (at least 10) for printing the modification index was used to consider model modification to increase the parsimony of the model (Muthen & Muthen, 2017).

Convergent Validity

After establishing the final modified measurement model, convergent validity was determined in MPlus 8.8 by calculating average variance extracted (AVE). This test was used to determine whether the convergent validity of the measurement model was satisfactory when the recommended AVE value was greater than 0.50 (Hair et al., 2019).

Discriminant Validity

The diagonal value indicated by the square root of each factor's AVE was used to evaluate discriminant validity. If this diagonal value exceeded its highest correlation with any other factor, discriminant validity was assumed (Compeau & Higgins, 1995).

Concurrent Validity

Concurrent validity was determined by the coefficient correlation (r) between the variables in the final measurement model. In our analysis, we classified correlation coefficients as small (r = 0.10), moderate (r = 0.30), and large (r = 0.50) to facilitate their interpretation (Cohen, 1988).

Predictive Validity

Following construction of the final structural equation modeling, we evaluated the predictive validity by analyzing the beta coefficients (β). To aid in their interpretation, we categorized the Beta coefficients as small ($\beta = 0.10$), moderate ($\beta = 0.30$), and large ($\beta = 0.50$) in our analysis (Cohen, 1988).

Reliability

The intraclass correlation coefficient (Scarapicchia et al., 2017) with 95% confidence intervals (CI) was used to assess the stability of item response (test-retest reliability) between Time 1 and Time 2 (two weeks apart). An ICC value higher than 0.8 was considered acceptable (Hair et al., 2019). The McDonald's Omega and composite reliability were calculated to determine the internal consistency reliability of each measure, with acceptable results being coefficients greater than 0.8 and 0.7, respectively (Hair et al., 2019).

Results

Stage I: Adaptation and Translation Process

The experts' evaluation of item relevance resulted in acceptable Content Validity Index (CVI) scores ranging from 0.85 to 0.95 (see Table 3.4 in Appendix A). While the overall CVI scores were satisfactory, minor revisions were required for the dietary adherence scale, designed to evaluate adherence to a BP control diet. The expert panel recommended replacing the example item of cheese (item 4) with a soybean-based dairy product. Further, modifications were made to item 9 of the dietary adherence scale, which assesses sodium intake. This involved the incorporation of additional sodium seasonings commonly used in Thai cooking, such as fish sauce and fermented fish. To enhance participants' accuracy in estimating their consumption, the three experts suggested using proportion criteria, including estimated serving sizes, to facilitate a

more precise assessment of the frequency of consuming each food item (see Table 3.5 in Appendix B). In addition, the measurement unit for quantifying the intake of each food item was changed from ounces to milliliters. During the back-translation process, it was found that both versions of the measures demonstrated consistent meaning and conceptual alignment with the original measures.

Finally, the translated instructions, item phrasing, recall period, and rating scales in Thai received confirmation of good face validity from the five eligible participants. These participants, who were young- and middle-aged adults with HTN (ages 27–54 years; M_{age} = 41.40), expressed their satisfaction with the clarity and comprehensibility of the measures. Among the participants, three belonged to the young-age adult category (ages 27–37 years), representing 60% of the sample. Moreover, the participants displayed diverse educational backgrounds, including elementary school educational attainment (n = 1), high school (n = 2), and attainment of a bachelor's degree or higher (n = 2).

Stage II: Psychometric Property Validation

Construct Validity

Structural Validity. According to exploratory factor analysis, the Kaiser-Meyer-Olkin measure (>0.60) and Bartlett's test (p <.001) indicated that the association structure was adequate for factor analysis, as shown in Table 3.1. Of the four psychosocial measures, a dietary adherence subscale of the Self-Efficacy for Hypertension Treatment Adherence Scale and the Workplace Support for Health Scale coalesced into a single-factor model. The Social Support for Diet Behavior Scale (Factor 1: positive functional support in dietary adherence; Factor 2: negative functional support in dietary adherence) and the Outcome Expectancies of Behavioral Change Scale (Factor 1: positive outcome expectancy in dietary adherence; Factor 2: negative

outcome expectancy in dietary adherence) had a two-factor solution. All of these measures had a cumulative percentage of variance ranging from greater than 57.85% to 75.79%, while the Dietary Adherence Scale accounted for 49.58% of the total variance. The Dietary Adherence Scale was grouped into a two-factor solution (Factor 1: fruits, vegetables, nuts, and legumes; Factor 2: sodium, low-fat meat, sweets, and oils) as the best fit to the data with all acceptable factor loadings (>0.60). We removed some indicators with factor loadings below 0.50, including Item 1 of the Dietary Adherence Scale (grains = 0.41), and Items 6 (= 0.44) and 7 (= 0.48) of the Social Support for Diet Behavior Scale.

Table 3.1: The final exploratory factor analysis of selected measurements in the Thai version (n = 110)

Variable/ Item	Factor		KMO	Bartlett's test of sphericity	Cumulative % of variance
	1	2			
Self-efficacy in DA			0.84	$\chi^2(15) = 241.99$, $p < .001$	57.85%
- Item 3	**0.80**	-			
- Item 2	**0.79**	-			
- Item 5	**0.77**	-			
- Item 4	**0.75**	-			
- Item 1	**0.71**	-			
- Item 6	**0.71**	-			
ω	0.85	-			
ICC [95%CI]	0.98[.972, .987]	-			
Outcome expectancy in DA			0.76	$\chi^2(15) = 289.27$, $p < .001$	75.79%
- Item 2	**0.89**	0.25			
- Item 3	**0.87**	0.16			
- Item 1	**0.83**	0.24			
- Item 5	-0.11	**0.87**			
- Item 4	-0.21	**0.81**			
- Item 6	-0.40	**0.62**			
ω	0.88	0.73			
ICC [95%CI]	0.97[.950, .977]	0.93[.896, .951]			

Table 3.1 (cont'd)

Variable/ Item	Factor 1	Factor 2	KMO	Bartlett's test of sphericity	Cumulative % of variance
Functional support in DA			0.70	$\chi^2(28) = 373.47$, $p < .001$	64.87%
- Item 4	**0.81**	-			
- Item 2	**0.78**	-			
- Item 3	**0.77**	-			
- Item 1	**0.74**	-			
- Item 5	**0.73**	-			
- Item 10	-	**0.93**			
- Item 9	-	**0.92**			
- Item 8	-	**0.71**			
ω	0.83	0.81			
ICC [95%CI]	0.96[.938, .971]	0.97[.958, .980]			
Workplace support			0.82	$\chi^2(10) = 304.94$, $p < .001$	65.71%
-Item 4	**0.86**	-			
-Item 5	**0.85**	-			
-Item 1	**0.85**	-			
-Item 2	**0.84**	-			
-Item 3	**0.74**	-			
ω	0.89				
ICC [95%CI]	0.98[.970, .986]	-			
Dietary adherence			0.68	$\chi^2(28) = 135.87$, $p < .001$	49.58%
- Item 3	**0.72**	0.22			
- Item 2	**0.70**	0.16			
- Item 4	**0.70**	-			
- Item 6	**0.60**	-			
- Item 8	-0.13	**0.76**			
- Item 9	0.17	**0.69**			
- Item 5	0.42	**0.63**			
- Item 7	0.21	**0.63**			
ω	0.63	0.62			
ICC [95%CI]	0.96[.941,.972]	0.96[.943, .973]			

Note: KMO=Kaiser-Meyer-Olkin measure of sampling adequacy; DA=dietary adherence to a low-sodium and low-fat diet; ω = McDonald's Omega coefficient; ICC = The intraclass correlation coefficient

The initial confirmatory factor analysis demonstrated an acceptable fit to the data (χ^2/df =1.61, RMSEA = 0.07 [90% CI = .060–.088], CFI = 0.87, TLI = 0.85). To improve the DA

measurement model, we added a correlation pathway between Items 1 and 2 of the workplace support measure, with an improvement in the modification indices value of 28.45. We also removed the Factor 2 of social support measure (Items 8, 9, and 10) from the model because their factor loadings were not significant (p >.05). The final modified DA models had a good fit (χ^2/df = 1.47, RMSEA = 0.06 [90%CI = .050–.081], CFI = 0.91, TLI = 0.89) and all standardized factor loadings were greater than 0.50, with all p-values <.001 (see Table 3.2).

Table 3.2: Estimates of final dietary adherence measurement model by confirmatory factor analysis (n = 110)

Variable	Item	Factor		SE
		1	2	
Self-efficacy in DA	1	0.65	-	0.09
	2	0.76	-	0.06
	3	0.75	-	0.08
	4	0.70	-	0.06
	5	0.76	-	0.08
	6	0.59	-	0.08
Average variance extracted		0.50	-	
Composite reliability		0.85	-	
ω		0.85	-	
Outcome expectancy in DA	1	0.79	-	0.04
	2	0.91	-	0.03
	3	0.86	-	0.03
	4	-	0.72	0.09
	5	-	0.78	0.09
	6	-	0.70	0.09
Average variance extracted		0.73	0.54	
Composite reliability		0.89	0.77	
ω		0.89	0.78	
Functional support in DA	1	0.76	-	0.05
	2	0.85	-	0.04
	3	0.77	-	0.05
	4	0.79	-	0.05
	5	0.58	-	0.07
Average variance extracted		0.57	-	
Composite reliability		0.87	-	
ω		0.87	-	

Table 3.2 (cont'd)

Variable	Item	Factor		SE
		1	2	
Workplace support	1	0.68	-	0.08
	2	0.74	-	0.06
	3	0.67	-	0.07
	4	0.80	-	0.06
	5	0.82	-	0.05
Average variance extracted		0.55	-	
Composite reliability		0.86	-	
ω		0.87	-	

Note: SE = standard error; DA = dietary adherence; ω = McDonald's Omega coefficient

Convergent and Discriminant Validity. The AVE was greater than 0.50, indicating convergent validity (see Table 3.2). Discriminant validity among factors in the final measurement model was evaluated by using the square root of AVE and presented as the diagonal value of the correlation matrix (see Table 3.3).

Criterion Validity

Concurrent Validity. In the final measurement model, the correlation coefficients between variables were found to be between 0.23 and 0.66 (see Table 3.3).

Table 3.3: Correlation matrix between psychosocial variables in final measurement model

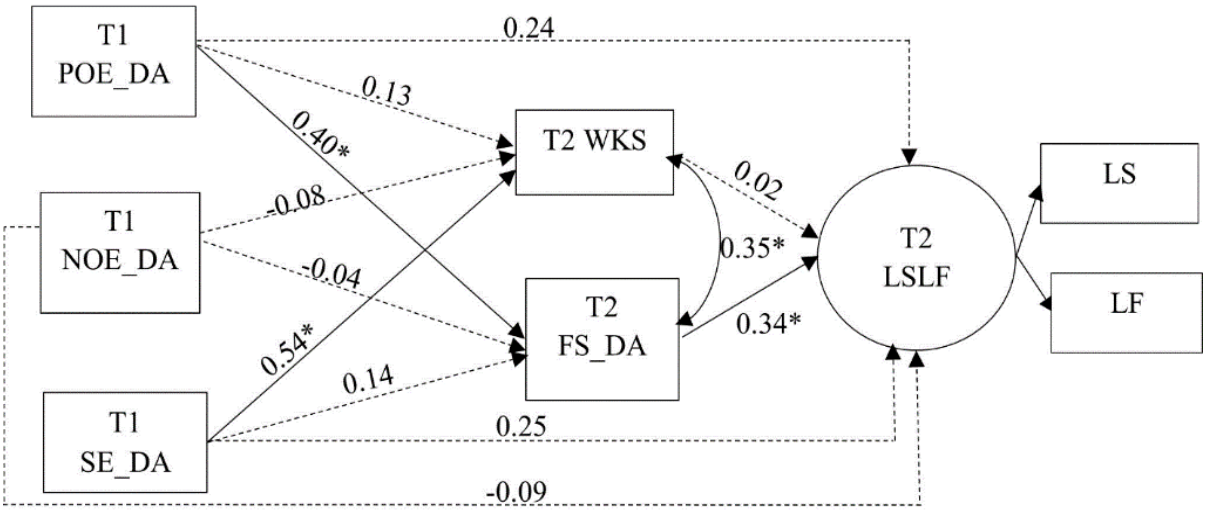
Variable	1	2	3	4	5
(1) SE_DA	0.71				
(2) +OE_DA	0.38*	0.85			
(3) -OE_DA	-0.46**	-0.58**	0.73		
(4) +FS_DA	0.30*	0.48**	-0.25	0.75	
(5) WKS	0.66**	0.29*	-0.23*	0.50**	0.74

Note: Correlations of the measurement model was estimated using the TECH4 command in Mplus; the diagonal values in blue indicated the square root of average variance extracted (AVE); SE_DA = self-efficacy in dietary adherence; +OE_DA = positive outcome expectancy in dietary adherence; -OE_DA = negative outcome expectancy in dietary adherence; +FS_DA = positive functional support in dietary adherence, WKS = workplace support; ** = p <.001; * = p <.05.

Predictive Validity. Structural equation modeling was performed to evaluate predictive validity. In SCT-based structural equation modeling, we hypothesized that positive and negative outcome expectancy in dietary adherence and self-efficacy in dietary adherence at Time 1 would predict a better perceived workplace support in dietary adherence at Time 2 because of participants' beliefs in the positive relationship between dietary adherence behavior and health consequences. In this model, we added a correlation pathway between workplace support and functional support in dietary adherence because it can increase the modification indices value by 16.77. The modified structural model had an excellent fit with the data ($\chi^2(df) = 4.67(4)$, $p = .322$; $\chi^2/df = 1.168$; RMSEA = 0.039; CFI = 0.993; TLI = 0.968). This model explained 46.30% of the variance in a low-fat diet; and 25.0%, 31.80%, and 20.20% of the variance in a low-sodium diet, workplace support, and functional support in dietary adherence, respectively.

Workplace support was directly predicted by self-efficacy in dietary adherence ($\beta = 0.54$, $p < .001$), whereas positive outcome expectancy in dietary adherence moderately predicted functional support in dietary adherence ($\beta = 0.40$, $p < .001$). Finally, functional support in dietary adherence was related to a low-sodium and low-fat diet ($\beta = 0.34$, $p = .035$) and also fully mediated the relationship between positive outcome expectancy in dietary adherence and a low-sodium and low-fat diet as shown in Figure 3.1.

Figure 3.1: Final structural equation modeling: The relationship between dietary adherence psychosocial factors and a low-sodium and low-fat diet



Note: Solid lines indicate statistically significant paths. Dotted lines indicate a non-statistically significant path. T1= data gathered from Time 1; T2 = data gathered from Time 2; SE_DA = self-efficacy in dietary adherence; POE_DA = positive outcome expectancy in dietary adherence; NOE_DA = negative outcome expectancy in dietary adherence; FS_DA = functional support in dietary adherence, WKS = workplace support, LSLF = a low-sodium and low-fat diet, LS = a low-sodium diet, LF = a low-fat diet, * = *p*-value <.05, ** = *p*-value <.001

Reliability

Internal Consistency Reliability. Three of the translated psychosocial measures achieved high internal consistency, with McDonald's Omega coefficients exceeding 0.8 (range 0.83–0.89). However, the negative outcome expectancy in DA subscale measure exhibited a slightly lower McDonald's Omega coefficient (ω) of 0.80 (see Table 3.1). It is worth noting that the Dietary Adherence Scale exhibited a lower McDonald's Omega coefficient of 0.62 compared to the other measures (Table 3.1).

Following the confirmatory factor analysis, the McDonald's Omega coefficients for the four psychosocial measures remained consistent with the previous analysis, and all the psychosocial measures demonstrated composite reliability values above the recommended threshold of 0.70 (see Table 3.2).

Test-Retest Reliability. Overall, the test-retest reliability of these selected psychosocial measures had an intraclass correlation coefficient of between 0.93 and 0.98 (see Table 3.1).

Discussion

The current study evaluated the psychometric properties of the five measures translated into Thai to determine their validity and reliability with cultural adaptation. Internal consistency, external consistency, construct validity (i.e., content, face, factorial structure, convergent, and discriminant), and criterion validity (concurrent and predictive validities) were evaluated. Only the Dietary Adherence Scale needed some minor changes during the adaptation stage. We defined dietary adherence as consuming a low-sodium and low-fat diet, which was similar to the DASH diet recommendation for hypertensive individuals who aimed to enhance their BP management (National Institutes of Health, 2021). Because of the differences in culinary traditions between Western and Thai cultures, selecting equivalent and suitable food items from the DASH guideline was challenging. For example, Thai people rarely consume cheese as a key food source. According to a survey on food consumption conducted in Thailand among adults, only a few of them (<4%) regularly consumed cheese (Department of Health Thailand, 2020). As a result, the expert panel recommended replacing cheese with other items frequently consumed by Thai people, such as tofu and soybean milk. In addition, our expert panel recommended adding fermented fish and fish sauce as part of the sodium group because Thai people regularly use these two high-sodium seasonings instead of sodium alone when preparing or cooking food. To enhance clarity, we also added an example to illustrate the sodium content per serving to assist with participants' estimates of these high-sodium food categories (see Table 3.5 in Appendix B). Lastly, the expert panel proposed changing the measurement unit from "*ounce*" to "*milliliter*" to correspond with the common measurement practice in Thailand.

This pilot project test demonstrated that all instructions and item descriptions in each of the translated Thai measures were easy for the initial five participants to understand after two repeated focus group meetings, ensuring consistency in the medical language and indicating good face validity. This clarity may be rooted in our rigorous procedure for assessing content validity (CVI ≥0.80) (see Table 3.4 in Appendix A). Furthermore, the internal consistencies of our translated measures were similar to the original ones in English (the Self-Efficacy for Hypertension Treatment Adherence Scale ($\omega_{\text{dietary subscale}}$ = 0.85 vs. 0.81) (Zhao et al., 2021), the Social Support for Diet Behavior Scale (ω = 0.82 vs. 0.87) (Sallis et al., 1987), and the Workplace Support for Health Scale (ω = 0.89 vs. 0.82) (Kava et al., 2021). Although our translated Dietary Adherence Scale had a relatively lower internal reliability (ω_{factor1} = 0.63; ω_{factor2} = 0.62) than the other translated measures, it was still within the general rule of thumb that an acceptable internal reliability level for science education measures should be greater than 0.60 (Taber, 2018). Thus, the reliability of this translated measure was deemed acceptable for this reason and also because the reliability of the original Dietary Adherence Scale had not been previously reported. Regardless, the results of the test-retest procedure with all translated measures were excellent in terms of test-retest reliability (ICC >0.90). These results further endorsed the feasibility of employing these translated Thai measures in the future since they are likely to produce similar results over time (Berchtold, 2016).

Exploratory factor analysis demonstrated one-factor solutions for the translated Thai versions for the self-efficacy in dietary adherence subscale (Zhao et al., 2021) and workplace support (Renner & Schwarzer, 2005), consistent with the original versions. Moreover, the pilot study findings showed that the Thai version of the functional support in dietary adherence was a two-factor solution (Factor 1: items 1–5; Factor 2: items 6–10), similar to the original study

(Factor 1: positive comment [items 1–5]; and factor 2: negative comment [items 6–10]) (Sallis et al., 1987). The Dietary Adherence Scale, which is designed to assess adherence with the DASH diet, had not previously been explored in the Thai population. This pilot study found that the scale yielded two factors. Factor 1 included the consumption of fruits, vegetables, grains, nuts and seeds, and low-fat dairy products. Unfortunately, our exploratory factor analysis suggested removing Item 1 (grain) from Factor 1 of this scale due to poor factor loading; otherwise, it would have poor convergent validity and inadequate construct validity (Hair et al., 2019). Factor 2 of the Dietary Adherence Scale, which included lean meat, oil/fats, sweets, and sodium, could better represent overall consumption of a low-sodium and low-fat diet than Factor 1. Although all DASH dietary components are important for BP management (Filippou et al., 2020), the greatest issue was that Thai adults were less adherent with a low-sodium diet compared to other food components in this diet, such as fruits and vegetables (Department of Health Thailand, 2020). According to a Thai national survey using a food frequency questionnaire, young- and middle-aged Thai adults consumed on average more than 3,636 mg of sodium per day (Chailimpamontree et al., 2021), which was significantly higher than the recommended 2,000 mg daily limit. For this reason, our structural equational model only used a low-sodium (item 9) and low-fat diet (item 4) as the primary outcomes.

By examining the relationships between the factors in the final measurement model, convergent and discriminant validity were evaluated. Discriminant validity is the degree to which one factor was different from another (Kline, 2016), while convergent validity is the degree to which one factor was related to other factors that measured the same construct (Campbell & Fiske, 1959). In this pilot study, all of the AVE values (>0.50) of factors in the measurement model were greater than the recommended cut-off value, implying good

convergent validity (Hair et al., 2019). From the correlation matrix table, we found that the correlations for each factor in the measurement model were less than the square root of the AVE (diagonal value), showing good discriminant validity (Campbell & Fiske, 1959).

We performed measurement and structural equation modeling to investigate criterion validity (concurrent and some variables' predictive validity). In our final measurement model, the small- to -moderate relationship between internal factors (self-efficacy, and outcome expectancy) and external factor (functional support and workplace support) were identified. Moreover, the structural model showed that self-efficacy at Time 1 and positive outcome expectancy at Time 1 were able to moderately predict workplace support at Time 2 and functional support at Time 2. Furthermore, positive functional support was directly related to a low-sodium and low-fat diet. These associations can be explained by Social Cognitive Theory—internal/personal factors (i.e., self-efficacy and outcome expectancy) can have a direct effect on external factors (i.e., functional or workplace support), while external factors can have a direct influence on behavior change (Bandura, 1987). Given the scarcity of relevant research to confirm these associations among younger-aged Thai adults with HTN, it is essential to further examine psychosocial influences on these younger hypertensive adults' lifestyles and BP management.

The generalizability of our findings may be limited due to methodological flaws in this study. The relatively small sample size used in the adaptation stage could potentially affect the quality (face validity) of translated measures. Specifically, although the cognitive interviews indicated that the translated measures were understandable and applicable to participants with diverse educational backgrounds, caution is advised when interpreting the face validity due to the small sample size of less than 20 subjects (Blair & Conrad, 2011). Furthermore, it is important to

note that our findings pertain specifically to younger adults (aged 18–55 years) with HTN in Thailand. To enhance the generalizability of the Thai versions of the translated measures, future validity and reliability assessments should include a larger and more diverse sample size, encompassing different age groups. By expanding the participant pool, we can improve the representativeness of our findings and provide more robust evidence regarding the validity and reliability of these measures in a wider population. Finally, our study depended on self-reported measurements, specifically the dietary adherence measure, which could potentially introduce participant bias into the data collection process.

