RESILIENCE, MOTIVATIONAL FACTORS, AND MEDICATION ADHERENCE AMONG RURAL OLDER ADULTS

by

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DEDICATION

I dedicate this accomplishment to my husband and the love of my life, Rob, and our children Daniel, Isabel, and Josie. With you by my side, anything is possible.
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ABSTRACT

Adherence to hypertension medications has been explored in previous studies; however, these studies focused on individuals who reside in urban areas. More information regarding demographic characteristics and relationships to motivational factors among rural older adults with hypertension is needed. The purpose of this study was to explore medication adherence among rural older adults with hypertension and constructs identified in self-determination theory (SDT) including motivation (autonomous versus controlled), perceived competence, perceived autonomy support and basic needs satisfaction. Rural nursing theory (RNT) was used to include the concept of resilience. This cross-sectional study included a sample of 80 older adults (≥ 65 years of age) prescribed at least one medication to control hypertension. Participants ranged in age from 65 to 89 (M=74.04, SD=6.18) from rural communities in the northwest. A demographic questionnaire, a measure of medication adherence and questionnaires to assess perceived autonomy support, basic needs satisfaction, autonomous and controlled motivation, perceived competence, and resilience were used. Correlational analysis and multiple regression were used to examine associations with adherence and to predict adherence. Perceived autonomy support, resilience, cost of medication and medication regimen complexity were the only variables significantly associated with medication adherence and predicted antihypertensive medication adherence. Overall, the measure used to assess medication adherence indicated high levels of adherence.
CHAPTER I: INTRODUCTION

Hypertension (HTN) is highly prevalent among older adults, with over 60% being diagnosed with HTN in the United States (US) each year (Fryar et al., 2017). Hypertension is the leading cause of stroke and cardiovascular diseases, contributing to premature mortality and disability (Carnevale et al., 2020; Dimatteo et al., 2002; Egan et al., 2019; Virani et al., 2020). Control of HTN reduces morbidity, mortality, and healthcare costs (Samanic, Barbour, Liu, Wang, Fang, Lu, Schieb, & Greenlund, 2020; Simpson et al., 2006). Because antihypertensive medication therapy is a key approach for effectively controlling HTN, adherence is importance for treatment success (Pont & Alhawassi, 2017). Poor adherence can lead to suboptimal medical outcomes, such as lower quality of life, more hospital readmissions, and poorer clinical outcomes among older adults (Yap et al., 2016). Despite improvements in treatment, controlling this disease in older adults is a challenge in the US. (Fryar et al., 2017), including rural America, where only one-third of rural older adults reach a targeted blood pressure (Lo et al., 2016).

Demographic, treatment, clinical and behavioral factors are associated with medication adherence, and previous studies have indicated psychological factors influence motivation and adherence among adults (Holt et al., 2010; Williams, Rodin et al., 1998). However, the association of motivation to adherence is less clear, particularly among rural older adults.

One theoretical framework that has been used to assess motivation in a variety of settings is self-determination theory (SDT) (Deci & Ryan, 1985; Ryan & Deci, 2017). SDT is a prominent theory of motivation that describes psychological factors and processes that determine motivated behavior in diverse health contexts. While SDT is not aimed explicitly at adherence, using SDT to design interventions has been shown to be useful in promoting motivation toward
health behavior across diverse populations, contexts, and behaviors (Gillison et al., 2019; Ng et al., 2012; Ntoumanis et al., 2020).

The current SDT literature emphasizes the importance of autonomous motivation, perceived competence, and psychological need satisfaction to improve medication adherence among adults with various chronic diseases (Bhattacharya, 2012; Chandler et al., 2019; Davidson et al., 2015; Gatwood et al., 2016; Ng et al., 2012; Ntoumanis et al., 2020). However, research focused on antihypertensive medication adherence as an outcome and motivation and need satisfaction as predictors, is lacking. Particularly among rural older adults who are more likely to have hypertension than their urban counterparts and make up a large percentage of the American population (Samanic, Barbour, Liu, Wang, Fang, Lu, Schieb, & Greenland, 2020). Therefore, the purpose of this study was to describe motivation factors, basic psychological need satisfaction and adherence to antihypertension medication among older adults living in rural communities.