Future research endeavors could focus on assessing dietary adherence behaviors, specifically the consumption of low-sodium or low-fat diets, by comparing the validity of this self-report measure with objective measures. For instance, examining the correlation between self-reported dietary adherence and objective measures such as estimating sodium excretion through urine or lipid levels in the blood would contribute to a more comprehensive understanding of dietary adherence.

Relevance to Clinical Practice

Determining the validity and reliability of these translated Thai measures is essential for improving clinical practice among patients with HTN, particularly for young- and middle-aged working adults. It could also allow for a theory-guided approach to understanding psychosocial influences on this group's dietary adherence with recommendations for BP management. Furthermore, it would allow for national and international comparisons to assist Thai researchers in designing effective intervention programs to promote BP management, subsequently improving quality of life among Thai young- and middle-aged adults with HTN.

Conclusion

This is the first study to translate and culturally adapt psychosocial measures grounded by Social Cognitive Theory and the Dietary Adherence Scale within the context of Thai eating habits. The translated Thai measures were found to have satisfactory psychometric properties. These translated measures can be used in future studies to examine how young- and middle-aged Thai adults with HTN perceive psychosocial factors associated with adherence with dietary recommendations. More specifically, a robust statistical method was employed to confirm factor loadings and examine the relationship between psychosocial factors and the adherence to a low-sodium and low-fat diet. This structural equational modeling approach can greatly minimize measurement bias. Thus, the results set a solid foundation for future use of these translated measures.

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APPENDIX A: CONTENT VALIDITY INDEX (CVI)

Table 3.4: Content validity index (CVI) of all measures, rating by three experts

Items	Expert1	Expert2	Expert3	Number in agreement	Item CVI
Self-efficacy in DA					
1	✓	-	✓	2	0.67
2	✓	✓	✓	3	1
3	✓	✓	✓	3	1
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
6	✓	✓	-	2	0.67
					Mean CVI = 0.89
Outcome expectancy in DA					
1	✓	✓	✓	3	1
2	✓	✓	✓	3	1
3	✓	✓	✓	3	1
4	✓	-	✓	2	0.67
5	✓	✓	✓	3	1
6	✓	✓	✓	3	1
					Mean CVI = 0.95
Functional support in DA					
1	✓	✓	✓	3	1
2	✓	✓	✓	3	1
3	✓	✓	✓	3	1
4	-	✓	✓	2	0.67
5	✓	✓	✓	3	1
6	✓	✓	-	2	0.67
7	✓	✓	✓	2	1
8	✓	✓	✓	3	1
9	✓	✓	✓	3	1
10	✓	-	✓	2	0.67
					Mean CVI = 0.90
Workplace support					
1	✓	✓	✓	3	1
2	✓	✓	✓	3	1
3	-	✓	✓	2	0.67
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
					Mean CVI = 0.93

Table 3.4 (cont'd)

Items	Expert1	Expert2	Expert3	Number in agreement	Item CVI
Dietary adherence					
1	-	-	✓	1	0.33
2	✓	✓	✓	3	1
3	✓	✓	✓	3	1
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
6	✓	✓	-	2	0.67
7	✓	✓	✓	3	1
8	-	✓	✓	2	0.67
9	✓	✓	✓	3	1
					Mean CVI = 0.85

Note: DA = dietary adherence

APPENDIX B: BACK-TRANSLATION AND ORGINAL MEASURES

Table 3.5: The comparison between back-translation and original version of five measures

Measure	Back-translation version	Original version
1.The Self-Efficacy for Hypertension Treatment Adherence Scale		
Self-efficacy in dietary adherence		
	1.When I'm eating with family or friends and no one else is on a diet except me.	1.When I am eating with family or friends and no one but me is on a diet.
	2.When I am on vacation or traveling.	2.When I am traveling or on vacation.
	3.When I am in a hurry.	3.When I am in a rush/hurry.
	4.When I am extremely stressed.	4.When I am under a lot of stress.
	5.When I don't have easy access to healthy foods.	5.When I don't have easy access to healthy foods.
	6.When the risk of abandoning my diet is low.	6.When the risk of going off my diet seems low to me.
2.The Outcome Expectancies of Behavioral Change Scale		
	1. I will not have weight issues anymore	1. I won't have weight problems (anymore)
	2. It will be beneficial to my blood pressure.	2. That will be good for my blood pressure.
	3. My cholesterol level will decrease.	3. My cholesterol level will improve.
	4. I'll have to spend more time to meal preparation.	4. I'll have to spend more time on preparing meals.
	5. I'll have to make an effort to purchase the appropriate products.	5. I'll have to make an effort of buying the right products.
	6. This will have a negative impact on my social life (at parties, with friends).	6. That will impair my social life (at parties, with friends).
3.The Social Support for Diet Behavior Scale		
	1. Reminded me not to consume foods high in sodium and fat.	1.Reminded me not to eat high-sodium, high-fat foods.
	2. Encouraged me to avoid eating foods high in sodium and fat when I am tempted to do so.	2.Encouraged me not to eat high-sodium, high-fat when I'm tempted to do so.
	3. Commented if I resumed my high-sodium, high-fat diet.	3.Commented if I went back to eating high-sodium, high-fat.
	4.Complimented me on my dietary modifications.	4.Complemented me about changing my eating habits.
	5.Changes in my eating habits were discussed with me.	5.Discussed my eating habit changes with me.

Table 3.5 (cont'd)

Measure	Back-translation version	Original version
	6.Made negative remarks when I resumed eating high-sodium and high-fat foods.	6.Made negative comments when I went back to eating high-sodium, high-fat foods.
	7.Complained that I spent too much money on low-sodium, low-fat foods.	7.Complained that I spent too much money on low-sodium, low-fat foods.
	8.Refused to consume the same foods that I do.	8.Refused to eat the same foods I eat.
	9.When I encouraged them to consume low-sodium and low-fat foods, they became angry.	9.Got angry when I encouraged them to eat low-sodium, low-fat foods.
	10. I was told that a low-sodium, low-fat diet is a waste of time.	10.Told me eating a low-sodium, low-fat diet is waste of time.
4.Workplace Support Scale		
	1.Overall, my workplace encourages me to live a healthier lifestyle.	1.Overall, my workplace supports me in living a healthier life.
	2.My employer encourages me to live a healthier lifestyle.	2.My supervisor supports me in living a healthier life.
	3. The majority of the employees here practice healthy habits.	3.Most employees here have healthy habits.
	4.At my workplace, we have one or more wellness champions (e.g., head staff or managers).	4.At my workplace we have one or more leaders (e.g. CEOs or managers) who are wellness champions.
	5.One or more employees at my workplace are wellness champions.	5.At my workplace we have one or more employees who are wellness champions.
5.Diet Adherence Scale		
	1.Grains such as brown rice, hand-drilled rice ≥6 servings/d 5–6 servings/d <5 servings/d Note: 1 serving = 1 ladle	1. Total Grain ≥7 servings/d 5–6 servings/d <5 servings/d
	2. Vegetables such as kale, Chinese cabbage, cantonese, chamomile, mushrooms, bamboo shoots, onions others □ Do not eat or eat less than 4 ladles per day □ Take 4-6 ladles per day (about 400 grams)	2. Vegetables ≥4 servings/d 2-3 serving/d <2 serving/d

Table 3.5 (cont'd)

Measure	Back-translation version	Original version
	□ Eat more than 6 ladles per day (more than 400g) 3.Fresh fruits such as bananas, guavas, dragon fruit, apples, oranges, pinks, mangoes, etc. □ Do not eat or eat less than 4 portions per day. □ Eat 4-6 portions per day □ Eat more than 6 portions per day Note: 1 portion equals 6-8 pieces or 1 small fruit (apple or orange) or 1/2 large fruit (guava, dragon fruit, mango)	3. Fruits ≥4 servings/d 2-3 serving/d <2 serving/d
	4.Dairy products such as low-fat milk, fat-free milk, low-fat yogurt, soy milk, tofu, etc. □ Do not eat or eat less than 1 portion per day. □ Take 1-2 portions per day □ Eat more than 2 portions per day * Note: 1 portion equals 250 ml or about 1 glass/cup of milk, yogurt or 1/2 tofu.	4. Dairy ≥2 servings/d 1 serving/d <1 serving/d
	5.Lean meats such as chicken, eggs, fish, lean pork □ Do not eat or eat less than 2 portions per day. □ Take 3 portions per day □ Eat more than 3 portions per day * Note: 1 portion equals 2 tablespoons (if eating 1 egg = 1 portion)	5. Meat, poultry, and fish ≤2 servings/d 3 serving/d ≥4 serving/d
	6.Nuts and seeds such as watermelon seeds Sunflower seeds, peanuts, cashews, almonds, etc. □ Do not eat or eat less than 2 portions per day. □ Take 2-3 portions per day 2-3 times a day	6. Nuts, seeds, and dry beans ≥4 servings/d 2-3 serving/d <2 serving/d

Table 3.5 (cont'd)

Measure	Back-translation version	Original version
	□ Eat more than 3 portions per day * Note: 1 portion equals 2 tablespoons of small beans (e.g. sunflower seeds, watermelon seeds), 1 handful of large beans (e.g. peanuts, cashews)	
	7.Oil (eating foods assembled by using rice bran oil canola oil, olive oil) □ Not eaten □ Eat sometimes □ Eat regularly	7. % kcal from fat ≤27% 28-29% ≥30%
	8. Sugar, sweets, beverages □ Do not eat or eat less than 6 tablespoons per day. □ Take 6-7 tablespoons per day □ Eat more than 7 tablespoons per day Note: 1 donut or 1 bottle of regular sugary drinks such as soft drinks Cold milk tea = > 7 tablespoons per day	8.Sweets ≤5 servings/wk 6-7 servings/wk ≥8 serving/wk
	9. Sodium or sodium □ Do not take or take less than 2,400 mg/day □ Take 2,400 mg/day □ Take more than 2,400 mg/day Note: 2,400 mg sodium content in each seasoning type: 1) 1 teaspoon curry sodium, 2) 5 teaspoons fish sauce, 3) an instant noodle, 4) 2 tablespoons shrimp paste, 5) seasoning powder (ex. Rod-Dee) 5 teaspoon, 6) 4 tablespoons oyster sauce (or 12 teaspoons) * If buying cooked food from the market, consider that sodium or sodium consumption exceeds 2,400 mg/day.	9. Sodium ≤2400 mg/d 2400-3000 mg/d >3000 mg/d

CHAPTER 4: ADAPTATION AND PSYCHOMETRIC EVALUATION OF PHYSICAL ACTIVITY RELATED PSYCHOSOCIAL MEASURES AMONG THAI ADULTS WITH HYPERTENSION

Abstract

Background: The precise relationship between psychosocial factors and physical activity in young Thai adults with hypertension remains uncertain due to a lack of validated Thai-language measurements.

Objective: To adapt and validate psychosocial measures for assessing physical activity and examine their psychometric properties.

Methods: In a two-stage cross-sectional study, we meticulously translated and back-translated four psychosocial measures (Self-efficacy for Hypertension Treatment Adherence, Outcome Expectancies of Behavioral Change, Social Support for Exercise Behavior, Workplace Support for Health). In Stage 2, we assessed their psychometric properties in 250 young working adults with hypertension (aged 18–55 years).

Results: We evaluated face, content, structural, concurrent, convergent, and discriminant validities, all yielding satisfactory results. Self-efficacy correlated positively with vigorous-intensity physical activity (β = 0.39, p <.001), not moderate or low intensity. Social support (family and peers) related positively to vigorous- (β = 0.18, p = .008) and moderate-intensity physical activity (β = 0.25, p = .014). Workplace support correlated with both moderate- (β = 0.24, p = .025) and vigorous-intensity physical activity (β = 0.21, p = .007). These Thai versions demonstrated high internal consistency (Cronbach's α = 0.91–0.97).

Conclusion: The findings establish satisfactory psychometric properties for these Thai measures, valuable for exploring how young Thai adults with hypertension perceive psychosocial factors related to physical activity.

Keywords: Physical activity, Young adults, Middle-aged adults, Hypertension, Validation Psychometric properties, Self-efficacy, Social support, Workplace support

Introduction

Inadequate adherence to recommended lifestyle practices for managing blood pressure (BP) is prevalent among young and middle-aged Thai adults with hypertension (HTN), particularly when compared to older adults (Apidechkul et al., 2022). This underscores the urgent need to address the psychometric properties of psychosocial measures in order to effectively tackle HTN-related comorbidities and implement timely interventions within this specific population.

The global incidence of HTN is on the rise, with projections indicating that nearly two-fifths of the adult population worldwide will be diagnosed with HTN by 2050 (World Health Organization, 2021). This upward trend is particularly concerning among younger adults (Zhou et al., 2019), including the young and middle-aged population in Thailand (The National Statistical Office Thailand [NSO], 2020), where the prevalence of HTN has experienced a significant increase. The NSO (2020) reports that without effective and timely interventions, the financial burden associated with complications arising from high BP, such as hemorrhagic stroke, heart failure, and myocardial infarction, is projected to exceed $100 per individual annually among young and middle-aged adults (aged between 18–55) in Thailand. Hence, it is imperative to prioritize BP management in this demographic to mitigate cardiovascular-related comorbidities and reduce associated healthcare costs in Thailand.

The effective management of BP entails adherence to healthy lifestyle recommendations, including dietary modifications, smoking cessation, weight reduction, and regular physical activity (PA) (Whelton et al., 2018). Among younger populations with HTN, a systematic review and meta-analysis have demonstrated that higher levels of PA, whether of moderate or vigorous intensity, result in greater reductions in systolic BP compared to other lifestyle interventions (Baena et al., 2014). Therefore, integrating regular PA is crucial for effective HTN management in young and middle-aged individuals.

To understand the impact of psychosocial factors on PA and improve BP management in this population, it is essential to utilize theory-guided and validated measures specific to the Thai context. Social Cognitive Theory (SCT), a widely used framework, provides constructs such as self-efficacy, social support, and outcome expectancy (Bandura, 1987), which have been employed to predict healthy lifestyle adherence in younger adults with HTN (Suriyawong et al., 2023). However, the relationship between these psychosocial factors and PA in the Thai population with HTN remains understudied.

Existing studies in Thailand have primarily focused on the association between psychosocial factors and PA among adults over the age of 60 with HTN (Chantakeeree et al., 2022; Jaiyungyuen & Wora-arun, 2018; Saminpanya et al., 2018). However, these studies utilized measures that lacked sufficient validation and alignment with the constructs of SCT. Importantly, the psychosocial measurements used, particularly self-efficacy and social support, were not specifically related to the domain of PA. Instead, they were evaluated in a general context rather than being specific to PA. Therefore, there is a critical need to develop and validate domain-specific measures that specifically assess psychosocial factors related to PA, such as self-efficacy, social support, outcome expectancy, and workplace support in Thailand.

To address these gaps, the objective of this pilot study was to develop and validate psychosocial measures specifically tailored to assess PA among young- and middle-aged adults with HTN in Thailand. These measures were aligned with the constructs of SCT and provided reliable insights into the psychosocial factors influencing PA behaviors. Additionally, the valuable understanding gained from this study offered significant insights for researchers and healthcare providers in Thailand when assessing psychosocial factors and perceptions of PA within this population. The study involved the translation and examination of the psychometric properties, including construct validity (i.e., content, face, structural, convergent, and discriminant validity), criterion validity, and reliability, of four psychosocial measures in this specific population.

Methods

Study Design

This cross-sectional pilot study design conducted in two phases with specific objective to: 1) translate; and 2) examine the psychometric properties of four psychosocial measures, including validity (construct [content, face, convergent, discriminant, and structural validity], and criterion validity [concurrent and predictive validity]) and reliability, postulated to be correlated with increased types of PA.

Ethical Considerations

The study underwent ethical review and obtained approval from the Michigan State University Institutional Review Board for both Phase 1 (ID: STUDY00008308) and Phase 2 (ID: STUDY00009017). In order to uphold the principles of informed consent, a rigorous consent process was implemented during the data collection phase of Phase 2. Participants were presented with clear and comprehensive information regarding the voluntary nature of their

participation, along with explicit assurance of their right to decline or withdraw from the study at any point without facing any negative consequences.

Study Setting and Subjects

Phase 1 of the study involved a meticulous selection process of eight participants. This group consisted of esteemed individuals comprising five young and middle-aged adults diagnosed with HTN, all of whom were actively employed full-time for over 20 hours per week. To ensure the methodical rigor of the study, three content experts played a vital role in evaluating the face and content validity of the study's assessments. Their valuable expertise significantly contributed to the evaluation of the assessments' quality, relevance, and suitability within the specific context of the study.

In Phase 2, the sample size comprised 250 eligible participants, consisting of working adults aged 18–55 years with HTN, seeking healthcare within a primary care setting in a province of Thailand. The inclusion criteria required participants to possess proficiency in the Thai language and engage in either part-time or full-time employment exceeding 20 hours per week. To ensure sample homogeneity, individuals with physical disabilities or diagnosed with coronary heart disease, such as heart failure or ischemic heart disease, were excluded from the study. Determining an appropriate sample size for psychometric studies has been a topic of scholarly debate, with various statistical studies suggesting ranges spanning from 30 to 400 participants (Bonett & Wright, 2015; Kline, 2000; Rea & Parker, 1992). While larger sample sizes have traditionally been advocated for factor analyses, recent research has indicated that a minimum sample size of 50 is considered acceptable (Kyriazos, 2018). Accordingly, in line with these recommendations, a sample size of 250 participants was deemed sufficient to conduct rigorous factor analyses, including confirmatory analysis and structural equation modeling.

Instrument Validity and Reliability

Self-Efficacy

The self-efficacy in PA subscale of The Self-Efficacy for Hypertension Treatment Adherence Scale, consisting of 6 items, was employed to assess the confidence levels of adults with HTN in adhering to regular PA despite facing various barriers (Zhao et al., 2021). Participants rated their confidence levels on a five-point scale, ranging from 1 (not confident) to 5 (very confident). The total score for this subscale ranged from 6 to 30, with higher scores indicating greater self-efficacy in adhering to PA recommendations. Previous research conducted among adults with HTN has established the subscale's good internal consistency, as indicated by Cronbach's alpha coefficients exceeding 0.80 (Zhao et al., 2021). Additionally, a small correlation coefficient of 0.27 was observed between self-efficacy in PA and the Seven-Day Physical Activity Recall score in the same study (Zhao et al., 2021).

Outcome Expectancy

The Outcome Expectancies of Behavioral Change Scale comprises two domains designed to evaluate the perceptions of adults with chronic diseases, including HTN, regarding the positive and negative consequences associated with adhering to regular PA (Renner & Schwarzer, 2005). The scale consists of 8 items and utilizes a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The total possible score for outcome expectancy in PA ranges from 8 to 56, with a higher sum score indicating a greater level of perceived outcome expectancy. This measure has been validated among individuals with chronic diseases, including those with HTN, demonstrating good reliability (α = 0.83) (Renner & Schwarzer, 2005). The two domains of outcome expectancy encompass positive and negative subscales, reflecting participants' perceptions of the beneficial or adverse outcomes resulting from their engagement

in PA behaviors. A higher score signifies a heightened perception of positive or negative outcome expectancy.

Social Support

The Social Support for Exercise Behavior Scale, a 5-item measure developed by Sallis et al. (1987), was employed in this study to assess participants' perceptions of functional support from family or peers in relation to regular PA (Sallis et al., 1987). Using a scale ranging from 1 (never) to 5 (very often), participants were asked to indicate the extent to which each item accurately reflected the support they received from their family or peers to maintain a PA routine. The total score was computed by summing the scores for each item. Higher scores indicated a stronger perception of functional support for engaging in regular PA. This original measure has demonstrated good internal consistency reliability (α = 0.91) and concurrent validity (r = 0.46) in relation to self-reported lifestyle behaviors, such as improved PA, particularly among younger adults (Sallis et al., 1987).

Workplace Support

To evaluate participants' perceptions of coworker and supervisor support in promoting a healthier lifestyle, particularly regarding PA, we employed the 5-item Workplace Support for Health Scale (Kava et al., 2021). Responses were rated on a 5-point Likert scale, ranging from 1 (totally disagree) to 5 (totally agree). The total sum score ranged from 5 to 25, with higher ratings indicating stronger workplace support for a healthy lifestyle. Prior research conducted among young healthy adults demonstrated satisfactory reliability (α = 0.82) and concurrent validity (r = 0.74) of this scale (Kava et al., 2021). Concurrent validity was established through a positive correlation between scale scores and increased implementation of evidence-based interventions by employers in the workplace (Kava et al., 2021).

Physical Activity

Physical activity was assessed either for moderate-to-vigorous PA [MVPA] (i.e., labor tasks and carrying objects) or low-intensity PA (i.e., walking, cleaning, and gardening) using a validated self-report measure (Thai version of the International Physical Activity Questionnaire [IPAQ-SF]; Pothirat et al., 2021) over the previous seven days. MVPA or low-intensity PA was measured using the metabolic equivalent (MET) score, which refers to the total energy expenditure used when engaging in such PA (International Physical Activity Questionnaire [IPAQ], 2005). The total MET-min/week for each PA type was calculated by multiplying the minutes, days, and MET level, which vary depending on the different types of PA (low intensity = 3.5 METs, moderate intensity = 4 METs, and vigorous intensity = 8 METs). To ensure consistency, any recorded time exceeding 4 hours or 240 minutes for low, moderate, or vigorous PA was adjusted to the maximum value of 240 minutes (IPAQ, 2005).

Phase I: Translation and Back-Translation Procedure

The process of translation and back-translation was conducted following the four steps outlined in the World Health Organization (2016) guidelines. Firstly, the forward translation from English to Thai was independently performed by the Primary Investigator (PI) and a bilingual nursing PhD candidate proficient in both languages (English and Thai). The resulting Thai versions were carefully compared and discussed to ensure consistency. This step was repeated twice until a mutual agreement was reached between the translators.

Secondly, to ensure content validity and cross-cultural relevance, an expert panel consisting of three PhD-prepared bilingual nursing professors with expertise in chronic disease management, instrument development, and translation procedures was involved. They meticulously reviewed the translated items to ensure cultural appropriateness and relevance to

Thai culture. Through virtual meetings with the PI, the expert panel addressed any issues, such as insufficient expressions or translation concepts, and resolved discrepancies throughout the translation and adaptation process. The expert panel used a content validity index (CVI) to rate their level of agreement on each item, with responses ranging from "do not agree" to "totally agree." The Thai measure version was then sent to a bilingual rater for backward translation, and the expert panel evaluated the consistency between the Thai measure and the original English version by consensus with the PI until agreement was reached.

Thirdly, following the establishment of content validity, the PI conducted a virtual focus group using Zoom. Five young- and middle-aged adults with HTN, recruited from the same clinic, participated in the group to assess the face validity of the translated version. The participants were asked to review the survey questions, identify any unclear or confusing aspects, and provide feedback on the need for modification. Any concerns raised during the focus group were discussed with the expert panel for further clarification and modification to ensure consistent terminology.

Finally, the PI reconvened with the same five participants to ensure that all concerns had been addressed in the final versions of the measures. This four-step process spanned approximately four months, from October 2022 to January 2023.

Phase II: Psychometric Properties

The PI recruited participants by accessing their paper medical records following the established protocol for protecting health information in primary care settings. Eligible participants were scheduled for in-person data collection at the primary care setting in a Thai province, receiving a research package by mail consisting of an invitation letter, consent form, and questionnaires. During data collection, the PI provided an overview of the study's purpose

and obtained written consent, allowing participants to withdraw without consequences. Participants were offered the choice to complete data collection either at the primary care setting or in a home-based environment. Study details were comprehensively explained to participants through telephone communication, and diligent reminder calls were employed to ensure survey return. The recruitment and data collection activities took place between April and June 2023

Data Analysis

The data analyses were conducted using IBM SPSS Statistics version 28 (IBM, US, 2022) and MPlus Version 8.8 software. Initially, 250 young- and middle-aged adults with HTN agreed to participate in the study. No missing data exceeding 50% was found in any variable of the survey. Therefore, 250 responses were retained for further analysis, with only 0.11% missing values remaining. To assess the missing data pattern, the Missing Completely at Random (MCAR) test was conducted (Little & Rubin, 2019), which indicated a random pattern (χ^2 = 170.471, *df* = 70, *p* = .611). To maximize the utilization of available data, multiple imputations were performed using MPlus with 10 datasets, as recommended (Jakobsen et al., 2017). Additionally, due to the non-normal distribution of most study variables based on the Kolmogorov–Smirnov test ($p < .05$), the final estimator chosen was the maximum likelihood parameter estimates with standard errors (MLR).

Content Validity

A panel of three content experts evaluated each item of the scales in terms of relevance to the underlying construct and Thai culture. The experts rated the items on a 4-point Likert scale (1 = not agreement; 4 = total agreement). The Content Validity Index (CVI) for each item was calculated by dividing the number of experts who rated it as quite agreement (3) or total

agreement (4) by the total number of experts. The mean CVI was considered an indicator of content validity.

Confirmatory Factor Analysis

The structural validity of the scales was assessed through factor analysis. Confirmatory factor analysis was performed to validate the factor structure of the observed variables. The adequacy of the number of factors within the measures was determined based on factor loadings greater than 0.60 (Kline, 2016). Confirmatory factor analysis with robust maximum likelihood (MLR) was carried out using MPlus to evaluate the fitness of the original factor structure obtained from the original study, considering potential violations of multivariate normal distribution (Muthen & Muthen, 2017). Fit indices, including the chi-square/degree of freedom ratio (χ^2/df ratio ≤ 3) (Hair et al., 2019), root mean square error of approximation (RMSEA; <0.08) (Hu & Bentler, 1999), comparative fit index (CFI) (Hair et al., 2019; Hu & Bentler, 1999), and Tucker-Lewis index (TLI) ≥ 0.95 (Hair et al., 2019; Hu & Bentler, 1999), were examined to assess the fit between the data and the proposed model. Modifications to the model were considered based on the minimum value (at least 10) for printing the modification index, aiming to increase the parsimony of the model (Muthen & Muthen, 2017).

Convergent Validity

After finalizing the modified measurement model, convergent validity was assessed by calculating the average variance extracted (AVE) in MPlus 8.8. A recommended AVE value greater than 0.50 indicated satisfactory convergent validity of the measurement model (Hair et al., 2019).

Discriminant Validity

Discriminant validity was evaluated by comparing the diagonal values (square root of AVE) with the highest correlation with any other factor. If the diagonal value exceeded the highest correlation, discriminant validity was assumed (Compeau & Higgins, 1995).

Concurrent Validity

Concurrent validity was determined by the coefficient correlation (r) between the variables in the final measurement model, which were then confirmed in the final structural equation modelling. In our analysis, we classified correlation coefficients as small (r = 0.10), moderate (r = 0.30), and large (r = 0.50) to facilitate their interpretation (Cohen, 1988).

Predictive Validity

After completing the construction of the final structural equation model, we assessed predictive validity by examining the beta coefficients (β). To facilitate their interpretation, we categorized the Beta coefficients as small (β = 0.10), moderate (β = 0.30), and large (β = 0.50) in our analysis (Cohen, 1988).

Reliability

Internal consistency reliability of each measure was assessed by calculating McDonald's Omega and composite reliability. Coefficients greater than 0.8 and 0.7, respectively, were considered acceptable (Hair et al., 2019).

Results

Participants

In phase 1, five eligible participants, who were young- and middle-aged adults with HTN (aged 27–54; M_{age} = 41.40), expressed their comprehension and satisfaction with the clarity and comprehensibility of the translated measures. Among the participants, three belonged to the

young-aged adult category (aged 27–37), representing 60% of the sample. Moreover, the participants displayed diverse educational backgrounds, including elementary school (n = 1), high school (n = 2), and higher bachelor's degree (n = 2).

During Phase 2, we reached out to 300 eligible young- to middle-aged Thai adults with HTN via telephone to inquire about their interest in participating in the study. Out of the initial cohort, 285 individuals expressed their willingness to take part. Ultimately, we received completed responses from 250 participants (87.71%) who actively engaged in the data collection process. Participants had a mean age of 46.94 years and reported an HTN duration ranging from one to 60 months (M_{duration} = 32.89 months). Approximately 60% had an educational level below high school, and 58.4% were female. Monthly household income varied from $85 to $2,500 ($M$ = $371.42).

Phase I: Translation and Back-Translation Process

Based on the recommendations of the expert panel, the self-efficacy in PA measure was adjusted to ensure its relevance in the specific geographical context of Thailand. Specifically, the item related to individuals' confidence in overcoming the PA barrier of snowing was removed and replaced with sweltering, which is more applicable to the Thai climate (refer to Table 4.4 in Appendix B). The content validity index (CVI) based on ratings from three experts ranged from 0.92 to 0.95 (refer to Table 4.3 in Appendix A).

During the assessment of face validity, five participants expressed their endorsement of the clarity and understandability of the translated instructions, item phrasing, recall period, and rating scales in Thai. This indicates good face validity for all the measures. However, during the initial focus group, one participant had difficulty understanding the distinction between the terms "myocardial infarction" and "heart disease". Despite this, the expert panel recommended keeping

this terminology in the measure. Finally, the translated instructions, item phrasing, recall period, and rating scales in Thai were reviewed and confirmed to have good face validity by the same group of five eligible participants after revisions were made.

Phase II: Psychometric Properties

Reliability

Internal Consistency Reliability. Four of the translated psychosocial measures had a McDonald's Omega coefficient greater than 0.80 (see Table 4.1).

Validity

Structural Validity. The initial confirmatory factor analysis demonstrated a poor fit of the PA components of translated measures to the data (χ^2/df =2.50, RMSEA = 0.10 (90% CI = .090–.110), CFI = 0.88, TLI = 0.86). To improve the PA model, three error covariances with the modification indices valued >10 were added to the PA measurement model (Items 1 with 2 of a self-efficacy measure [26.71], Items 3 with 4 of a outcome expectancy measure [21.68], and Items 1 with 2 of social support measure [50.44]). None of any item of measures was removed because the factor loadings were statistically significant (p >.05) with factor loading >0.6 (see Table 4.1). The final PA measurement model had overall good fit indices (χ^2/df = 1.66, RMSEA = 0.07 (90%CI = .060–.085), CFI = 0.94, TLI = 0.93).

Table 4.1: Estimates of final physical activity measurement model by confirmatory factor analysis (n = 110)

Variable	Item	Factor loading	SE	AVE	CR	ω
Self-efficacy	1	0.87	0.03	0.75	0.95	0.96
	2	0.83	0.04			
	3	0.93	0.02			
	4	0.89	0.04			
	5	0.88	0.04			
	6	0.77	0.05			

Table 4.1 (cont'd)

Variable	Item	Factor loading	SE	AVE	CR	ω
Positive outcome expectancy	1	0.87	0.04	0.83	0.97	0.98
	2	0.96	0.01			
	3	0.95	0.03			
	4	0.94	0.03			
	5	0.97	0.01			
	6	0.75	0.06			
Negative outcome expectancy	7	0.96	0.04	0.80	0.89	0.91
	8	0.82	0.05			
Social support	1	0.87	0.03	0.78	0.95	0.96
	2	0.91	0.03			
	3	0.92	0.02			
	4	0.96	0.01			
	5	0.75	0.05			
Workplace support	1	0.91	0.03	0.74	0.94	0.95
	2	0.93	0.02			
	3	0.93	0.02			
	4	0.82	0.05			
	5	0.65	0.07			

Note: χ^2 = Chi-square test; RMSEA = Root mean square error of approximate; GFI = the goodness of fit index; AGFI = adjusted goodness-of-fit index; SE = standard error; AVE = average variance extracted; CR = composite reliability; ω = McDonald's Omega coefficient

Convergent and Discriminant Validity. The AVE was greater than 0.50, indicating convergent validity (see Table 4.1). Discriminant validity among factors in PA measurement model was evaluated by using the square root of AVE and presented as the diagonal value of the correlation matrix (see Table 4.2).

Concurrent Validity. The final PA measurement model showed correlation coefficients ranging from 0.44 to 0.69 among the psychosocial variables (see Table 4.2). Structural equation modeling was then conducted to investigate the relationship between psychosocial factors and three types of PA (see Figure 4.1). Based on Social Cognitive Theory (SCT) proposed by Bandura (1987), personal factors (such as self-efficacy and outcome expectancy), behavior (PA), and environmental factors (including social support and workplace support) interact with each

other bidirectionally. Hence, in the SCT-based structural equation modeling, we hypothesized that positive and negative outcome expectancy in PA, self-efficacy in PA, social support in PA, and workplace support would be associated with three types of PA as measured by MET score. The initial PA structural model demonstrated an excellent fit with the data (χ^2/df = 2.244; RMSEA = 0.071; CFI = 0.928; TLI = 0.915), indicating that no additional pathways between variables were required. This model accounted for 5.5%, 24%, and 43.2% of the variance in vigorous, moderate, and low-intensity PA, respectively.

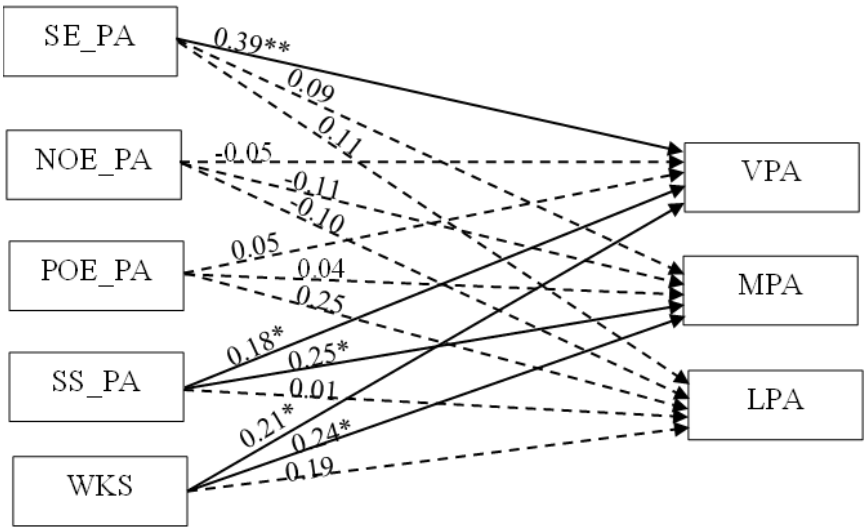
Figure 4.1 demonstrates that self-efficacy in PA had a significant positive association with vigorous-intensity PA (β = 0.39, p < .001). However, no significant associations were found between self-efficacy in PA and either moderate-intensity (p = .319) or low-intensity PA (p = .263). On the other hand, social support in PA showed positive associations with both vigorous-intensity (β = 0.18, p = .008) and moderate-intensity PA (β = 0.25, p = .014). Additionally, workplace support was positively related to both moderate-intensity (β = 0.24, p = .025) and vigorous-intensity PA (β = 0.21, p = .007).

Table 4.2: Correlation matrix between psychosocial variables in the final physical activity measurement model

Variable	1	2	3	4	5
(1) SE_PA	0.86				
(2) +OE_PA	0.55	0.91			
(3) -OE_PA	-0.44	-0.69	0.89		
(4) SS_PA	0.44	0.53	-0.43	0.88	
(5) WKS	0.62	0.80	-0.53	0.67	0.86

Note: Correlations of the measurement model was estimated using the TECH4 command in Mplus; the diagonal values in blue indicated the square root of average variance extracted (AVE); SE_PA = self-efficacy in physical activity; +OE_PA = positive outcome expectancy in physical activity; -OE_PA =negative outcome expectancy in physical activity; SS_PA = social support in physical activity, ** = p <.001; * = p <.05

Figure 4.1: Final structural equation modeling: The relationship between physical activity psychosocial factors and physical activity



Note: Solid lines indicate statistically significant paths. Dotted lines indicate a non-statistically significant path. SE_PA = self-efficacy in physical activity, NOE_PA = negative outcome expectancy in physical activity, POE_PA = positive outcome expectancy in physical activity, SS_PA = social support in physical activity, WKS = workplace support, VPA = vigorous-intensity physical activity, MPA = moderate-intensity physical activity, LPA = low-intensity physical activity * = *p*-value <.05, ** = *p*-value <.001

Discussion

The present pilot study aimed to evaluate the validity and reliability of the translated Thai versions of four psychosocial measures, with a focus on cultural adaptation. Various psychometric properties, including internal consistency, construct validity (content, face, factorial structure, convergent, and discriminant), and criterion validity (concurrent), were assessed. During the translation process, expert panel recommendations were carefully considered to ensure contextual relevance in Thailand for the self-efficacy in PA measure. After careful evaluation, it was determined that the item associated with confidence in overcoming the barrier to engaging in PA caused by snowing was deemed inappropriate and consequently removed from the assessment. In its place, the term "sweltering" was chosen to replace this particular item, ensuring its alignment with the intended construct. These modifications were

implemented to enhance the applicability and validity of the measurement tool, aligning it with the unique circumstances and climate of Thailand. The content validity index (CVI), computed based on ratings from three experts, demonstrated substantial agreement (ranging from 0.92 to 0.95), thereby affirming the item relevance during the validation process. The understandability of the translated Thai measures was effectively then assessed through two repeated focus group meetings involving five hypertensive participants. This rigorous process ensured consistency in the medical language used and provided evidence for good face validity.

The internal consistencies of the translated measures demonstrated comparable reliability to their original English versions. For instance, in our study, the Self-Efficacy for Hypertension Treatment Adherence Scale exhibited a McDonald's Omega coefficient of 0.96 for the PA subscale, whereas the original version reported a Cronbach's alpha of 0.87 (Zhao et al., 2021). Similarly, the Social Support for Exercise Behavior Scale showed a McDonald's Omega coefficient of 0.96 in our study, compared to a Cronbach's alpha of 0.85 in the original version (Sallis et al., 1987). Furthermore, the Workplace Support for Health Scale demonstrated high internal consistency, with a McDonald's Omega coefficient of 0.95 in our study, while the original version reported a Cronbach's alpha of 0.89 (Kava et al., 2021). Notably, our pilot study found high reliability (ω >0.90) for the two subscales of the outcome expectancy measure, even though the original study did not report their reliability (Renner & Schwarzer, 2005). These consistent findings support the potential use of these translated Thai measures in future research, ensuring reliable results over time.

Confirmatory factor analysis supported one-factor solutions for the translated Thai versions of self-efficacy in PA (Zhao et al., 2021), social support in PA (Sallis et al., 1987), and workplace support (Kava et al., 2021), in line with the original versions. In all translated

measures in Thai, the factor loadings for each item exceeded 0.60, indicating strong associations between the items and their respective constructs (Kline, 2016). Likewise, the outcome expectancy in PA scale exhibited a two-factor solution, consistent with the original version (Renner & Schwarzer, 2005). By examining the relationships between the factors in the measurement model, convergent and discriminant validity were evaluated. Discriminant validity is the degree to which one factor was different from another (Kline, 2016), while convergent validity is the degree to which one factor was related to other factors that measured the same construct (Campbell & Fiske, 1959). In this pilot study, all of the AVE values (>0.50) of factors in the final measurement model were greater than the recommended cut-off value, implying good convergent validity (Hair et al., 2019). From the correlation matrix table, we found that the correlations for each factor in this measurement model were less than the square root of the AVE (diagonal value), showing good discriminant validity (Campbell & Fiske, 1959).

In addition to measurement model, we performed structural equation model to investigate criterion validity (concurrent validity). In our measurement model, the small- to -moderate relationship between internal factors (self-efficacy, and outcome expectancy) and external factor (functional support and workplace support) were identified. The PA structural model revealed the associations between psychosocial factors and the three types of PA. Notably, self-efficacy in PA emerged as the strongest predictor of increased engagement in vigorous-intensity PA (β = 0.39, p <.001), surpassing the effects of workplace support (β = 0.21, p <.05) and social support (β = 0.18, p <.05). Only two psychosocial factors (social support in PA and workplace support) displayed a positive correlation with enhanced moderate-intensity PA. These findings are consistent with previous literature review that consistently demonstrates a low-to- moderate correlation between self-efficacy in PA, social support in PA, and MVPA (Suriyawong et al.,

2023). It is important to note that for individuals with HTN and the management of BP, engaging in MVPA is recommended. This recommendation suggests that hypertensive individuals should aim for either 150 minutes of moderate-intensity PA per week or 75 minutes of vigorous-intensity PA, according to the guidelines provided by the American Heart Association (Whelton et al., 2018).

According to the theoretical framework of Social Cognitive Theory (SCT) proposed by Bandura (1987), these significant associations can be explained by the direct influence of internal/personal factors, such as self-efficacy, and external factors, such as workplace support, on behavioral changes, including engagement in PA. However, we found that self-efficacy in PA did not show a significant association with moderate-intensity PA. Furthermore, the analysis did not reveal any significant relationships between positive and negative outcome expectancy in PA and any level of PA, including low-intensity, moderate-intensity, or vigorous-intensity PA. It is possible that this study's methodological flaws may interfere with our findings such as small sample size. Thus, psychosocial factors that predict low-intensity or moderate-intensity PA, such as self-efficacy or outcome expectancy, should be further investigated in the next study with an increased sample size.

We acknowledge certain limitations in our study that affect the generalizability of the findings. It is important to highlight that our results are specific to a particular subgroup, specifically young adults aged 18 to 55 years with HTN. Therefore, caution is advised when applying these findings to other populations or age groups. While cognitive interviews demonstrated the understandability and applicability of the translated measures among participants with diverse educational backgrounds, it is essential to exercise caution when interpreting face validity due to the small sample size of fewer than 20 participants (Blair &

Conrad, 2011). To enhance the generalizability and reliability of the translated measures in the Thai context, we recommend future research with larger sample sizes and broader age ranges. By incorporating diverse populations, we can gain a more comprehensive understanding of the psychometric properties and applicability of the measures, facilitating their effective utilization in various contexts.

Establishing the validity and reliability of these translated Thai measures plays a crucial role in enhancing clinical practice for individuals with HTN, specifically targeting young and middle-aged working adults. It offers an opportunity to adopt a theory-driven perspective in comprehending the psychosocial factors influencing their lifestyle behaviors and BP control. Moreover, it facilitates national and international comparisons, aiding Thai researchers in developing impactful intervention programs aimed at promoting BP control and ultimately enhancing the quality of life for young and middle-aged Thai adults with HTN.

Conclusion

This study presents the initial translation and cultural adaptation of psychosocial measures related to physical activity, guided by Social Cognitive Theory. The findings demonstrate satisfactory psychometric properties of the translated Thai measures. These measures can be employed in future research to investigate how psychosocial factors associated with physical activity recommendations are perceived by young- and middle-aged Thai adults with HTN. The use of robust statistical methods, including confirmatory factor analysis and structural equation modeling, allowed for the examination of factor loadings and the relationship between psychosocial factors and physical activity, minimizing measurement bias. Consequently, these results establish a strong foundation for the future utilization of the translated measures.

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APPENDIX A: CONTENT VALIDITY INDEX (CVI)

Table 4.3: Content validity index (CVI) of all measures, rating by three experts

Items	Expert1	Expert2	Expert3	Number in agreement	Item CVI
Self-efficacy in PA					
1	✓	✓	✓	3	1
2	✓	✓	✓	3	1
3	✓	✓	✓	3	1
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
6	✓	✓	-	2	0.67
					Mean CVI = 0.95
Outcome expectancy in PA					
1	✓	✓	✓	3	1
2	✓	✓	✓	3	1
3	✓	✓	✓	3	1
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
6	✓	✓	✓	3	1
7	✓	✓	✓	3	1
8	✓	-	-	1	0.33
					Mean CVI = 0.92
Functional support in PA					
1	✓	✓	✓	3	1
2	-	✓	✓	3	0.67
3	✓	✓	✓	2	1
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
					Mean CVI = 0.93
workplace support					
1	✓	✓	✓	3	1
2	✓	✓	✓	3	1
3	-	✓	✓	2	0.67
4	✓	✓	✓	3	1
5	✓	✓	✓	3	1
					Mean CVI = 0.93

Note: PA = physical activity

APPENDIX B: BACK-TRANSLATION AND ORGINAL MEASURES

Table 4.4: The comparison between back-translation and original version of four measures

Measure	Back-translation version	Original version
1.The Self-Efficacy for Hypertension Treatment Adherence Scale		
Self-efficacy in physical activity		
	1.When I am under high stress.	1. When I am under a lot of stress.
	2.When I feel I don't have the time.	2. When I feel I don't have the time.
	3.When I have to exercise alone.	3. When I have to exercise alone.
	4.When I don't have access to equipment for exercise.	4. When I don't have access to exercise equipment.
	5.When I'm with friends or family members who don't exercise.	5. When I am spending time with friends or family who do not exercise.
	6.When it's raining or sweltering	6. When it's raining or snowing.
2.The Outcome Expectancies of Behavioral Change Scale		
Outcome expectancy in physical activity		
	1. I'll simply feel better afterwards.	1. I will simply feel better afterwards.
	2. I will not have weight issues anymore.	2. I won't have weight problems (anymore).
	3. My cholesterol level will improve.	3. My cholesterol level will improve.
	4. It will be beneficial to my blood pressure.	4. That will be good for my blood pressure.
	5. I avert a heart disease such as myocardial infarction, heart failure.	5. I prevent a heart attack.
	6. This will improve my life quality.	6. That will mean an increase of life quality for me.
	7. I'll have to spend a lot of time each time.	7. I'll have to take a lot of time each time.
	8. That will be a burden on my financial situation.	8. That will be a burden for my financial situation.
3.The Social Support for Exercise Behaviors Scale		
	1. Exercised with me	1.Exercised with me
	2. Offered to exercise with me	2. Offered to exercise with you
	3. Provided you with helpful exercise reminders	3. Gave you helpful reminders to exercise
	4. Encouraged you to stick with your exercise program	4. Gave you encouragement to stick you're your exercise program
	5. Modified their schedule to allow you to exercise together	5. Changed their schedule so you could exercise together

Table 4.4 (cont'd)

Measure	Back-translation version	Original version
4.Workplace Support Scale		
	1.Overall, my workplace encourages me to live a healthier lifestyle.	1.Overall, my workplace supports me in living a healthier life.
	2.My employer encourages me to live a healthier lifestyle.	2.My supervisor supports me in living a healthier life.
	3. The majority of the employees here practice healthy habits.	3.Most employees here have healthy habits.
	4.At my workplace, we have one or more wellness champions (e.g., head staff or managers).	4.At my workplace we have one or more leaders (e.g. CEOs or managers) who are wellness champions.
	5.One or more employees at my workplace are wellness champions.	5.At my workplace we have one or more employees who are wellness champions.