**Background and Significance**

**Health Consequences of Hypertension among Older Adults**

HTN increases with advancing age to the point where approximately three-fourths of those 65 years of age and older are affected (Guo et al., 2012; Kochanek et al., 2019; Samanic, Barbour, Liu, Wang, Fang, Lu, Schieb, & Greenland, 2020). A major modifiable risk factor for cardiovascular disease, HTN is associated with high costs in healthcare, along with increased morbidity, mortality, and the consequent impact on quality of life (Guo et al., 2012; Samanic, Barbour, Liu, Wang, Fang, Lu, Schieb, & Greenland, 2020; Scogin et al., 2016; Tucker et al., 2017; U.S. Department of Health and Human Services [USDHHS], 2020). Further, HTN increases a person’s risk of disability from the potential consequences of stroke (Benjamin et al.,
2019; Goldmann et al., 2020; Tadic et al., 2016), cognitive dysfunction (Carnevale et al., 2020), myocardial infarction, coronary artery disease, heart failure (Benjamin et al., 2019), vision loss (Bhargava et al., 2012; Tsukikawa & Stacey, 2020), and damage to the kidneys, retina, and brain (Tsukikawa & Stacey, 2020; Tucker et al., 2017; Wing & Gabb, 2018; Zhang et al., 2018). By 2035, one in five Americans is expected to be ≥ 65 years old, and approximately 45.1% of the US population will have some form of cardiovascular disease accounting for 42.6% of all deaths (Adeyemo et al., 2013; Benjamin et al., 2019; Guo et al., 2012; Lionakis et al., 2012; Tucker et al., 2017; Virani et al., 2020).

As with many conditions, HTN increases with age, with prevalence increasing from 70% in patients aged 65 years and older to 74% in those 80 years and older (Virani et al., 2020). The Framingham heart study (Franklin et al., 2001) showed that more than 90% of the participants with normal blood pressure (BP) at age 55 years eventually develop HTN. By the year 2060, the projected number of people living aged 65 years or older will comprise 25% of the US, of which nearly 20 million will surpass the eighth decade of life. Up to 50% of the people born in the US today will reach their 100th year (Centers for Disease Control and Prevention [CDC], 2017). With this rapidly aging population, the prevalence of HTN, and the use of antihypertensive medications, can only be expected to rise (Thuy et al., 2020).

The need to address the high rates of HTN and its related health consequences has never been more relevant, as disparities in disease burden have been recognized during the coronavirus disease 2019 (COVID-19) pandemic. People with underlying health conditions, including cardiovascular disease, are at an increased risk of worse outcomes related to the COVID-19 infection (Chow et al., 2020). Therefore, this study focuses on a highly prevalent and
controllable condition that remains poorly managed and inequitably experienced and leads to a greater risk of direct or indirect (e.g., COVID-19-related) complications (Adams & Wright, 2020).

**Nonadherence to Hypertension Medication**

Blood pressure (BP) can be safely and effectively reduced in older adults (Oliveros et al., 2020; Wing & Gabb, 2018). Poor adherence to antihypertensive medication results in poorer BP control (Breekveldt-Postma et al., 2008; Virani et al., 2020) and increases in health care utilization and overall health expenditure (Egan et al., 2019; Sokol et al., 2005; USDHHS, 2020). Adherence to prescribed antihypertensive medications is an important health behavior to manage high blood pressure (Guo et al., 2012; Thuy et al., 2020; Williamson et al., 2016).

Many placebo-controlled trials, as well as meta-analyses, have demonstrated the benefits of antihypertensive therapy in the elderly population (Beckett et al., 2008; Lenfant et al., 2003; Parati et al., 2018; Staessen et al., 2000; Weiss et al., 2017; Williamson et al., 2016; Wing et al., 2003; Wright et al., 2015) and there is no age limit at which antihypertensive drugs should not be used (Nguyen et al., 2012; Qaseem et al., 2017). Analyses from the hypertension in the very elderly trial (HYVET) showed a benefit with antihypertensive medications on outcomes among adults aged 80 and older (Warwick et al., 2015).