CHAPTER 5: EXAMINING THE RELATIONSHIP AMONG SOCIAL COGNITIVE THEORY-BASED CONSTRUCTS, LIFESTYLE BEHAVIORS, AND BLOOD PRESSURE IN THAI ADULTS LIVING WITH HYPERTENSION

Abstract

In contrast to older adults, young- and middle-aged adults in Thailand grappling with hypertension often exhibit inadequate blood pressure management, possibly due to psychosocial- or work-related barriers to adhering to recommended lifestyle behaviors like physical activity and dietary adherence to a low-sodium or low-fat diet. This study, underpinned by Social Cognitive Theory, scrutinizes the intricate interplay between psychosocial factors (perceived stress, self-efficacy, outcome expectancy), environmental factors (functional and workplace support), lifestyle behaviors, and blood pressure management in this population. The analysis encompassed 400 adults with hypertension (M_{age} = 47.98 years; *SD* = 7.66), with nearly 60% being female. Findings highlight self-efficacy in physical activity as a potent predictor of moderate-to-vigorous physical activity (β = 0.26, p <.001), while functional support in physical activity emerged as a determinant associated with reduced systolic blood pressure (β = -0.24, p <.001). Regarding dietary adherence, self-efficacy in dietary adherence demonstrated noteworthy associations with adherence to low-sodium (β = 0.36, p <.001) and low-fat (β = 0.16, p = .035) diets, along with systolic (β = -0.25, p <.001) and diastolic blood pressure (β = -0.16, p = .002).

Moreover, moderate-to-vigorous physical activity emerged as a significant mediator between self-efficacy in physical activity (indirect effect = -0.050, p = .005) or functional support in physical activity (indirect effect = -0.031, p = .046) and systolic blood pressure. Notably, HTN duration significantly moderated the relationship between moderate-to-vigorous physical activity ($\Delta\chi^2$ = 7.424, p = .006) or functional support in physical activity ($\Delta\chi^2$ = 4.173, p

= .041) and diastolic blood pressure in the shorter HTN duration group (≤1 year) compared to the longer duration group (>1 year). In addition, both systolic and diastolic blood pressures exhibited a negative association with moderate-to-vigorous, low-intensity physical activity, and adherence to a low-sodium and low-fat diet among hypertensive adults (β = -0.18 to -0.33).

Keywords: Physical activity, dietary adherence, blood pressure, perceived stress, self-efficacy, outcome expectancy, functional support, workplace support, medication adherence, young adults, middle-aged adults.

Introduction

Hypertension (HTN) is a pervasive global health issue, contributing significantly to cardiovascular diseases and premature mortality, particularly in Asian countries (Chia et al., 2020). Projections from the World Health Organization indicate that the prevalence of HTN among adults will surpass 40% by 2050 (World Health Organization, 2021), leading to an alarming annual death toll exceeding 10 million in the absence of effective interventions. Notably, low- and middle-income Asian countries, including Thailand, bear a disproportionately higher burden of HTN compared to their high-income counterparts (Mills et al., 2020). The prevalence of HTN across 44 low- and middle-income countries stands at approximately 20% (Geldsetzer et al., 2019). In Thailand, the cumulative prevalence of HTN among adults has surged by 25%, from 1.2 million in 2017 to approximately 1.5 million in 2021, with a notable impact on young- and middle-aged adults between 18 and 55 years (National Statistical Office Thailand [NSO], 2020; Sakboonyarat et al., 2019). The escalating mortality rate associated with HTN underscores the urgency of timely preventive managements, particularly for individuals diagnosed at a young age (NSO, 2020).

Regrettably, the attainment of optimal blood pressure (BP) management among young- and middle-aged Thai adults with HTN remains suboptimal, with only one-third successfully achieving their goals compared with half in older adults aged over 60 (Sakboonyarat et al., 2019). Timely lifestyle modifications assume paramount significance in effective BP management, particularly for individuals newly diagnosed with HTN (Whelton et al., 2018). Young- and middle-aged adults exhibit a greater propensity to embrace lifestyle changes immediately or within a few years following the diagnosis of a chronic illness (Newsom et al., 2012). The critical period of the first five years subsequent to an HTN diagnosis significantly influences the success of lifestyle modifications (Amoah et al., 2020). Consequently, a comprehensive understanding of the impact of psychosocial factors on lifestyle behaviors and BP management among these young- and middle-aged adults within this crucial five-year timeframe is imperative for formulating effective strategies to prevent HTN-related comorbidities and mortality.

Efficient and timely BP management assumes paramount importance in averting the development of serious cardiovascular diseases. Noteworthy findings from Ettehad et al. (2016) demonstrate a 20% reduction in major adverse cardiovascular risks, including myocardial infarction, through early and effective BP management (Ettehad et al., 2016). Lifestyle behaviors are unequivocally recommended as the first-line approach to BP management, underscoring the significance of regular physical activity (PA) and adherence to a low-sodium and low-fat diet (DA), particularly for Asian adults with HTN (National Institutes of Health, 2021). Synthesizing evidence from a systematic review and meta-analysis of 43 studies (Baena et al., 2014) reveals a significant reduction in systolic BP by 11.37 mmHg among adults with HTN in middle-income countries through engagement in regular PA. Moreover, the combination of regular PA with DA

yields a pronounced effect, lowering systolic BP by 16.10 mmHg among Africans with HTN, compared to interventions that solely focus on a low-sodium diet (Blumenthal et al., 2010). Multiple studies have found a significant reduction in mortality rate among uncontrolled hypertensive adults who engage in regular PA and DA, highlighting the health benefits of lifestyle modifications (Jeong et al., 2019; Joseph et al., 2019; Soltani et al., 2020; Wang et al., 2021). Nonetheless, despite the myriad advantages of adopting healthy lifestyles to prevent HTN-related comorbidities and mortality, young- and middle-aged Thai adults with HTN display a lower propensity for adoption of these behaviors compared to their older counterparts (Apidechkul et al., 2022; Namwong et al., 2015). For instance, Apidechkul et al. (2022) found that 65% of young- and middle-aged adults with HTN did not engage in PA, and about 50% consumed excessive sodium. In contrast, Namwong et al. (2015) reported that over 60% of Thai adults over 60 with HTN met recommended PA levels (150 minutes per week) and followed dietary guidelines (e.g., low-sodium or low-fat diets). Thus, examining the psychosocial factors' contribution to young- and middle-aged Thai adults' BP management is critical.

Social Cognitive Theory (SCT) posits bidirectional associations between personal factors (beliefs and thoughts) and external factors (social environment) in driving behavioral change (Bandura, 1987). Self-efficacy, perceived stress, and outcome expectancy represent critical personal factors within SCT, while social support assumes significance as an external environmental factor (Bandura, 1987). Among younger adults with HTN in Western and Middle Eastern countries, these SCT factors have emerged as substantial determinants of recommended lifestyle behaviors for BP management (Suriyawong et al., 2023). Regrettably, limited research has explored these relationships within the context of Thailand. Additionally, investigations examining the link between workplace support as a form of social support and PA or DA in

young- and middle-aged adults diagnosed with HTN within five years remain scarce. Given the cultural variations between Western and Eastern countries, further SCT-based inquiry is crucial.

This study builds on the results of our previous two psychometric validation studies in which we employed structural equation modeling and found distinctive relationships between psychosocial factors and recommended lifestyle behaviors (DA and PA) in young- and middle-aged Thai adults diagnosed with HTN within five years. However, it's essential to note that these two explorations were conducted with relatively small sample sizes (n = 100 in DA model, n = 250 in PA model). Moreover, biological outcomes (systolic and diastolic BP) were not assessed in our previous psychometric evaluations Therefore, our current study incorporates a larger sample size and aims to verify the influences of personal and environmental factors on these young- and middle-aged adults' lifestyles and BP (systolic and diastolic). A fuller understanding can inform the development of effective interventions that can improve BP management, ultimately contributing to enhancing overall well-being among the young- and middle-aged adults with HTN in Thailand.

Purpose

The purpose of this cross-sectional study was fourfold: 1) to examine the relationships of SCT-based constructs (perceived stress, self-efficacy, outcome expectancy, functional support, workplace support) with DA and PA, and systolic/diastolic BP; 2) to explore the potential mediation effects of DA and PA on the associations between the SCT-based constructs and systolic/diastolic BP; 3) to investigate moderation effects of HTN medication adherence and HTN diagnosis duration on the relationship among SCT-based constructs, DA/PA, and systolic/diastolic BP via group comparison modeling; and 4) to compare the impacts of DA and PA on systolic/diastolic BP.

Methods

Sample

A total of 400 participants aged between 18 and 55 years were recruited from 25 primary care settings in the Songphinong district, Suphanburi province, Thailand, which accounted for 64% of the total adults with HTN in the Suphanburi province (Health Administration Division Thailand, 2021). The sample size estimation was completed using the A-Priori Sample Size for Structural Equation Models program. The study's parameter values were based on the following: (a) anticipated small effect size = 0.30 (both DA and PA model), (b) desired statistical power level = 0.9, (c) number of latent variables (8 in the DA model and 7 in the PA model), (d) number of observed variables (12 in the DA model and 11 in the PA model), and (e) probability level of .01. A minimum sample size of 265 and 257 can achieve a desired statistical power of 90% for the DA and PA models, respectively. The selected effect size was based on the reported correlations between the psychosocial factors and recommended lifestyle behaviors (DA or PA) in our previous studies and ranged from 0.20 to 0.40. We oversampled by about 30% to account for the potential nonresponse rate, missing data, and significant covariant that needs to be included in additional mediation or moderation analyses. Therefore, our sample size of 400 was considered sufficient to examine the study's four objectives.

The inclusion criteria were that an individual: (a) was diagnosed with primary HTN within the past five years as documented in their medical record; (b) was between 18 and 55 years of age; (c) was able to read and communicate in the Thai language; (d) held a job of equal or greater than 20 hours per week; and (e) was willing to have their blood pressure measured at least twice in a same visit. We excluded individuals who: 1) had documented physical

disabilities or cognitive/psychological impairments; or 2) had a diagnosis of coronary heart diseases (i.e., heart failure, ischemic heart disease); and 3) were pregnant.

Procedures

Recruitment for the study (STUDY00009017) commenced after obtaining approval from the Michigan State University Institutional Review Board. The primary investigator (PI) meticulously reviewed the medical records to purposefully select eligible participants. Subsequently, the PI directly contacted them via phone calls and/or extended invitations in-person to participate in the study.

During the screening phone call, inclusion and exclusion criteria were used to determine participants' eligibility. Once eligibility was confirmed and verbal consent was obtained, the PI scheduled in-person data collection appointments within one week. The in-person data collection took place in a private counseling room at a primary care setting and participants' systolic/diastolic BP were assessed following the National Health Commission Office, Thailand (2023) protocol. To streamline the process, a group of five participants was scheduled simultaneously for data collection.

Prior to completing the paper-and-pencil questionnaires and BP assessments, participants were required to provide written consent. The consenting participants were encouraged to complete all data collection during the same visit. For those who preferred to complete the questionnaires at home, the PI explained the study information by phone and then mailed a study package with a consent form to their home, along with a pre-stamped return envelope so they could return the consent form and completed study questionnaire by mail. In such cases, their BP measurements were taken at a time and place agreeable to both parties. The majority of participants (about 85%) underwent BP measurements at the primary care setting. Participants

who completed data collection received compensation of approximately $10. The recruitment and data collection activities took place between April 17 and July 28, 2023.

Measurements

Demographic Characteristics

A demographic survey developed by the PI in the Thai language was used to assess participants' demographic characteristics. The survey consisted of eleven items: 1) age, 2) sex, 3) personal monthly income, 4) marital status, 5) educational level, 6) smoking status, 7) alcohol drinking status, 8) working hours per week, 9) height (centimeter), 10) weight (kilogram), and 11) duration of HTN (measured in months). Additionally, body mass index (BMI) is determined by dividing an individual's weight in kilograms by the square of their height in meters.

Hypertension Medication Adherence

The 8-item Morisky Medication Adherence Scale (Thai version) with acceptable test-retest reliability (r = 0.83; Sakthong et al., 2009) was used to assess participants' adherence to taking their HTN medication. Participants provided dichotomous responses (i.e., yes/no, or never/always) for these eight items. A score of 1 or 0 was assigned to each item, with a total possible score ranging from 0 to 8. A sum score of 8 represents high adherence, while scores of 6–7 and 0–5 are moderate and low medication adherence, respectively.

A Low-Sodium and Low-Fat Diet

To pilot test with young- and middle-aged Thai adults with HTN to assess their low-sodium and low-fat diet intake, we selected the two items (Items 4 and 9) of the Dietary Adherence Scale-Thai version with acceptable internal (α = 0.63) and external reliability (ICC = 0.96). Each item was assigned a score of 0 to 1. This component score criteria for consuming a particular food was estimated using a scoring scheme adopted from Folsom et al. (2007) and the

Thailand Department of Health (2020). A score of 1 was given to individuals who consumed sodium or fats at or less than the recommended amount for these two food items, 0.5 to those who were close, and 0 to those who exceeded the suggested maximum intake value.

Physical Activity

The International Physical Activity Questionnaire-Short Form (IPAQ-SF, Thai version), which consisted of seven items, was used to assess the amount of time spent each day performing vigorous-, moderate-, and low-intensity activity over the previous 7 days. This instrument has undergone translation into Thai and has been validated with Thai adults, yielding good reliability (α = 0.96; Pothirat et al., 2021). The collected data from the IPAQ-SF were transformed into MET-minute scores, representing various types of physical activities. The calculation process involved computing total MET-minute scores for each type of PA by applying the coding instructions, which entailed the multiplication of minutes, days, and MET levels (3.5 for low intensity, 4 for moderate, 8 for vigorous). The summation of moderate and vigorous MET-minute scores constituted the metric for moderate-to-vigorous PA (MVPA), while low-intensity PA relied solely on its MET-minute score. A higher MET-minute score corresponded to a higher level of PA.

Blood Pressure Assessment

Participants' systolic and diastolic BP were independently obtained after 5 minutes of rest with the Omron HEM-907 electronic sphygmomanometer, which has been validated in hypertensive patients to within 0.2 mmHg by the International Protocol (El Assaad et al., 2002). More specifically, systolic/diastolic BP was measured at two distinctive times (two minutes apart) to minimize random errors (Muntner et al., 2019). If the difference between these two readings exceeded 10%, a third measurement would be taken. Finally, the two closest readings

were averaged to represent the systolic and diastolic BP. Since systolic BP readings >140 mmHg and diastolic BP >90 mmHg is generally considered an inadequate BP management in hypertensive patients (Whelton et al., 2018), in such cases, participants were advised to follow up with their physicians (Sirisawat et al., 2022).

Psychosocial Factors

The Thai version of SCT-based psychosocial measures within the context of DA or PA behaviors were used to assess self-efficacy, outcome expectancy, functional support, perceived stress, and workplace support. All measures had demonstrated good reliability and validity (see Table 5.1).

Table 5.1: Detailed information about selected psychosocial measures

Measure, Thai version	Variable names: constructs	Details of measure	Validity in literature	Reliability in literature
The Self-Efficacy for Hypertension Treatment Adherence Scale	Self-efficacy in Dietary Adherence (DA)	6-item 5-point Likert scale	r = 0.54 with workplace support, CVI = 0.89, good convergent (AVE = 0.50) (Suriyawong et al., under review[a])	ω = 0.85 (Suriyawong et al., under review[a])
	Self-efficacy in Physical Activity (PA)	6-item 5-point Likert scale	r = 0.39 with MVPA using self-report, CVI = 0.88, good convergent (AVE = 0.50) (Suriyawong et al., under review[b])	ω = 0.87 (Suriyawong et al., under review[b])
The Outcome Expectancies of Behavioral Change Scale	Outcome expectancy in DA: 1) negative and 2) positive	6-item (3 negative items and 3 positive items) 7-point rating scale	r = 0.40 with functional support in DA self-report) (Suriyawong et al., under review[a])	$\omega_{\text{negative subscale}}$ = 0.89, $\omega_{\text{positive subscale}}$ = 0.78 (Suriyawong et al., under review[a])
	Outcome expectancy in PA: 1) negative and 2) positive	8-items (2 negative items and 6 positive items) 7-point rating scale	r = 0.39 with vigorous PA self-report, good convergent (AVE = 0.75) (Suriyawong et al., under review[b])	$\omega_{\text{negative subscale}}$ = 0.98, $\omega_{\text{positive subscale}}$ = 0.91 (Suriyawong et al., under review[b])

Table 5.1 (cont'd)

Measure, Thai version	Variable names: constructs	Details of measure	Validity in literature	Reliability in literature
The Perceived Stress Scale	Perceived stress: 1) perceived distress and 2) coping ability	10-item 5-point Likert scale	r = 0.60 with the State Trait Anxiety Inventory (Wongpakaran & Wongpakaran, 2010)	α = 0.80 (Wongpakaran & Wongpakaran, 2010)
The Social Support for Diet and Exercise Behaviors Scale	Functional support in DA: 1) positive comment and 2) negative comment	10-item 5-point Likert scale	$r_{\text{positive comment}}$ = 0.34 with DA in a low-sodium and low-fat diet self-report, good convergent (AVE = 0.57) (Suriyawong et al., under review[a])	$\omega_{\text{positive comment}}$ = 0.82, $\omega_{\text{negative comment}}$ = 0.86 (Suriyawong et al., under review[a])
	Functional support in PA	5-item 5-point Likert scale	r = 0.18 with vigorous PA self-report, CVI = 0.93, good convergent (AVE=0.78) (Suriyawong et al., under review[b])	ω = 0.85 (Suriyawong et al., under review[b])
The Workplace Support for Health	Workplace support	5-item 5-point Likert scale	r = 0.35 with functional support in DA, CVI = 0.93, good convergent (AVE = 0.55) (Suriyawong et al., under review[a])	ω = 0.89 (Suriyawong et al., under review[a])

Note: CVI = Content validity index; r = correlation coefficient; AVE = average variance extracted; α = Cronbach's Alpha, ω = McDonald's Omega coefficient; DA = dietary adherence; PA = physical activity; MVPA = moderate-to-vigorous physical activity

Statistical Analysis

Descriptive analyses were conducted using the Statistical Package for Social Sciences (SPSS 28). Pearson's chi-square tests were performed to examine the relationships between the demographic factors and BP management status. All variables, particularly outcome variables, were evaluated for their normal distributions using Kolmogorov-Smirnov and Shapiro-Wilk (Mishra et al., 2019). Percentage and pattern of missing data were analyzed using Little's

Missing Completely at Random Test (MCAR). A missing pattern appeared to be random (χ^2 = 910.811, *df* = 868, *p* = .152) and with less than 1% of missing values noted. Multiple imputations (10 datasets) were conducted using Mplus to maximize the use of all available data (Jakobsen et al., 2017).

A robust statistical analysis package (Mplus version 8.7) was used to examine the relationships among psychosocial determinants, recommended lifestyle behaviors (DA and PA), and BP management (systolic and diastolic BP) simultaneously. Four global fit indices were used to estimate the model fit (both measurement and structural model), including Chi-square/degree of freedom ratio (χ^2/df ratio $\leq$3) (Hair et al., 2019; Kline, 2000), root mean square error of approximate (RMSEA; <0.08) (Chen et al., 2008; Hu & Bentler, 1999), comparative fit index (CFI) and Tucker-Lewis index (TLI $\geq$0.95) (Hair et al., 2019; Hu & Bentler, 1999). The minimum value for printing the modification index (M.I.) greater than 10.00 was used to consider model modification to increase the parsimony of the model (Muthen & Muthen, 2017). Both unstandardized and standardized coefficients were evaluated and reported to evaluate the direct and indirect associations between hypothesized variables and latent factors (Chou & Bentler, 2002).

Using the Mplus IND function, we performed a mediation analysis to explore the mediating effect of lifestyle behaviors encompassing a low-sodium diet, a low-fat diet, MVPA, and low-intensity PA. Our approach adhered to mediation analysis assumptions as outlined by Jung (2021). This analysis was prompted by the significant relationship found between psychosocial factors (independent variables) and BP (dependent variables: both systolic and diastolic). The 5,000 BC bootstrap method and BC bootstrapping of the 95% confidence intervals (CIs) for indirect effects were used to test the significance and degree of the mediation

effect (Muthen & Muthen, 2017). In addition, we validated this significance using the Sobel Test calculator at https://www.danielsoper.com, which assesses the significance of the indirect effect of the independent variable on the dependent variable through the mediator.

We utilized the DIFFTEST procedure within Mplus to determine moderation effects. The investigation focuses on examining the moderating effects of HTN medication adherence and diagnosis duration, building upon the significant relationships previously identified using the final DA or PA structural equation modeling. Within the existing DA or PA structural model, we categorized individuals into three groups based on HTN medication adherence (Low, Moderate, and High) and two groups based on HTN duration (<1 year and >1 year), followed by a comparative analysis. Our moderation analysis was initiated with the most constrained model (the nested model), wherein initial assumptions held all pathways to be equal across the groups of HTN medication adherence or diagnosis duration models. Gradually, pathways were selectively relaxed one by one, enabling the examination of group disparities and the evaluation of changes in chi-square values ($\Delta\chi^2$). This systematic approach yielded valuable insights into the notable variations observed among these groups. Additionally, we conducted a post-hoc analysis involving a two-group comparison model based on HTN medication adherence, specifically above and below the mean.

Results

Participants

Table 2 provides an overview of the participants' characteristics. The study included a total of 400 participants, of whom 58.8% were female; the mean age of participants was 47.98 years (*SD* = 7.66). Approximately 49% of the participants exhibited a BMI exceeding 25 kg/m^2. The majority of participants (61.5%) reported a monthly household income below $285 USD,

and nearly 50% were employed in general labor. Moreover, more than 70% had an educational attainment below high school level. In terms of health behaviors, approximately 80% reported smoking fewer than 10 cigarettes per day, and 60.3% engaged in regular alcohol consumption, typically 2–4 times per month. In addition, more than half of the participants (56.8%) worked more than 40 hours per week. Approximately 25% demonstrated high adherence to HTN medication. Pearson's chi-square tests also revealed significant correlations between demographic variables (HTN medication adherence and diagnosis duration) and BP status (see Table 5.2).

Table 5.2: Participant demographics (n = 400)

Demographic characteristics	n (%)	BP status		χ^2	*p-value*
		SBP/DBP <140/90 mmHg n (%)	SBP/DBP ≥140/90 mmHg n (%)		
Age (M = 47.98, SD =7.66)				25.378	.068
Young-aged (18–35 years)	43(10.8)	18(41.9)	25(58.1)		
Middle-aged (36–55 years)	357(89.2)	182(51.0)	175(49.0)		
Sex				4.975	.426
Female	235(58.8)	152(64.7)	83(35.3)		
Male	165(41.2)	100(60.6)	65(39.4)		
Hypertension diagnosis duration (months; M = 32.73, SD = 15.73)				27.394	**<.001**
≤12	60(15.0)	23(38.3)	37(61.7)		
13–24	79(19.8)	53(67.1)	26(32.9)		
25–36	108(27.0)	81(75.0)	27(25.0)		
37–48	92(23.0)	68(73.9)	24(26.1)		
49–60	61(15.3)	42(68.9)	19(31.1)		
Body mass index (kg/m^2)				2.129	.546
Underweight (<18.5)	8(2.0)	7(87.5)	1(12.5)		
Normal (18.5–22.9)	107(26.8)	69(64.5)	38(35.5)		
Overweight (23–24.9)	78(19.5)	54(69.2)	24(30.8)		
Obese (>25.0)	194(48.5)	127(65.5)	67(34.5)		
Monthly household income				1.339	.720
<$285 USD	246(61.5)	164(66.7)	82(33.3)		
$285–850 USD	104(26.0)	66(63.5)	38(36.5)		
$851–1,449 USD	28(7.0)	21(75.0)	7(25.0)		

Table 5.2 (cont'd)

Demographic characteristics	*n* (%)	BP status		χ^2	*p-value*
		SBP/DBP <140/90 mmHg *n* (%)	SBP/DBP ≥140/90 mmHg *n* (%)		
Monthly household income					
≥$1,450 USD	6(1.5)	4(66.7)	2(33.3)		
Education level				1.789	.878
No schooling completed	159(39.8)	107(67.3)	52(32.7)		
Less than high school	142(35.5)	98(69.0)	44(31.0)		
High school	26(6.5)	17(65.4)	9(34.6)		
Some diploma/Bachelor	57(14.2)	34(59.6)	23(40.4)		
Higher than Bachelor degree	16(4.0)	11(68.8)	5(31.2)		
Marital status				2.843	.241
Single	59(14.8)	37(62.7)	22(37.3)		
Married	311(77.8)	206(66.2)	105(33.8)		
Widowed/separated/divorced	30(7.5)	24(80.0)	6(20.0)		
Smoking status (Yes)	76(19.0)			1.570	.666
≤10 cigarettes/day	60(78.9)	36(61.0)	24(39.0)		
11–20 cigarettes/day	12(15.8)	8(66.7)	4(33.3)		
21–30 cigarettes/day	4(5.3)	2(50.0)	2(50.0)		
Drinking alcohol status (Yes)	121(30.3)			6.790	.147
Once a month	20(16.5)	16(80.0)	4(20.0)		
2–4 times a month	73(60.3)	41(56.2)	32(43.8)		
2–3 times a week	24(19.8)	18(75.0)	6(25.0)		
>4 times a week	4(3.4)	2(50.0)	2(50.0)		
Occupation				2.300	.681
Farmer	114(28.5)	79(69.3)	35(30.7)		
Government official	42(10.5)	29(69.0)	13(31.0)		
General labor	196(49.0)	93(46.6)	103(53.4)		
Office employee	48(12.0)	27(57.4)	21(42.6)		
Working hours/week				0.037	.848
20–40 hours	173(43.2)	114(65.9)	59(34.1)		
>41 hours	227(56.8)	141(66.8)	70(33.2)		
Hypertension medication adherence				9.872	**.007**
Low	119(29.8)	33(27.7)	86(72.3)		
Moderate	182(45.5)	125(68.7)	57(31.3)		
High	99(24.7)	35(50.7)	34(49.3)		

Note: SBP = systolic blood pressure; DBP = diastolic blood pressure

Measurement Model

Confirmatory factor analysis conducted initially indicated that both measurement models had an acceptable fit to the data. For DA model, the fit indices were as follows: $\chi^2/df = 2.50$, RMSEA = 0.100 (90% CI = 0.090–0.011), CFI = 0.885, and TLI = 0.869. For PA model, the fit indices were: $\chi^2/df = 3.04$, RMSEA = 0.079 (90% CI = 0.075–0.083), CFI = 0.829, and TLI = 0.810. Because of poor factor loading (λitem4 = 0.32, λitem5 = 0.18) with *p*-values greater than .05, Items 4 and 5 of the functional support in the DA measure were removed.

To improve the model fit, we incorporated additional correlation pathways based on the M.I. values greater than 10.00. Specifically, two correlation pathways were added to the DA measurement model and five correlation pathways were added to the PA measurement model. These pathways included the following items: DA (Items 1 and 2 of the self-efficacy measure, Items 4 and 5 of the workplace support measure) and PA (Items 1 and 2 of the self-efficacy measure, Items 4 and 5 of the outcome expectancy measure, Items 1 and 2 of the perceived stress measure, Items 1 and 2 of the functional support measure, and Items 1 and 2 of the workplace support measure).

The final measurement models for DA and PA exhibited a strong alignment with the data. The DA model's fit was adequate with the following indices: $\chi^2/df = 1.80$, RMSEA = 0.049 (with a 90% CI of 0.044–0.054), CFI = 0.946, and TLI = 0.938. Similarly, the PA model's fit was good with the following indices: $\chi^2/df = 1.86$, RMSEA = 0.048 (90% CI = 0.043–0.053), CFI = 0.952, and TLI = 0.947. In both final measurement models, all standardized factor loadings were statistically significant ($p < .001$) and exceeded 0.6, ranging from 0.66 to 0.97 for the DA model and 0.66 to 0.95 for the PA model (see Tables 5.7 and 5.8 in Appendix A). Furthermore, examining the proposed correlations between variables within these models revealed a range of

low-to-moderate correlations (see Table 5.9 in Appendix A). Specifically, correlations for the DA model ranged from 0.18 to 0.57, while those for the PA model ranged from 0.25 to 0.53.

Structural Model

We conducted structural modeling to examine the relationships among psychosocial factors (self-efficacy, outcome expectancy, perceived stress, functional support, and workplace support), DA to a low-sodium and low-fat diet, PA, and BP. The initial PA and DA models showed a good fit to the data based on four global fit indices (PA model: $\chi^2/df = 1.84$, RMSEA = 0.050 [90% CI = 0.046–0.055], CFI = 0.943, TLI = 0.935; DA model: $\chi^2/df = 2.26$, RMSEA = 0.062 [90% CI = 0.057–0.066], CFI = 0.917, TLI = 0.902). All factor loadings in both models were significant ($p < .001$) and above 0.60 (PA ranged from 0.71 to 0.95, DA ranged from 0.68 to 0.96). No further modifications were needed.

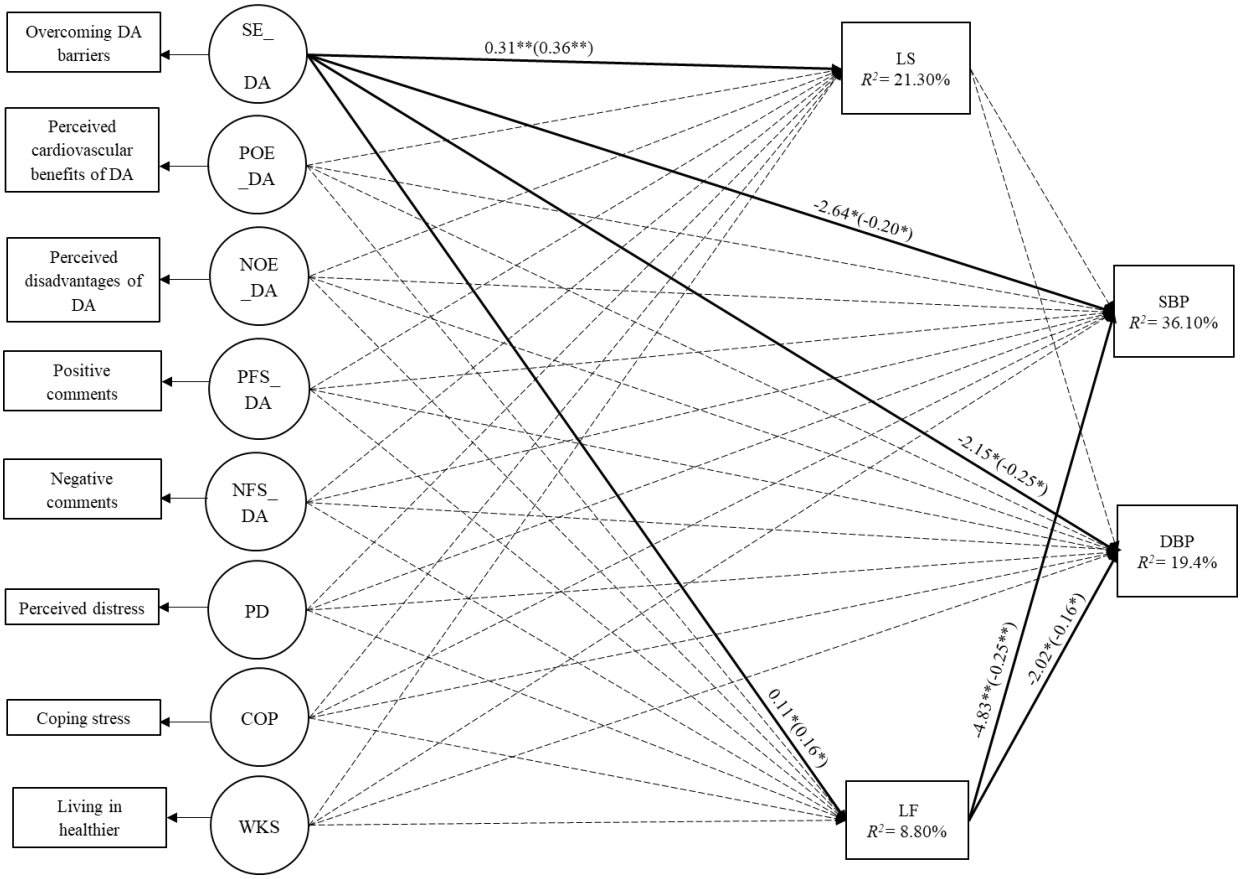
The path coefficients in the final structural equation models are presented in Figures 5.1 and 5.2. The final DA model explained 21.30% and 8.80% of the variance in low-sodium and low-fat DA, and 36.1% of systolic BP and 19.4% of diastolic BP, respectively. The final PA model explained 22.8% and 4.6% of the variance in MVPA and low-intensity PA, respectively. It also accounted for 38.4% of the variance in systolic BP and 18.40% for diastolic BP.

In the DA model, self-efficacy in DA was significantly associated both with adherence to a low-sodium diet ($\beta = 0.36$, $p < .001$) and low-fat diet ($\beta = 0.16$, $p = .035$) among all SCT-based factors. Furthermore, only self-efficacy in DA was related to both systolic BP ($\beta = -0.20$, $p = .002$) and diastolic BP ($\beta = -0.25$, $p = .001$). Only a low-fat diet had a small relationship with systolic ($\beta = -0.25$, $p < .001$) and diastolic BP ($\beta = -0.16$, $p = .002$).

In the PA model, increased self-efficacy in PA ($\beta = 0.26$, $p < .001$) and functional support in PA ($\beta = 0.22$, $p < .001$) were identified as significant predictors of MVPA, while no SCT-

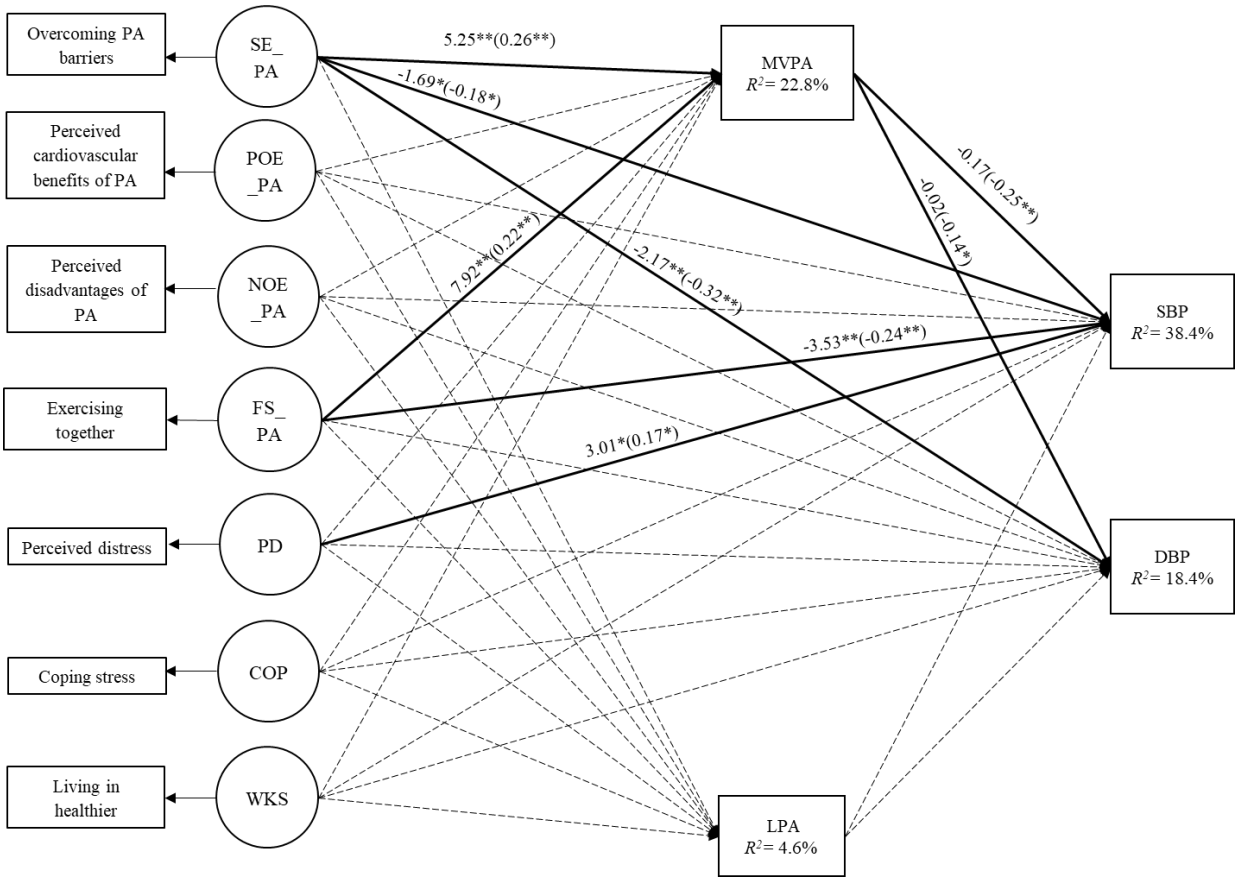
based factors were correlated with low-intensity PA. Self-efficacy in PA was significantly correlated with both systolic (β = -0.18, p = .012) and diastolic BP (β = -0.32, p <.001), while functional support in PA (β = -0.24, p <.001) and perceived distress (β = -0.17, p = .011) were only associated with systolic BP. When evaluating the correlation between different types of PA and BP, only MVPA exhibited a significant association with lower systolic (β = -0.25, p <.001) and diastolic BP (β = -0.14, p = .008).

Figure 5.1: Final dietary adherence structure model of Thai young- and middle-aged adults with HTN (n = 400)



Note: Solid lines indicate statistically significant paths. Dotted lines indicate a non-statistically significant path. Standardized coefficients are presented in parentheses. * = p-value <.05; ** = p-value <.001; SE_DA = self-efficacy in dietary adherence; POE_DA = positive outcome expectancy in dietary adherence; NOE_DA = negative outcome expectancy in dietary adherence; PFS_DA = positive functional support in dietary adherence; NFS_DA = negative functional support in dietary adherence; PD = perceived distress; COP = coping ability; WKS = workplace support; LS = a low-sodium diet; LF = a low-fat diet; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Figure 5.2: Final physical activity structure model of Thai young- and middle-aged adults with HTN (n = 400)



Note: Solid lines indicate statistically significant paths. Dotted lines indicate a non-statistically significant path. Standardized coefficients are presented in parentheses. * = p-value <.05; ** = p-value <.001; SE_PA=self-efficacy in physical activity; POE_PA = positive outcome expectancy in physical activity; NOE_PA = negative outcome expectancy in physical activity; FS_PA = functional support in physical activity; PD = perceived distress; COP = coping ability; WKS = workplace support; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Mediation Analysis

In the DA model, we did not find any significant mediation of either a low-sodium or low-fat DA on the association between self-efficacy in DA and systolic or diastolic BP (see Table 5.3). In comparison to the PA model, the association of self-efficacy in PA (indirect effect = -0.050, p = .005) and functional support in PA (indirect effect = -0.031, p = .046) with systolic

BP were partially mediated by MVPA (see Table 5.4). MVPA also partially mediated the relationships between self-efficacy in PA and diastolic BP (indirect effect = -0.031, p = .037).

Table 5.3: Mediation effects of dietary adherence on young- and middle-aged adults with HTN on psychosocial factors and blood pressure

Pathway A→ B→ C	Mplus (Bootstrap)			Mediation Interpretation	Sobel test	
	Indirect effect A via B to C	Direct effect A to C	95% CI		*Z*-statistic	*p*-value
SE_DA→LS→SBP	-0.024^{ns}	-0.204*	-0.064, 0.011	No	-1.101	.271
SE_DA→LF→SBP	-0.041^{ns}	-0.204*	-0.081, -0.007	No	-1.927	.051
SE_DA→LS→DBP	-0.037^{ns}	-0.251*	-0.088, 0.007	No	-1.367	.171
SE_DA→LF→DBP	-0.026^{ns}	-0.251*	-0.056, -0.003	No	-1.662	.097

Note: Standardized path coefficients for indirect effects obtained from Mplus IND function. SE_DA = self-efficacy in dietary adherence; LS = a low-sodium diet; LF = a low-fat diet; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05.

Table 5.4: Mediation effects of physical activity on young- and middle-aged adults with HTN on psychosocial factors and blood pressure

Pathway A→ B→ C	Mplus (Bootstrap)			Mediation Interpretation	Sobel test	
	Indirect effect A via B to C	Direct effect A to C	95% CI		*Z*-statistic	*p*-value
SE_PA→MVPA→SBP	**-0.050***	**-0.198***	**-0.084, 0.021**	**Partially**	**-2.935**	**.003**
SE_PA→LPA→SBP	-0.003^{ns}	-0.198*	-0.020, 0.011	No	-0.317	.751
SE_PA→MVPA→DBP	**-0.031***	**-0.305****	**-0.064, 0.008**	**Partially**	**-2.081**	**.037**
SE_PA→LPA→DBP	-0.001	-0.305**	-0.013, 0.005	No	-1.123	.262
FS_PA→MVPA→SBP	**-0.031***	**-0.233****	**-0.061, 0.007**	**Partially**	**-1.948**	**.046**
FS_PA→LPA→SBP	0.001^{ns}	-0.233**	-0.014, 0.018	No	-0.078	.938
PD→MVPA→SBP	0.014^{ns}	0.140*	-0.036, 0.004	No	1.154	.249
PD→LPA→SBP	0.005^{ns}	0.140*	-0.008, 0.016	No	0.638	.524

Note: Standardized path coefficients for indirect effects obtained from Mplus IND function. SE_PA = self-efficacy in physical activity, FS_PA = functional support in physical activity, PD = perceived distress, MVPA = metabolic equivalents score spent by moderate- to vigorous physical activity, LPA = low-intensity physical activity measured by metabolic equivalents score, SBP = systolic blood pressure, DBP = diastolic blood pressure, * = p <.05, ** = p <.001.

Moderation Analysis: Group Comparison

In both the PA and DA models, we observed no significant differences in the association between any variable across the three levels of HTN medication adherence (see Table 5.5). This consistent pattern held true when comparing Low to High, or Moderate to High HTN medication adherence groups (see Tables 5.10, and 5.11 in Appendix B). Conversely, when we divided these adherence groups based on mean scores (below and above mean), we identified significant differences in the relationship between self-efficacy and MVPA ($\Delta\chi^2 = 5.014$, $p = .025$), as well as functional support and MVPA ($\Delta\chi^2 = 5.598$, $p = .018$) in the PA model (see Table 5.12 in Appendix B). Additional sensitivity analysis involved either dividing the adherence score by the median or combining the Moderate and High adherence groups (Moderate-to-High) for comparison with the Low adherence group. The group comparison findings paralleled those from the division by mean or the latter two group comparison (see Tables 5.13, and 5.14 in Appendix B).

In our study, individuals with HTN diagnosis lasting less than a year exhibited a heightened likelihood (*OR* = 4.09 p <.001) of failing to control their BP (Systolic BP/diastolic BP ≥140/90 mmHg) in comparison to those with HTN lasting greater than one year. We employed an online calculator provided by MedCalc Software Ltd. at https://www.medcalc.org/calc/odds_ratio.php (MedCalc Software Ltd, 2023) to assess the odds ratio (*OR*) by utilizing the number of uncontrolled (Systolic BP/diastolic BP ≥140/90 mmHg) and controlled BP (Systolic BP/diastolic BP <140/90 mmHg) cases as indicated in Table 5.2. This allowed us to quantify the likelihood across varying durations of HTN. The additional analysis yielded significantly elevated *OR* values for individuals with HTN duration less than one year regarding their failure to control BP, relative to those with HTN duration of 2, 3, 4, and

5 years, producing *OR* values of 3.27, 4.82, 4.56, and 3.55, respectively, all boasting *p*-values less than 0.05.

Within the PA model, significant differences emerged across two HTN duration groups. We observed substantial correlations between self-efficacy in PA and both MVPA ($\Delta\chi^2 = 7.424$, $p = .006$) and diastolic BP ($\Delta\chi^2 = 3.878$, $p = .049$), particularly in the group with a shorter duration of HTN (≤1 year), which were notably stronger compared to the group with a longer duration (>1 years). Similarly, a distinct stronger association between family support and MVPA ($\Delta\chi^2 = 4.173$, $p = .041$) was observed for the shorter duration group in the PA model. Importantly, the strengths of association were most prominent in the HTN duration ≤1 year group compared to the HTN duration >1 years group (see Table 5.6).

Table 5.5: Moderating effect of hypertension medication adherence on path coefficients: A comparison of low, moderate, and high adherence groups

Pathways	Low (n = 119)		Moderate (n = 182)		High (n = 99)		Group difference	
	β	SE	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.67, RMSEA = 0.079 [90% CI = 0.059–0.099], CFI = 0.959, TLI = 0.952)								
SE_DA→LS	0.46**	0.056	0.39**	0.051	0.43**	0.103	1.140	.566
SE_DA →LF	0.27**	0.061	0.25**	0.055	0.23*	0.075	0.347	.841
SE_DA →SBP	-0.38**	0.054	-0.38**	0.051	-0.41**	0.090	1.444	.486
SE_DA →DBP	-0.31**	0.061	-0.28**	0.053	-0.36**	0.101	3.844	.146
LF→SBP	-0.26**	0.048	-0.28**	0.051	-0.32**	0.084	1.073	.584
LF→DBP	-0.18*	0.055	-0.17*	0.053	-0.23*	0.085	0.333	.847
PA model (χ^2/df = 1.76, RMSEA = 0.071 [90% CI = 0.069–0.076], CFI = 0.918, TLI = 0.911)								
SE_PA→MVPA	0.32**	0.069	0.27**	0.061	0.25*	0.072	4.872	.088
SE_PA→SBP	-0.24**	0.059	-0.24**	0.059	-0.27*	0.080	0.435	.805
SE_PA→DBP	-0.36**	0.062	-0.33**	0.054	-0.47**	0.116	0.698	.705
FS_PA→MVPA	0.27**	0.067	0.25**	0.063	0.18*	0.061	3.017	.221
FS_PA→SBP	-0.28**	0.052	-0.31**	0.055	-0.28**	0.064	1.612	.445
PD→SBP	0.09^{ns}	0.054	0.07^{ns}	0.042	0.05^{ns}	0.029	2.981	.225
MVPA→SBP	-0.17*	0.049	-0.19*	0.056	-0.24*	0.073	2.336	.311
MVPA→DBP	-0.10^{ns}	0.056	-0.11^{ns}	0.059	-0.17^{ns}	0.089	1.719	.423

Note: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. Low = low adherence group; Moderate = moderate adherence group; High = high adherence group; β = standardized Beta coefficient; SE = standard error; SE_DA = self-efficacy in dietary adherence; SE_PA = self-efficacy in physical activity; FS_PA=functional support in physical activity; PD = perceived distress; MVPA = moderate-to-vigorous intensity

physical activity measured by metabolic equivalents score; LS = a low-sodium diet; LF = a low-fat diet; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

Table 5.6: Moderating effect of hypertension duration on path coefficients: A comparison of hypertension duration ≤1 year and >1-year groups

Pathways	HTN duration ≤1 year (n = 60)		HTN duration >1 year (n = 340)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.67, RMSEA = 0.066 [90% CI = 0.044–0.086], CFI = 0.974, TLI = 0.967						
SE_DA→LS	0.57**	0.074	0.41**	0.046	0.576	.448
SE_DA →LF	0.31**	0.074	0.24**	0.054	0.244	.621
SE_DA →SBP	-0.39**	0.063	-0.37**	0.050	0.014	.906
SE_DA →DBP	-0.33**	0.071	-0.28**	0.054	0.046	.830
LF→SBP	-0.24**	0.049	-0.29**	0.051	0.130	.718
LF→DBP	-0.189*	0.055	-0.20**	0.055	0.192	.661
PA model (χ^2/df = = 1.70, RMSEA = 0.073 [90% CI = 0.063–0.083], CFI = 0.946, TLI = 0.941)						
SE_PA→MVPA	**0.37****	**0.089**	**0.21***	**0.064**	**7.424**	**.006**
SE_PA→SBP	-0.33**	0.083	-0.27**	0.067	1.718	.190
SE_PA→DBP	**-0.41****	**0.087**	**-0.35****	**0.062**	**3.878**	**.049**
FS_PA→MVPA	**0.42****	**0.089**	**0.31****	**0.068**	**4.173**	**.041**
FS_PA→SBP	-0.27**	0.070	-0.30**	0.062	0.034	.854
PD→SBP	0.18*	0.078	0.11*	0.045	0.211	.646
MVPA→SBP	-0.12*	0.045	-0.17*	0.060	1.088	.297
MVPA→DBP	-0.09^{ns}	0.044	-0.13*	0.066	0.005	.944

Note: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. Statistically significant difference path across groups is shown in bold. HTN = hypertension; β = standardized Beta coefficient; SE = standard error; SE_DA = self-efficacy in dietary adherence; SE_PA = self-efficacy in physical activity; FS_PA=functional support in physical activity; PD = perceived distress; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LS = a low-sodium diet; LF = a low-fat diet; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

The Association between Various Lifestyle Behaviors and Blood Pressure

To better understand how different lifestyle behaviors may directly impact systolic/diastolic BP, we conducted another structural equation model to investigate the influences of various lifestyle behaviors on systolic/diastolic BP, while controlling for HTN medication adherence (see Figure 5.3 in Appendix C). The initial model showed acceptable fit based on four indices: χ^2/df = 2.89, RMSEA = 0.075 (90% CI = 0.035–0.118), CFI = 0.965, TLI

= 0.876. Since these indices met recommended levels, no further model modifications were needed.

In the final model, we found that MVPA played a significant role in predicting both systolic and diastolic BP, showing the strongest influence on systolic BP (β = -0.33, p <.001) and diastolic BP (β = -0.21, p <.001) compared to other lifestyle behaviors. Adherence to a low-fat diet also demonstrated a significant impact on both decreased systolic (β = -0.29, p <.001) and diastolic BP (β = -0.19, p <.001). Adherence to a low-sodium diet was associated with lower systolic BP (β = -0.21, p <.001) and diastolic BP (β = -0.18, p = .003), though to a lesser extent. Lastly, engagement in low-intensity PA was also significantly associated with lower systolic BP (β = -0.19, p <.001).

Discussion

This cross-sectional study aimed to deepen our understanding of the relationship among SCT-based psychosocial factors, recommended lifestyle behaviors, and BP management in young- and middle-aged Thai adults with HTN. We also explored how HTN medication adherence and diagnosis duration have served as moderating variables, influencing these associations. This knowledge is crucial for tailoring interventions to optimize BP management. Our findings provide novel insights into psychosocial and behavioral factors contributing to systolic/diastolic BP, including adoption of low-intensity PA and a low-fat diet. These findings can guide policymakers in Thailand to better support young- and middle-aged adults with HTN in their BP management endeavors.

Psychosocial Factors and Lifestyle Behaviors

Our analysis highlighted self-efficacy in DA as a critical predictor of improved DA. This corroborated previous evidence suggesting that self-efficacy is a strong predictor of behavior

change, including DA in adults with HTN (Suriyawong et al., 2023). Notably, our domain-specific self-efficacy in DA measure exhibited a stronger association with adherence to a low-sodium diet (r = 0.36) as compared to a general self-efficacy measure used in another similar study (r = 0.14; Ma, 2018). Conversely, our self-efficacy in PA measure demonstrated a moderate correlation with MVPA (r = 0.26), in contrast to findings from Western or Middle Eastern studies with young hypertensive patients that showed higher strength of association (r = 0.38–0.46; Idowu et al., 2012; Lee & Laffrey, 2006; Mohammadi et al., 2021). This divergence might be attributed to cultural and contextual discrepancies. For example, in Thai culture, communal meals and shared food experiences are deeply ingrained, with the strong influence of family and peer dynamics positively impacting DA. The presence of social support structures and adherence to cultural norms associated with communal eating may reinforce self-efficacy in adhering to a low-sodium or low-fat diet, thereby promoting health-conscious dietary behaviors, including compliance with low-sodium or low-fat dietary guidelines. However, regarding PA, higher levels of PA, particularly in moderate or vigorous intensity, are generally more prevalent in economically developed countries, as noted in the study by Haase et al. (2004). Their study encompassed young adult participants recruited from 23 countries, which exhibited varying cultural backgrounds and levels of economic development (Haase et al., 2004). This contextual variation could explain the observed differences in the correlation between self-efficacy in PA and actual PA levels.

Outcome expectancy stands as a relatively underexplored construct within the framework of SCT. Our study, however, failed to establish its significance in either the DA or PA models. In contrast, an Iranian study involving 176 middle-aged adults (M_{age} = 49.54 years) with HTN ($M_{duration}$ = 51.23 months), found a significant association between positive outcome expectancy

and increased engagement in PA (Mohammadi et al., 2021). This discrepancy might stem from the fact that our sample was slightly younger (M_{age} = 47.98 years) and had a shorter duration of HTN diagnosis ($M_{duration}$ = 32.73 months). A prior qualitative study conducted in Nepal indicated that individuals experiencing HTN for less than a year perceived their health condition as less severe, resulting in limited concern about potential complications arising from elevated BP (Shrestha et al., 2018). Our present study observed a similar pattern, with around 62% of participants diagnosed with HTN within the first year having uncontrolled BP (>140/90 mmHg). Their inadequate management of BP during the initial year could be attributed to their limited exposure to symptomatic manifestations commonly associated with high BP, such as headaches or chest pain. Furthermore, in our moderation analysis, for those who had a shorter diagnosis duration (≤1 year), their diastolic BP and MVPA were significantly impacted by their self-efficacy in PA and functional support as compared to those who had a longer diagnosis (>1 years). Our findings signify the importance of improving this newly diagnosed group's self-efficacy as well as MVPA as means to enhance their BP management. Adding complexity to the picture, a study by Smachew et al. (2022) reported that adults with HTN duration of less than five years exhibited reduced adherence to recommended lifestyle behaviors, encompassing both PA and DA, compared to those dealing with HTN for more than five years (Smachew et al., 2022). Consequently, individuals within five years of their HTN diagnosis might lack the motivation to adopt recommended lifestyle behaviors, leading to decreased adherence to activities like DA or PA. This cascade effect could ultimately result in a diminished perception of the potential positive or negative consequences linked to such activities and contribute to the absence of a significant association. Therefore, further exploration is warranted to clarify the role

of outcome expectancy in behaviors related to BP management, especially for individuals with varying durations of HTN diagnosis.

Regarding external SCT factors, functional support in PA displayed a significant association with MVPA, consistent with earlier studies involving young adults with HTN (Daniali et al., 2017; Idowu et al., 2012; Yan et al., 2012). However, no significant correlations were observed between other external SCT-related factors and low-intensity PA. Furthermore, our structural model did not find significant associations between all external SCT factors and adherence to a low-sodium or low-fat diet. The absence of notable associations could be attributed to the need for improved measurement tools to more accurately capture younger adults' perceptions about external supports needed to manage their BP. For instance, the workplace support measure we employed to assess individuals' perceptions about their workplace's promotion of general health behaviors, rather than specific cardiovascular health behaviors like monitoring BP or encouraging MVPA and a low-fat and low-sodium diet. A more specific measurement tool may be needed to understand young- and middle-aged hypertensive Thai adults' needs for functional and structural supports in the workplace. It is also possible that necessary workplace supports were not yet in place in Thailand to meet their HTN management needs.

An essential factor to consider is the influence of occupation as a potential confounder in the relationship between workplace support and DA or PA. The distinctive characteristics of blue-collar jobs, involving physical exertion, exposure to hazards, and specific workplace demands (Jones et al., 2016), could lead to varied interpretations of workplace support. Notably, in this present study, the majority of participants held blue-collar positions (approximately 70%: farmers and general laborers). For them, assistance related to workplace injuries and health

challenges arising from their job responsibilities might take precedence over preventive measures targeting chronic diseases, such as PA or DA. These dynamics reflect the findings of a systematic review that examined the impact of workplace-supported interventions on PA. Among the 40 studies analyzed in the review, a significant confounding influence of occupation was observed, particularly in distinguishing between white-collar and blue-collar workers (Smith et al., 2016). Noteworthy advancements in promoting PA through workplace support were apparent among white-collar workers, whereas their blue-collar counterparts experienced relatively fewer substantial effects (Smith et al., 2016). This trend is also evident in qualitative evidence collected from Australian employees across various industries, revealing that supportive workplace health policies often tend to overlook PA and DA (Chau et al., 2019). Instead, they prioritize initiatives focused on injury prevention and safety measures (Chau et al., 2019). Drawing a parallel to the Thai context, the Thai government places a strong emphasis on safety practices within industrial workplaces. This focus on ensuring employee safety aligns seamlessly with the Thai Labour Standard TLS 8001-2020 (Department of Labour Protection and Welfare Ministry of Labour Thailand, 2022). This standard delineates voluntary guidelines for establishments aspiring to establish a comprehensive labor management system rooted in international labor standards. Notably, the Thai Labour Standard TLS 8001-2020 embodies the principles of corporate social responsibility and aims to foster an environment characterized by employee acceptance, equitable treatment, suitable remuneration, and, notably, workplace safety. This emphasis on safety stands in contrast to the focus of behavioral promotions that prevent chronic diseases, such as PA or DA. Thus, when considering the specific work environment, it is conceivable that young- and middle-aged Thai employees might interpret workplace support policies differently, particularly when it comes to lifestyle behaviors such as BP management

through PA or DA. It is possible that the perceived level of support for adopting recommended lifestyle behaviors is relatively lower among Thai employees, potentially influencing the discernible impact on PA or DA.

Psychosocial Factors and Blood Pressure

Our study unveiled significant moderate associations of self-efficacy in DA, self-efficacy in PA, functional support in PA, and perceived stress with BP, particularly systolic BP. A previous cross-sectional study using a similar measure reported a contrasting result, associating increased self-efficacy in DA with elevated systolic BP in middle-aged black women adults with HTN in the US (Kang et al., 2020). It is important to note that there is currently a dearth of studies employing the same measurement and focusing on a similar population to validate this direct association between self-efficacy in DA and systolic BP. This discrepancy in findings, whether it represents a direct association of self-efficacy in DA on this relationship, calls for further investigation, particularly among young- and middle-aged adults dealing with HTN.

Our PA model explained a higher variance than a previous study that investigated the relationship between psychosocial factors, such as functional support (from family), and cardiovascular outcomes such as high BP (either systolic or diastolic BP greater than 140 or 90 mmHg, respectively) in U.S. adults with HTN (M_{age} = 48.7; R^2 = 19%) (Gorman & Sivaganesan, 2007). These associations are consistent with previous studies in adults with HTN. For instance, a study in Sweden with middle-aged men found that enhancing self-efficacy in PA was associated with physiological benefits in lowering systolic BP (Bergström et al., 2015). Similarly, functional support was linked to reduced systolic BP in older adults (Gorman & Sivaganesan, 2007), and a study of middle-aged Chinese adults found an association between functional support and improved systolic and diastolic BP (Lei et al., 2019). This relationship

may be explained by an indirect mechanism through increased recommended lifestyle behaviors, such as PA or DA, as suggested by SCT.

Potential Mediators

Mediation analysis did not confirm a significant mediation effect of adherence to a low-sodium or low-fat diet on the relationship between self-efficacy in DA and BP. However, we did observe a significant direct effect of self-efficacy in DA on the reduction of systolic BP. It is important to emphasize that the indirect effect through adherence to a low-fat diet exhibits marginal significance (p = .051). This finding could be attributed to the possibility that the self-efficacy measurement used to assess DA captures individuals' confidence in adhering to both low-sodium and low-fat diets. Alternatively, it's conceivable that each item in the measurement assesses the perception of adhering to both diets simultaneously, especially when we investigate different mediators for the two domains (low-sodium and low-fat diet adherence). In future research, it is advisable to consider selecting a self-efficacy measurement that specifically focuses on either low-fat or low-sodium diet adherence when targeting a particular dietary domain.

On the other hand, significant indirect effects of self-efficacy in PA and functional support in PA on systolic BP emerged when these psychosocial factors were mediated by MVPA. These significant findings suggest that tailoring interventions to focus on improving self-efficacy or functional support and MVPA could be a beneficial approach for young-and middle-aged adults with HTN. Comparing these two psychosocial factors, self-efficacy in PA exhibited a slightly larger indirect effect compared to functional support in PA. In the existing literature within electronic databases, some evidence consistently confirms the direct effect with a moderate relationship between self-efficacy in PA (β = 0.35; Bergström et al., 2015) and

functional support in PA (β = 1.78; Coulon et al., 2016) and systolic BP in young and middle-aged adults with HTN. However, limited research delves into the indirect effect of MVPA on the relationship between these two psychosocial factors and systolic or diastolic BP.

In light of our mediation analysis results, it's clear that adherence to a low-fat diet or low-intensity PA might not serve as ideal mediators for enhancing systolic BP management by increasing psychosocial factors such as self-efficacy. This challenge encourages further investigation into how psychological factors can be leveraged to improve adherence to a low-fat diet or low-intensity PA, thereby enhancing systolic and diastolic BP management in younger populations.

Group Comparison

Pearson's chi-square tests revealed significant differences in BP status across three distinct groups stratified by HTN medication adherence (p = .007) and HTN duration (p <.001). The influence of HTN medication adherence on reducing BP is well-documented in guidelines for the pharmacological treatment of HTN in adults (World Health Organization, 2021). Additionally, a study has reported a significant association between varying HTN durations and controlled BP levels (Zheng et al., 2022). A particularly significant observation emerged from our study, indicating that a majority of adults with HTN and a duration of less than 12 months exhibited a poorer BP management status (approximately 60%) compared to those with a HTN duration exceeding 12 months (only about 25–30%). This underscores a notably higher risk of uncontrolled BP in individuals with HTN diagnosis lasting less than a year, as evidenced by the elevated likelihood (OR = 4.09) as compared to those who had HTN greater than one year (1–5 years). This discrepancy points to the possibility that individuals recently diagnosed with HTN (duration <1 year) might need additional self-efficacy to adhere to recommended lifestyle

behaviors in order to better manage their BP as revealed in our moderation analysis result. Furthermore, these newly diagnosed individuals may not experience overt HTN-related symptoms like headache, chest pain, or blurred vision (Shrestha et al., 2018). It's noteworthy that individuals newly diagnosed with HTN often initiate hypertensive medication earlier. Consequently, these factors could contribute to the less favorable BP management status observed among newly diagnosed adults compared to those with a HTN duration exceeding 12 months. This comprehension underscores the critical necessity of designing interventions aimed at achieving BP management goals, particularly for young- and middle-aged adults with a HTN duration of less than 12 months, to effectively lower their BP.

When assessing the groups categorized by below mean and above mean adherence levels, it becomes apparent that heightened self-efficacy in PA or functional support in PA has a more pronounced influence on promoting MVPA within the below mean adherence group. This insight suggests that interventions designed to enhance self-efficacy or functional support in PA could play a pivotal role in enhancing MVPA levels and, subsequently, overall health outcomes among individuals who struggle with HTN medication adherence.

Moreover, our findings underscore the paramount importance of HTN duration, especially among younger individuals with HTN. Those with a HTN duration of less than 12 months stand to gain substantial benefits in terms of improved MVPA levels, contributing to the achievement of their BP management goals. This analysis reaffirms the significance of HTN duration <12 months, as young adults in this group can derive enhanced benefits in terms of improving their MVPA through heightened self-efficacy in PA or functional support in PA. Notably, our observations also suggest that individuals within this HTN duration group could

also experience more favorable diastolic BP management status through self-efficacy in PA when compared to those in the HTN duration >12 months group.

Influence of Lifestyles on Blood Pressure

We conducted an additional structural equation model to assess the impact of various lifestyle behaviors on systolic/diastolic BP (see Figure 5.3 in Appendix C). Notably, the effects of MVPA and adherence to a low-sodium diet align with well-established recommendations for adequate BP management in national guidelines such as those set forth by the American Heart Association (Whelton et al., 2018). Our findings, however, illuminate additional factors influencing systolic BP: adherence to a low-fat diet and engagement in low-intensity PA, while accounting for HTN medication adherence.

While we lack a comprehensive understanding of the impact of low-intensity PA on improved systolic BP, it's noteworthy that such activity has been associated with a 29% reduction in all-cause mortality in patients with HTN (pooled *HR* = 0.71; 95% CI = 0.62–0.83) (Chastin et al., 2019). In terms of dietary influence on systolic/diastolic BP, our study reveals that a low-fat diet exerts a stronger effect on reducing both systolic and diastolic BP compared to a low-sodium diet, even though the latter is a more commonly advocated practice for HTN management. Adhering to a low-sodium diet is particularly challenging for young- and middle-aged adults with HTN in Thailand, given the high-sodium content of traditional Thai cuisine. Thus, encouraging adherence to a low-fat diet could offer a more feasible strategy for these individuals. Furthermore, a cohort study with a 7.4-year follow-up indicated that consuming more than 125 gm/day of low-fat soybean-based products contributed to a reduction of 1.05 mmHg in systolic and 0.44 mmHg in diastolic BP among 67,499 Asian adults with HTN (Wei et al., 2020).

Limitations

Our study has provided valuable insights into the complex interplay of psychosocial factors, recommended lifestyle behaviors, and BP management among young- and middle-aged Thai adults with HTN. However, it is important to acknowledge the limitations inherent to our sample. The majority of participants were young- and middle-aged adults who had been diagnosed with HTN within five years. This skewed representation in terms of age and HTN duration could potentially affect how widely our findings can be applied, especially to populations with diverse age ranges and durations of HTN. Therefore, caution is necessary when extending our conclusions to groups with varying ages and durations of HTN.

To gain a deeper understanding of the intricate relationships between psychosocial factors, recommended lifestyle behaviors, and BP management, the key lies in developing or utilizing measurements that are specifically tailored to the context of HTN. Incorporating measures that focus on HTN-specific variables, like workplace support and outcome expectancy, could significantly enhance sensitivity and clarity in deciphering the nuanced outcomes underlying the non-significant results observed in our study. In addition, it is important to note that our study heavily relied on self-report measures to assess psychosocial factors, recommended lifestyle behaviors, and medication adherence. It is crucial to recognize that self-report measures might inadvertently introduce response biases or recall errors, potentially compromising the accuracy of the collected data. To enhance the reliability and validity of our findings, future research could benefit from integrating objective measurements or utilizing multi-method approaches.

Finally, acknowledging the scope of our investigation is important. Although our study was designed to examine the effect of pathway coefficients among groups categorized by HTN

medication adherence and diagnosis duration, it is worth noting that the sample size within each group is relatively small (fewer than 100 participants per group). This inherent limitation could potentially limit the statistical power needed to detect subtle nuances. Recognizing the limitations imposed by the constraints of the sample size, researchers should keep this consideration in mind when interpreting the results (Kyriazos, 2018).

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APPENDIX A: MEASUREMENT MODEL RESULTS

Table 5.7: Estimates of final DA measurement model by confirmatory factor analysis (n = 400)

Variable	Item	Factor		SE
		1	2	
DA measurement model (χ^2/df = 1.80, RMSEA = 0.049 (90% CI = 0.044–0.054), CFI = 0.946, TLI = 0.938).				
Self-efficacy in Dietary Adherence (DA)	1: When dining with non-dieters	0.79	-	0.028
	2: When traveling or on vacation	0.82	-	0.025
	3: When during rush or stress	0.80	-	0.030
	4: When under stress	0.78	-	0.033
	5: When limited access to healthy foods	0.83	-	0.028
	6: When get low risk of diet lapses	0.84	-	0.027
Average variance extracted		0.66	-	
Composite reliability		0.92	-	
Cronbach's Alpha		0.91	-	
Outcome expectancy in DA	1: No more weight issues	0.89	-	0.022
	2: Benefits blood pressure	0.97	-	0.019
	3: Improves cholesterol	0.92	-	0.027
	4: Requires more meal prep time	-	0.83	0.038
	5: Needs effort for product purchases	-	0.81	0.038
	6: Affects social life negatively	-	0.70	0.048
Average variance extracted		0.86	0.61	
Composite reliability		0.95	0.83	
Cronbach's Alpha		0.96	0.82	
Functional support in DA	1: Advised against unhealthy foods	0.84	-	0.030
	2: Supported resisting unhealthy foods	0.89	-	0.033
	3: Checked on my food choices	0.77	-	0.034
	6: Criticized food lapses	-	0.71	0.033
	7: Complained about food expenses	-	0.94	0.015
	8: Different food preferences	-	0.90	0.018
	9: Reacted negatively food	-	0.92	0.015
	10: Dismissed healthy diet efforts	-	0.85	0.027
Average variance extracted		0.70	0.75	
Composite reliability		0.87	0.94	
Cronbach's Alpha		0.86	0.93	
Workplace support	1: Workplace encouragement	0.82	-	0.034
	2: Employer's encouragement	0.92	-	0.015
	3: Employees with good habits	0.88	-	0.019
	4: ≥1 champions in management	0.85	-	0.029
	5: ≥1 champions in employees	0.68	-	0.044
Average variance extracted		0.70	-	
Composite reliability		0.92	-	
Cronbach's Alpha		0.93	-	

Table 5.7 (cont'd)

Variable	Item	Factor		SE
		1	2	
Perceived stress	1: Unexpected upset frequency	0.79	-	0.028
	2: Managing important matters	0.79	-	0.032
	3: Nervousness and stress levels	0.78	-	0.030
	6: Coping with overwhelming tasks	0.66	-	0.046
	9: Uncontrollable anger	0.70	-	0.036
	10: Overwhelming challenges	0.72	-	0.036
	4: Confidence in problem-solving	-	0.75	0.041
	5: Things going your way feeling	-	0.85	0.028
	7: Handling irritations	-	0.83	0.029
	8: Sense of control	-	0.85	0.024
Average variance extracted		0.55	0.67	
Composite reliability		0.88	0.89	
Cronbach's Alpha		0.89	0.90	

Note: χ^2 = Chi-square test; RMSEA = Root mean square error of approximate; GFI = the goodness of fit index; AGFI = adjusted goodness-of-fit index; SE = standard error; DA = dietary adherence.

Table 5.8: Estimates of final PA measurement model by confirmatory factor analysis (n = 400)

Variable	Item/Description	Factor		SE
		1	2	
PA model (χ^2/df =1.86, RMSEA = 0.048 (90% CI =0.043–0.053), CFI = 0.952, TLI = 0.947)				
Self-efficacy in physical activity (PA)	1: When under stress	0.80	-	0.026
	2: When no time	0.80	-	0.028
	3: Exercise alone	0.88	-	0.019
	4: When no equipment	0.87	-	0.027
	5: When no family/peer support	0.93	-	0.012
	6: While raining or sweltering	0.84	-	0.021
Average variance extracted		0.73	-	
Composite reliability		0.94	-	
Cronbach's Alpha		0.94	-	
Outcome expectancy in PA	1: Feel better afterward	0.85	-	0.027
	2: Reduce weight issue	0.93	-	0.016
	3: Improve cholesterol	0.95	-	0.012
	4: Improve BP	0.94	-	0.022
	5: Reduce CVD risks	0.86	-	0.030
	6: Improve life quality	0.81	-	0.027
	7: Time consuming	-	0.83	0.051
	8: Financial burden	-	0.91	0.033
Average variance extracted		0.80	0.76	
Composite reliability		0.96	0.86	
Cronbach's Alpha		0.97	0.87	

Table 5.8 (cont'd)

Variable	Item/Description	Factor		SE
		1	2	
Functional support in PA	1: Exercise with me	0.82	-	0.032
	2: Exercise offers	0.87	-	0.021
	3: Helpful reminders	0.91	-	0.015
	4: Stick to plan encouragement	0.89	-	0.017
	5: Support by modifying schedule	0.83	-	0.023
Average variance extracted		0.75	-	
Composite reliability		0.94	-	
Cronbach's Alpha		0.93	-	
Workplace support	1: Workplace encouragement	0.81	-	0.034
	2: Employer's encouragement	0.91	-	0.016
	3: Employees with good habits	0.89	-	0.019
	4: ≥1 champions in management	0.85	-	0.029
	5: ≥1 champions in employees	0.69	-	0.044
Average variance extracted		0.70	-	
Composite reliability		0.92	-	
Cronbach's Alpha		0.92	-	
Perceived stress	1: Unexpected upset frequency	0.80	-	0.028
	2: Managing important matters	0.79	-	0.033
	3: Nervousness and stress levels	0.79	-	0.029
	6: Coping with overwhelming tasks	0.66	-	0.047
	9: Uncontrollable anger	0.69	-	0.036
	10: Overwhelming challenges	0.71	-	0.035
	4: Confidence in problem-solving	-	0.75	0.039
	5: Things going your way feeling	-	0.85	0.028
	7: Handling irritations	-	0.83	0.028
	8: Sense of control	-	0.85	0.024
Average variance extracted		0.55	0.67	
Composite reliability		0.88	0.89	
Cronbach's Alpha		0.89	0.90	

Note: χ^2 = Chi-square test; RMSEA = Root mean square error of approximate; GFI = the goodness of fit index; AGFI = adjusted goodness-of-fit index; SE = standard error; PA = physical activity; BP = blood pressure; CVD = cardiovascular diseases.

Table 5.9: Correlation matrix between psychosocial variables in final dietary adherence and physical activity measurement models

Variable	1	2	3	4	5	6	7	8
Dietary Adherence (DA) model								
(1) SE_DA	-							
(2) +OE_DA	0.28**	-						
(3) -OE_DA	-0.25**	-0.42**	-					
(4) PFS_DA	0.47**	0.28**	-0.18*	-				
(5) NFS_DA	-0.23**	-0.35**	0.30**	-0.28**	-			
(6) PD	-0.25**	-0.47**	0.40**	-0.21*	0.26**	-		
(7) COP	0.38**	0.46**	-0.34**	0.33**	-0.27**	-0.57**	-	
(8) WKS	0.39**	0.37**	-0.25**	0.40**	-0.39**	-0.32**	0.32**	-
Physical Activity (PA) model								
(1) SE_PA	-							
(2) +OE_PA	0.46**	-						
(3) -OE_PA	-0.33**	-0.52**	-					
(4) FS_PA	0.52**	0.48**	-0.35**	-				
(5) PD	-0.26**	-0.41**	0.39**	-0.33**	-			
(6) COP	0.46**	0.55**	-0.49**	0.46**	-0.53**	-		
(7) WKS	0.36**	0.45**	-0.25**	0.40**	-0.28**	0.34**	-	

Note: Correlations of the measurement model were estimated using the TECH4 command in Mplus. DA = dietary adherence, PA = physical activity, SE_DA = self-efficacy in dietary adherence, +OE_DA = positive outcome expectancy in dietary adherence, -OE_DA = negative outcome expectancy in dietary adherence, PFS_DA = positive functional support in dietary adherence, NFS_PA = negative functional support in dietary adherence, PD = perceived distress, COP = coping ability, WKS = workplace support, SE_PA = self-efficacy in physical activity; +OE_PA = positive outcome expectancy in physical activity; -OE_PA = negative outcome expectancy in physical activity; FS_PA = functional support in physical activity, * = p <.005, ** = p <.001.

APPENDEIX B: MODERATING EFFECT OF MEDICATION ADHERENCE

Table 5.10: Moderating effect of hypertensive medication adherence on path coefficients: A comparison of Low and High adherence groups

Pathways	Low (n = 119)		High (n = 99)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.74, RMSEA = 0.089 [90% CI =0.078–0.102], CFI = 0.939, TLI = 0.923)						
SE in DA→LS	0.41**	0.074	0.40**	0.110	0.065	.799
SE in DA→LF	0.28*	0.083	0.25*	0.092	0.239	.625
SE in DA→SBP	-0.38**	0.076	-0.41**	0.105	1.088	.297
SE in DA→DBP	-0.37**	0.077	-0.43**	0.121	1.830	.176
LF→SBP	-0.25*	0.075	-0.30*	0.109	0.701	.402
LF→DBP	-0.16*	0.078	-0.21ns	0.111	0.313	.576
PA model (χ^2/df = 1.93, RMSEA = 0.090 [90% CI = 0.085–0.113], CFI = 0.821, TLI = 0.815)						
SE in PA→MVPA	0.25*	0.102	0.19*	0.087	0.078	.780
SE in PA→SBP	-0.42**	0.072	-0.31*	0.126	0.014	.906
SE in PA→DBP	-0.26*	0.091	-0.31**	0.136	0.006	.938
FS in PA→MVPA	0.25*	0.102	0.16*	0.079	0.197	.658
FS in PA→SBP	-0.25*	0.088	-0.25*	0.096	1.557	.212
PD→SBP	0.02ns	0.072	0.01^{ns}	0.040	1.062	.303
MVPA→SBP	-0.12^{ns}	0.079	-0.18^{ns}	0.114	3.262	.071
MVPA→DBP	-0.03^{ns}	0.085	-0.11^{ns}	0.212	0.514	.473

Note: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. β = standardized Beta coefficient; SE = standard error; SE in DA = self-efficacy in dietary adherence; SE in PA = self-efficacy in physical activity; FS in PA = functional support in physical activity; PD = perceived distress; LS = a low-sodium diet; LF = a low-fat diet; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

Table 5.11: Moderating effect of hypertensive medication adherence on path coefficients: A comparison of Moderate and High adherence groups

Pathways	Moderate (n = 182)		High (n = 99)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.50, RMSEA = 0.072 (90% CI = 0.042–0.099), CFI = 0.969, TLI = 0.961)						
SE in DA→LS	0.44**	0.063	0.46**	0.112	0.026	.872
SE in DA→LF	0.22*	0.073	0.21*	0.082	0.136	.712
SE in DA→SBP	-0.36**	0.063	-0.38**	0.095	1.318	.251
SE in DA→DBP	-0.25**	0.070	-0.32*	0.114	3.585	.058
LF→SBP	-0.32**	0.060	-0.37**	0.095	0.411	.521
LF→DBP	-0.20*	0.066	-0.28*	0.103	0.234	.629

Table 5.11 (cont'd)

Pathways	Moderate (n = 182)		High (n = 99)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
PA model (χ^2/df = 2.24, RMSEA = 0.097 (90% CI = 0.084–0.109), CFI = 0.823, TLI = 0.817)						
SE in PA→MVPA	0.33**	0.078	0.30*	0.086	1.343	.247
SE in PA→SBP	-0.27**	0.073	-0.30*	0.097	0.236	.627
SE in PA→DBP	-0.31**	0.071	0.45*	0.137	0.231	.630
FS in PA→MVPA	0.28**	0.079	0.20*	0.072	0.296	.586
FS in PA→SBP	-0.31**	0.065	-0.29**	0.072	1.874	.171
PD→SBP	0.10^{ns}	0.062	0.09^{ns}	0.058	1.318	.251
MVPA→SBP	-0.17*	0.071	-0.22*	0.087	1.491	.222
MVPA→DBP	-0.11^{ns}	0.060	-0.18^{ns}	0.115	1.655	.198

Note: *Note*: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. β = standardized Beta coefficient; SE = standard error; SE in DA = self-efficacy in dietary adherence; SE in PA = self-efficacy in physical activity; FS in PA = functional support in physical activity; PD = perceived distress; LS = a low-sodium diet; LF = a low-fat diet; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

Table 5.12: Moderating effect of hypertensive medication adherence on path coefficients: A comparison of below and above mean adherence groups

Pathways	Below mean (n = 82)		Above mean. (n = 318)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.68, RMSEA = 0.067 [90% CI = 0.046–0.087], CFI = 0.974, TLI = 0.966)						
SE in DA→LS	0.57**	0.074	0.41**	0.046	0.576	.448
SE in DA→LF	0.31**	0.074	0.24**	0.054	0.242	.622
SE in DA→SBP	-0.39**	0.063	-0.37**	0.050	0.002	.964
SE in DA→DBP	-0.34**	0.074	-0.28**	0.054	0.008	.929
LF→SBP	-0.24**	0.049	-0.29**	0.051	0.130	.718
LF→DBP	-0.15^{ns}	0.111	-0.21**	0.057	0.192	.661
PA model (χ^2/df = 1.56, RMSEA = 0.061 [90% CI = 0.051–0.070], CFI = 0.960, TLI = 0.957)						
SE in PA→MVPA	**0.35****	**0.079**	**0.28****	**0.063**	**5.014**	**.025**
SE in PA→SBP	-0.23**	0.064	-0.23**	0.060	0.004	.950
SE in PA→DBP	-0.40**	0.077	-0.34**	0.056	0.649	.420
FS in PA→MVPA	**0.29****	**0.077**	**0.24****	**0.065**	**5.598**	**.018**
FS in PA→SBP	-0.30**	0.059	-0.31**	0.054	0.006	.938
PD→SBP	0.09^{ns}	0.050	0.09^{ns}	0.045	0.007	.932
MVPA→SBP	-0.17**	0.048	-0.20**	0.054	0.605	.437
MVPA→DBP	-0.12*	0.058	-0.12*	0.056	0.002	.964

Note: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. β = standardized Beta coefficient; SE = standard error; SE in DA = self-efficacy in dietary adherence; SE in PA = self-efficacy in physical activity; FS in PA = functional support in physical activity; PD = perceived distress; LS = a low-sodium diet; LF = a

low-fat diet; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

Table 5.13: Moderating effect of hypertensive medication adherence on path coefficients: A comparison of below and above median adherence groups

Pathways	Below median (n = 82)		Above median (n = 318)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.53, RMSEA = 0.059 [90% CI = 0.039–0.078], CFI = 0.973, TLI = 0.968)						
SE in DA→LS	0.57**	0.074	0.41**	0.046	0.576	.448
SE in DA→LF	0.31**	0.074	0.24**	0.054	0.244	.621
SE in DA→SBP	-0.39*	0.063	-0.37**	0.050	0.014	.906
SE in DA→DBP	-0.33**	0.071	-0.28**	0.054	0.045	.832
LF→SBP	-0.24**	0.049	-0.29**	0.051	0.129	.719
LF→DBP	-0.17^{ns}	0.055	-0.20*	0.055	0.191	.662
PA model (χ^2/df = 1.57, RMSEA = 0.061 [90% CI = 0.051–0.070], CFI = 0.960, TLI = 0.957)						
SE in PA→MVPA	**0.35****	**0.079**	**0.27****	**0.061**	**5.014**	**.025**
SE in PA→SBP	-0.293*	0.064	-0.24**	0.059	0.004	.950
SE in PA→DBP	-0.40**	0.077	-0.33**	0.054	0.649	.420
FS in PA→MVPA	**0.29****	**0.077**	**0.25****	**0.063**	**5.598**	**.018**
FS in PA→SBP	-0.30**	0.059	-0.31**	0.055	0.006	.938
PD→SBP	0.09^{ns}	0.050	0.07^{ns}	0.042	0.004	.965
MVPA→SBP	-0.17**	0.048	-0.19*	0.056	0.605	.437
MVPA→DBP	-0.12*	0.058	-0.11*	0.059	0.002	.964

Note: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. β = standardized Beta coefficient; SE = standard error; SE in DA = self-efficacy in dietary adherence; SE in PA = self-efficacy in physical activity; FS in PA = functional support in physical activity; PD = perceived distress; LS = a low-sodium diet; LF = a low-fat diet; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

Table 5.14: Moderating effect of hypertensive medication adherence on path coefficients: A comparison of Low and Moderate-to-High adherence groups

Pathways	Low (n = 177)		Moderate-to-High (n = 222)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
DA model (χ^2/df = 1.72, RMSEA = 0.075 [90% CI = 0.055–0.094], CFI = 0.960, TLI = 0.952)						
SE in DA→LS	0.42**	0.059	0.42**	0.057	0.000	1.000
SE in DA→LF	0.34**	0.065	0.31**	0.058	0.305	0.581
SE in DA→SBP	-0.42**	0.056	-0.43**	0.056	0.405	0.525
SE in DA→DBP	-0.33	0.064	-0.32**	0.061	0.073	0.787
LF→SBP	-0.26**	0.051	-0.29**	0.057	1.825	0.177
LF→DBP	-0.19*	0.060	-0.20*	0.062	0.455	0.499

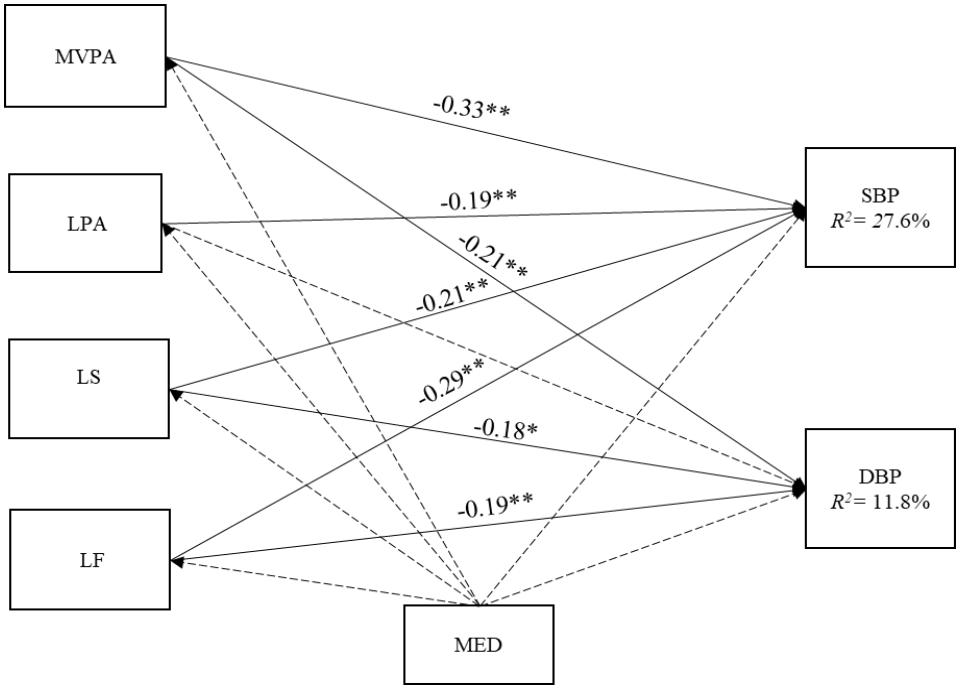
Table 5.14 (cont'd)

Pathways	Low (n = 177)		Moderate-to-High (n = 222)		Group difference	
	β	SE	β	SE	$\Delta\chi^2$	p-value
PA model (χ^2/df = 1.58, RMSEA = 0.067 [90% CI = 0.056–0.078], CFI = 0.955, TLI = 0.951)						
SE in PA→MVPA	**0.32****	**0.077**	**0.27****	**0.067**	**4.392**	**0.036**
SE in PA→SBP	-0.26**	0.065	-0.27**	0.070	0.040	0.841
SE in PA→DBP	-0.37**	0.067	-0.37**	0.065	0.038	0.845
FS in PA→MVPA	**0.32****	**0.076**	**0.28****	**0.070**	**5.848**	**0.016**
FS in PA→SBP	-0.29**	0.060	-0.31**	0.065	0.006	0.938
PD→SBP	0.10^{ns}	0.057	0.08ns	0.045	1.284	0.257
MVPA→SBP	-0.16*	0.051	-0.21*	0.063	0.398	0.528
MVPA→DBP	-0.08^{ns}	0.088	-0.16*	0.074	0.417	0.518

Note: Chi-square difference values ($\Delta\chi^2$) obtained from Mplus DIFFTEST function. β = standardized Beta coefficient; SE = standard error; SE in DA = self-efficacy in dietary adherence; SE in PA = self-efficacy in physical activity; FS in PA = functional support in physical activity; PD = perceived distress; LS = a low-sodium diet; LF = a low-fat diet; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; SBP = systolic blood pressure; DBP = diastolic blood pressure; ^{ns} = non-statistically significant; * = p <.05; ** = p <.001.

APPENDIX C: THE ASSOCIATION BETWEEN RECOMMENDED LIFESTYLE BEHAVIORS AND BLOOD PRESSURE

Figure 5.3: The association between lifestyle behaviors and blood pressure



Note: Solid lines indicate statistically significant paths. Dotted lines indicate a non-statistically significant path.* = *p*-value <.01; ** = *p*-value <.001; MVPA = moderate-to-vigorous intensity physical activity measured by metabolic equivalents score; LPA = low-intensity physical activity measured by metabolic equivalents score; LS = a low-sodium diet; LF = a low-fat diet; MED = hypertension medication adherence; SBP = systolic blood pressure; DBP = diastolic blood pressure.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

This dissertation represents a pivotal contribution to the field of nursing. It focuses on the intricate interplay between multiple Social Cognitive Theory (SCT)-based psychosocial factors and recommended lifestyle behaviors—specifically, dietary adherence (DA) to a low-sodium and low-fat diet and engagement in physical activity (PA)—and the effective management of blood pressure (BP) among young- and middle-aged adults with hypertension (HTN) in Thailand. To achieve its three-fold aims, this dissertation spans Chapters 2 through 5, adopting a comprehensive approach through development of multiple manuscripts.

Chapter 2 explores the existing scientific landscape, uncovering the connections between SCT-based psychosocial factors and their association with recommended lifestyle behaviors (DA and PA) among adults with HTN. This exploration culminated in Manuscript 1, which was published in the *Western Journal of Nursing Research*. Chapter 3 (Manuscript 2) describes a pilot study conducted to meticulously assess the psychometric properties of a carefully selected set of psychosocial measures related to DA to a low-sodium and low-fat diet that were translated into the Thai language. This study involved 110 young- and middle-aged adults with HTN to ensure the measures' reliability and validity. In parallel, Chapter 4 (Manuscript 3) followed a similar path, performing a similar process of psychometric validation with a distinct set of psychosocial measures that assess engagement in PA. In this study, a larger sample of 250 individuals was enrolled. Finally, Chapter 5 (Manuscript 4) delves comprehensively into the intricate relationship between SCT-based psychosocial factors, recommended lifestyle behaviors (DA and PA), and BP management among young- and middle-aged adults with HTN in Thailand. This chapter is dedicated to exploring the following four main objectives: 1) examining the relationships between SCT-based constructs and recommendations for DA, PA,

and systolic/diastolic BP; 2) investigating the potential mediating effects of DA and PA on the connections between SCT-based constructs and systolic/diastolic BP; 3) assessing the moderation effects of HTN medication adherence and the duration of HTN diagnosis on the relationship between SCT-based constructs, DA and PA adherence, and systolic/diastolic BP through group comparison modeling; and 4) comparing the impacts of DA and PA on systolic/diastolic BP. This broad endeavor culminates in a compelling body of evidence, poised to guide both nursing researchers, public health professionals, and workplace policymakers in Thailand. Equipped with the insights derived from this dissertation, a proactive approach can be adopted to address the critical issue of BP management among working-age adults (18–55 years) with HTN, thereby catalyzing a tangible and positive impact on public health in Thailand.

Summary of Dissertation Aims

This dissertation's overarching objectives encompassed an integrative literature review aiming to advance the current scholarly landscape by delving into the intricate interplay between psychosocial factors—namely, self-efficacy, outcome expectancy, and various facets of social support (functional [from peer and family] and workplace support)—and their correlation with the adherence of adults with HTN to recommended lifestyle behaviors encompassing DA and/or PA. The synthesis of these findings comprehensively updates our understanding of this important health issue. Next, a meticulous scrutiny of the psychometric attributes of the newly translated measurements from their original English version to their contextualized Thai rendition was conducted, ensuring that the translations accurately encapsulated the nuances pertinent to the domains of DA and PA, particularly in the context of Thai lifestyles. Rigorous assessment across various psychometric dimensions, encompassing validity and reliability, secured the robustness of these translated tools. In the final stage of this project, we embarked on a multifaceted inquiry

that uniquely explored the contributions of a spectrum of psychosocial factors derived from the SCT—perceived stress, self-efficacy, outcome expectancy, and diverse manifestations of social support (functional and workplace support). This inquiry scrutinized their role in shaping DA, PA, and BP management across a cohort of 400 young- and middle-aged Thai adults with HTN. Anchored in empirical exploration, this chapter explicates the intricate interconnections within this triadic relationship.

Dissertation Aim 1: Evaluate the state of science on psychosocial factors related to adherence to lifestyle behaviors in young- and middle-aged adults with hypertension.

A series of comprehensive literature reviews adeptly elucidated the intricate interplay between psychosocial factors from SCT and their influence on recommended lifestyle behaviors aimed at BP management, including DA and PA. As a logical progression, an integrative review was meticulously conducted and subsequently published in the peer-reviewed *Western Journal of Nursing Research,* which engendered a rich understanding of the nexus between the designated SCT-based psychosocial factors and their impact on DA and/or PA. Chapter 2 of the research study delineated the varying degrees of the relationship strength, contingent upon the domain under scrutiny and the geographic origin of the studies (Suriyawong et al., 2023). It is noteworthy that a predominant proportion of the identified research studies—approximately 50%—were older adults with HTN with their ages surpassing 60 years. This suggests a possible age-related bias in this line of research that could also be self-perpetuating.

Evident within the scholarly discourse, certain SCT-based psychosocial factors, including social support when operationalized in terms of workplace support or outcome expectancies, remained conspicuously absent within the scope of inquiries probing their rapport with either DA or PA among adults with HTN. This paucity of exploration was particularly pronounced among

young- and middle-aged adults recently diagnosed with HTN. It is plausible that participant age, culture, and the duration of HTN may introduce confounding factors to these intricate relationships, thereby warranting careful examination. Therefore, the present research endeavored to address these knowledge gaps, explicitly focusing on these relationships within the demographic group of young adults recently diagnosed with HTN, whose ages span 18 to 55 years, in the context of Thailand. Delving into these relationships within this demographic could play a crucial role in raising awareness and developing early strategies to mitigate complications arising from HTN and its associated health risks.

Dissertation Aim 2: Conduct forward and backward translation (from English to Thai) and evaluate psychometric properties of psychosocial measures.

Given the lack of psychometrically validated measures that assess the intricate psychosocial facets of DA and PA in the Thai language and cultural context, the present dissertation is structured around two discrete sub-aims, each tailored to correspond with its respective psychosocial domain (DA or PA). Chapter 3 discussed the comprehensive exploration of psychosocial measures within the realm of DA, while Chapter 4 meticulously examined measures germane to the PA domain. Employing rigorous adherence to the guidelines stipulated by the World Health Organization (2016), the study sought to translate multiple measures into the Thai language and meticulously evaluate their psychometric properties. These assessments examined construct validity (face, content, factorial structure, convergent, and discriminant validity), criterion validity (concurrent and predictive validity), and reliability (internal and test-retest reliability).

The methodological approach involved bifurcated data collection strategies. The project described in Chapter 3 used a sample of 110 participants and included data collection across two

distinct time points, each separated by a two-week interval. Somewhat differently, Chapter 4 adopted a single time-point data collection methodology with a more substantial sample size of 250 participants. The resulting translated measures demonstrated acceptable psychometric properties in terms of validity and reliability. Notably, the results of McDonald's Omega coefficient tests ($\omega > 0.60$) and test-retest procedure (ICC >0.90) revealed acceptable internal and external consistency across all translated measurements. Moreover, the results of confirmatory factor analysis (factor loading > 0.6) affirmed the translated measures' construct validity within the context of young- and middle-aged adults with HTN in Thailand. These validated measures then were employed in our principal study (Chapter 5), which sought to ascertain the perspectives of young- and middle-aged adults with HTN in Thailand pertaining to the psychosocial factors intertwined with DA and PA.

Dissertation Aim 3: Examine the relationships of selected psychosocial factors with recommended lifestyle behaviors (DA and PA) and BP management; the potential mediation effects of DA and PA on the associations between psychosocial factors and BP management; the moderating effect of hypertension medication adherence and hypertension duration on the relationship between SCT-based constructs, DA/PA adherence, and systolic/diastolic BP through group comparison modeling; and compare the impacts of DA and PA on systolic/diastolic BP.

In Chapter 5, our focus was on exploring relationships between psychosocial factors derived from SCT—including self-efficacy, perceived stress, functional support, and outcome expectancy—and recommended lifestyle behaviors (DA and PA), as well as their impact on BP management. While these relationships have been studied in young adults with HTN in Western and Middle Eastern countries, their relevance to young- and middle-aged Thai adults recently

diagnosed with HTN remains uncharted territory. In Chapter 5, we delved into these aspects, utilizing structural equation modeling to analyze the mediation effects of DA or PA on the connections between multiple SCT-factors and BP management, thus bridging the knowledge gap highlighted in Chapter 2. Furthermore, we investigated how adherence to HTN medication and HTN duration moderated the relationships between DA, PA, and BP management. Finally, we compared the impacts of different types of DA and PA on the level of systolic and diastolic BP.

Our analysis involved 400 participants, averaging 48 years of age, with 60% being female. The study provided significant insights into the associations between multiple psychosocial factors and recommended lifestyle behaviors (DA and PA). Notably, we found that self-efficacy in DA was significantly correlated with adherence to both low-sodium and low-fat diets. This finding implies that individuals with higher self-efficacy in DA were more likely to adhere to these recommended dietary practices, resulting in observable reductions in both systolic and diastolic BP levels. These associations offer valuable insights into how psychosocial factors, specifically self-efficacy in DA, can have an impact on BP management among young- and middle-aged adults with HTN. However, it is essential to note that certain psychosocial factors, such as workplace support, outcome expectancy, and perceived stress, did not exhibit direct and significant associations with recommended lifestyle behaviors or BP management. However, while they did not show direct significance, their potential contributions to explaining variance in BP management warrant further investigation.

Regarding PA, our findings highlight the crucial role of self-efficacy in motivating young- and middle-aged adults with HTN to engage in higher levels of moderate-to-vigorous PA (MVPA). As discussed in Chapter 2, this information aligns with established evidence

emphasizing self-efficacy as a powerful driver of behavior change, especially in the context of PA. Furthermore, our study uncovered a significant relationship between receiving functional support in PA and engaging in MVPA. This occurrence suggests that support from peers and family members plays a role in promoting MVPA among young- and middle-aged adults with HTN. When examining the relationship between systolic and diastolic BP, we observed that both self-efficacy in PA and functional support in PA were associated with decreased systolic BP.

In the mediation analysis, a significant finding was that MVPA served as a significant mediator between self-efficacy in PA or functional support in PA and systolic BP. This information indicates that improvement in PA self-efficacy or the presence of functional support in PA indirectly contributes to reduced systolic BP outcomes by promoting increased engagement in MVPA. However, the mediation effect of adherence to a low-fat diet for systolic BP was submarginal, suggesting uncertainty about its role as a mediator between self-efficacy in DA and BP outcomes, therefore necessitating further exploration.

Regarding the moderation analysis, our study found significant differences in BP management based on HTN duration, but no significant differences were observed among groups having low, moderate, or high HTN medication adherence. However, when we divided the medication adherence groups based on mean scores, we found that heightened self-efficacy in PA or functional support in PA had a more pronounced influence on promoting MVPA in the below-mean group compared to the above-mean group. Furthermore, in the PA model, significant differences emerged across two HTN duration groups (diagnosis ≤1 year or >1 year). Specifically, self-efficacy had notably stronger associations with MVPA and diastolic BP in the shorter HTN duration group (≤1 year) compared to the longer duration group (>1 year). Similarly, family support in PA exhibited a stronger association with MVPA in the shorter than

longer duration group. These group differences indicate that for adults newly diagnosed (≤1 year) with HTN, enhancing their self-efficacy in PA and family support in PA can play a significant role in their engaging in MVPA and reducing their diastolic BP compared with those who had a diagnosis of HTN longer than 1 year.

Finally, our study investigated the impact of various lifestyle behaviors on BP management, revealing the influence of MVPA, adherence to a low-sodium diet, adherence to a low-fat diet, and low-intensity PA. These findings highlight the multifaceted nature of effective BP management and provide valuable guidance for health care interventions tailored to young- and middle-aged adults with HTN.

Limitations

In Chapter 2, the literature review primarily incorporated cross-sectional studies conducted predominantly in Western countries, such as the United States. However, the cultural variations inherent in these studies might limit the generalizability of their findings. In addition, variations in sample sizes and the age ranges of participants across these studies could potentially have an impact on the overall validity and applicability of the conclusions drawn. Furthermore, the review was restricted to English language articles, thus omitting potentially pertinent research conducted in other languages.

In Chapters 3 and 4, the pilot testing of measures to assess validity and reliability was conducted exclusively with a specific group of young- and middle-aged Thai adults. This situation raises a valid concern regarding the potential impact on the overall validity of the study, as highlighted by Kyriazos (2018). In addition, the translated and validated measurements were tailored to fit the Thai population and cultural context and may not be directly generalizable or applicable to other populations with different cultural or contextual backgrounds.

In Chapter 5, the findings are constrained to the population of young- and middle-aged Thai adults recently diagnosed with HTN. This specific focus, while informative, limits the extrapolation of the results to other populations or to older adults with HTN in diverse geographical and cultural settings. The omission of occupation as a controlled variable could have contributed to the nonsignificant results observed, especially concerning the association between workplace support and engagement in PA. Refinements to measurement, especially those capturing perceptions of psychosocial factors such as workplace support and outcome expectancy, could enhance the precision of the study's outcomes because these measurements lack specificity in addressing the context of HTN or BP outcomes, highlighting the need for improvement.

Notwithstanding the overall sample size of 400 participants, the subset sizes used for comparison analysis were relatively modest, each containing fewer than 100 participants categorized by their adherence to HTN medication, particularly for the high-adherence group (n = 99). This inherent limitation potentially hampers the statistical power required to discern subtle distinctions within the data and might have implications for the robustness of the results (Blair & Conrad, 2011).

The reliance on self-reported measurements introduces the potential for social desirability and recall bias (Khalili et al., 2021), underscoring the need for future research that uses more objective measurement approaches. To definitively establish causal relationships between psychosocial factors, recommended behaviors for BP management, and actual BP outcomes, it is imperative to employ a longitudinal study design. Such an approach would facilitate a more comprehensive exploration of the interrelationships under investigation over time (Burnes & Grove, 2009).

Implications

Nursing Research

There are several significant implications of this study. Primarily, the research sought to validate the translation into the Thai language of several measures, thus opening new avenues for nurses and health care practitioners in Thailand. Through rigorous scrutiny and validation of these newly translated measures, this study equips nurses in Thailand with powerful tools to explore the intricate dynamics underpinning the relationship between psychosocial factors, recommended lifestyle behaviors, and BP management in young and middle-aged adults with HTN. These validated measures provide nurses with valuable instruments that allow them to comprehensively assess their patients' perspectives on the psychosocial elements influencing their adherence to a low-sodium and low-fat diet and engagement in PA. By incorporating these measures into their assessments, nurses can gain insights that can guide the development of tailored interventions and patient-centric care strategies. Consequently, this awareness can enhance the potential to achieve HTN management outcomes, which specifically aim for improvement of systolic or diastolic BP levels.

The nuanced moderating effect of HTN duration on the relationship between self-efficacy in PA and engagement in MVPA presents a strategic opportunity for nursing interventionists. Customizing intervention strategies to align with an individual’s duration of HTN, particularly for those diagnosed within the first year, holds the potential to significantly enhance the efficacy of interventions. This consideration should prominently shape the design of interventions, especially when the primary objective is to boost self-efficacy to engage in PA. Ultimately, this approach can lead to more effective promotion of increased MVPA engagement, particularly in comparison to individuals whose duration of HTN exceeds one year.

Our findings encourage nursing researchers to investigate the mediation effect of other DA approaches for BP management, such as the Dietary Approaches to Stop Hypertension [DASH] diet, rather than solely concentrating on low-sodium or low-fat diets as mediators. This expanded focus may illuminate previously unclear relationships because it is conceivable that DASH diet could play a significant role in the relationship between psychosocial factors and BP. The DASH diet, designed to prevent or stop HTN, emphasizes nutrient-rich foods (i.e., lean meat, fruits, vegetables, whole grains) while also limiting sodium. Research consistently shows its effectiveness in lowering BP levels in adults with HTN (Filippou et al., 2020). Therefore, investigating mediation effects of such factors within the DASH diet could enhance our understanding of its role in HTN management.

It is evident from the existing literature that biological sex can act as a potential confounding factor when examining the adoption of recommended lifestyle behaviors, such as DA and PA, among adults with chronic diseases (Ng et al., 2020) or in the general adult population (Mauvais-Jarvis et al., 2020; Werneck et al., 2019). This situation presents an opportunity for nursing researchers to delve deeper into the moderating role of biological sex in the relationship between psychosocial factors, recommended lifestyle behaviors, and BP management. This valuable insight can equip nursing researchers with the tools to design interventions that effectively target improved BP management through adoption of recommended lifestyle behaviors among males and females with HTN. Such tailored interventions have the potential to enhance BP management outcomes and contribute significantly to the field of nursing research.

Nursing Education

From the perspective of nursing education, the outcomes of this study offer valuable insights that are particularly relevant to nursing educators and researchers. The significant impact of self-efficacy on promoting MVPA highlights the critical need to seamlessly integrate strategies for enhancing self-efficacy within educational interventions. Nursing educators have the capacity to empower young- and middle-aged adults with HTN by guiding them in setting achievable activity goals, thereby bolstering their confidence to engage in higher intensity PA and subsequently enhancing their self-efficacy (Bandura, 1987). In addition, it is essential to recognize the cultural dimension; nursing educators should remain attentive to potential cultural influences on self-efficacy beliefs, recognizing that these influences may vary among diverse populations (Kastanakis & Voyer, 2014).

The study's findings emphasize the influential role of functional support from family or peers in encouraging engagement in MVPA. This information provides nursing educators with clear guidance on fostering supportive social networks that strongly advocate for participation in such activities. With these insights as a guiding principle, nursing educators can design educational programs that empower individuals to overcome challenges and embrace recommended lifestyle behaviors such as engaging in MVPA. This effort involves actively involving family members or peers in the program, thereby fostering a sense of communal support that can motivate individuals to achieve positive health outcomes, including the adoption of healthy behaviors (Thompson et al., 2016).

Nursing Practice

The findings of this study also have important implications for enhancing nursing practice, particularly within the context of caring for patients with HTN. The significance

attributed to self-efficacy as a driving force behind both DA and PA underscores the pivotal role of assessing and nurturing patients' self-confidence in managing their BP, with a specific focus on overcoming barriers to DA or PA (Bandura, 1987). Nurses can initiate conversations centering on self-efficacy during patient interactions, providing a platform for working collaboratively with their patients to formulate tangible objectives and offering essential guidance to navigate these obstacles. By anchoring these dialogues in the psychosocial realm of self-efficacy, nurses can exert transformative influence over the spectrum of PA and DA, which may ultimately translate into enhanced BP control.

The recognition of the substantial influence of functional support from family and peers on both MVPA and systolic BP unveils a pathway for nurses to cultivate symbiotic collaborations. Nurses can actively advocate for such family involvement, illuminating pathways through which family members or peers can catalyze heightened participation in PA—whether through mutual encouragement or shared activity endeavors. This collaborative ethos can extend to the dietary domain, where nurses can foster an environment conducive to young- and middle-aged adults with HTN collectively embracing low-fat or low-sodium dietary choices. This synergy, forged between nurses, patients, and their support networks, stands poised to usher in a holistic transformation in hypertension management, underscoring the integral role of collaborative efforts for nurturing comprehensive well-being.

Policy and Society

Broadening the perspective to the policy and societal level, the study's findings underscore the pivotal role played by psychosocial factors in motivating young- and middle-aged adults contending with HTN to take specific actions to improve their BP management. Policymakers can use these findings to establish public health policies and programs targeting

primary care settings that ensure young- and middle-aged adults with a recent HTN diagnosis receive sufficient counseling or education to increase their confidence in adopting or maintaining recommended lifestyle behaviors for BP management, such as recommendations to engage in MVPA.

This knowledge can enhance the awareness that steadfast compliance with these recommended lifestyle behaviors could potentially avoid the prolonged need for pharmacological treatments (Whelton et al., 2018). In parallel, a convergence of intervention opportunities unfolds within the professional arena, where workplace policies can be thoughtfully standardized to support employees in their pursuit of healthier lifestyles. While our analysis did not identify a significant effect of perceived workplace support on increasing recommended lifestyle behaviors, either in terms of DA or PA, recognizing the pivotal role of workplace support in stimulating both PA engagement and BP management is important. However, at present, few companies offer workplace wellness programs. The lack of existing workplace support may limit the value of investigating wellness support mechanisms within organizational structures (Laing & Jones, 2016). Additional efforts are needed to incorporate workplace support for adults with HTN in Thailand.

Beyond workplace settings, community-wide interventions can foster access to health-oriented marketplaces and promote a culture of health consciousness. This resonates with the study's discoveries, where adhering to low-fat and low-sodium dietary practices and low-intensity PA demonstrated associations with reduced BP. Furthermore, the results highlight the potency of previously underemphasized strategies in BP management. Notably, the significance of integrating low-intensity PA and low-fat dietary practices emerged. This newfound insight in this population signals an avenue for transformative policy integration. In workplaces, for

instance, policies can be tailored to accommodate and advocate for these hitherto underrepresented dimensions of BP management. This endeavor might encompass provisions for relaxation breaks during the workday where employees could engage in 30 minutes of MVPA or low-intensity PA, such as walking and yoga. Recognizing the time constraints faced by young- and middle-aged adults with HTN, initiatives that facilitate access to wholesome nourishment also can gain traction. This effort could involve establishing health-oriented groceries within communities or introducing nourishing options within workplace dining facilities.

Conclusion

This dissertation delves deeply into the intricate interplay between psychosocial factors, recommended lifestyle behaviors, and BP management in young- and middle-aged adults with HTN in Thailand. A thorough literature review revealed crucial correlations between psychosocial factors, guided by SCT, and recommended lifestyle behaviors. Furthermore, the diligent translation and validation of several measurement tools should result in an increased precision of assessments.

In conducting several analyses, significant insights were gained. The study underscores the pivotal role of self-efficacy in promoting various forms of PA and the positive impact of functional support in PA on notably reducing systolic BP levels. In addition, a noteworthy association emerged between self-efficacy in DA and adherence to a low-sodium or low-fat diet, further enhancing BP management. Remarkably, mediation analysis provided crucial insights for designing interventions targeting recommended lifestyle behaviors, especially in the context of PA-related initiatives. We also have identified the important moderating role of HTN duration on the relationship between self-efficacy in PA and MVPA among individuals with a HTN diagnosis of less than one year. This finding emphasizes the potential for greater benefits for

individuals with a more recent HTN diagnosis compared to those diagnosed longer than one year ago.

Furthermore, our analysis pinpointed low-intensity PA and low-fat diets as significant predictors of systolic BP reduction. These findings carry substantial implications for nursing research, education, practice, and policy. They pave the way for tailored interventions, particularly those that seek to heighten self-efficacy, and holistic health strategies.

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