Despite considerable progress in the diagnosis and treatment of HTN, medication adherence among older adults with HTN varies considerably due to the influence of several factors (Guo et al., 2012; Krousel-Wood et al., 2015). Medication adherence is a complex behavior, and approximately one-half of older adults who take at least one medication find adherence challenging (Lionakis et al., 2012; Muntner et al., 2020; Wannasirikul et al., 2016;
Yap et al., 2016). Known predictors of medication nonadherence are multifactorial and include demographic characteristics, psychosocial and behavioral characteristics, social factors, disease-related factors, financial and other health system barriers, patient-provider relationships, and treatment-related factors (Wheeler et al., 2014). Yet, the results of studies remain mixed. Some studies have demonstrated that medication adherence in hypertensive patients increases chronologically (Alhaddad et al., 2016; Cummings et al., 2016; Li et al., 2016). However, antihypertensive adherence is not simply a function of age but may also be modulated by several individual-related characteristics including regimen complexity and duration of HTN (Jankowska-Polańska et al., 2017). Some studies have shown an inverse correlation between age and adherence to antihypertensives (Jackevicius et al., 2002; Lam et al., 2007).

**Rural America**

Such challenges may be compounded in rural communities where blood pressure control remains suboptimal (Roberts et al., 2016), related in part to difficulty accessing adequate healthcare and individual barriers experienced by older adults living in rural communities (Warnecke et al., 2008). Individuals living in rural areas have higher rates of diagnosed, uncontrolled HTN than urban counterparts (CDC, 2016; Samanic, Barbour, Liu, Wang, Fang, Lu, Schieb, & Greenland, 2020). According to a CDC (2020) report, 40% of persons living in nonmetropolitan areas have HTN compared to 29.4% in metropolitan areas. With approximately 7.5 million older adults living in rural America (Roberts et al., 2016), little is known about rural older adults’ health behaviors such as taking prescribed medication (Scogin et al., 2016).
Rural Health Disparities

Rural populations in the US experience disparities in access to care, such as limited access to health care personnel and lack of public transportation (Douthit et al., 2015), limiting their receipt of hypertension-related care. There is also a higher prevalence of risk factors for HTN in rural areas (Matthews et al., 2017), including obesity (Lundeen et al., 2018), cigarette smoking, and physical inactivity (Matthews et al., 2017). Furthermore, rural communities might be more affected by poor access to affordable healthy food options (Kris-Etherton et al., 2020).

Nearly 90% of the US landmass comprises rural areas (United States Health Bureau, 2010). Although scientific and technological discoveries have improved the health of the US population overall, rural people continue to experience many health disparities and inequities compared to the nation. Subgroups within the American population that have an elevated risk for experiencing healthcare disparities, such as rural older adults, are generally described as vulnerable. The vulnerability of rural persons changes in relation to social determinants of health (SDoH) and the extent of the lack of accessibility to healthcare for individuals and communities (Fahs, 2017). Rural adults often have fewer unique resources and, on average, are poorer and less educated. Limited healthcare access related to transportation limitations, financial constraints, social isolation, and lack of quality healthcare available (e.g., lower number of healthcare providers practicing in rural areas) further compound the issue (Blumenthal et al., 2014; Cohen et al., 2018; Thornton et al., 2016).

Health disparities are differences in incidence, prevalence, mortality, and burden of diseases among specific population groups. Conditions in which people live (e.g., rural), learn, and work impact health and produce disparities. Health equity is the attainment of the highest
level of health for people and requires valuing everyone equally to eliminate health and healthcare disparities (CDC, 2020; National Partnership for Action, 2018). The definition of health inequity is “the difference or disparity in health outcomes that are systematic, avoidable, and unjust” (CDC, 2014). Health inequity concerns those differences in population health that can be traced to unequal economic and social conditions and are systemic and avoidable. A problematic consequence of health disparities in the US is the resulting perpetuation of substantive inequities (Bethea et al., 2012; CDC, 2020). Health disparities may amount to de facto racism and classism by perpetuating preexisting inequities in vulnerable populations. One implication of disparities in health worth noting include access to equitable and quality health care. Economically, a burden of health disparities is excess direct medical care expenditures caused by health inequities (Dankwa-Mullan, 2010; Koh et al., 2010).

Health equity and health disparities are closely related to each other and influenced by various factors, either positively or negatively (CDC, 2018; World Health Organization [WHO], 2006; WHO, 2019). Many social factors, or social determinants of health (SDoH), are root causes poorer health outcomes and arise from variable social and economic conditions in which we live and can influence our health (Koh et al., 2010; WHO, 2019).

A person’s culture fundamentally represents the shaping of characteristics, preferences, personality, and worldview. Culture creates diversity, representing the broad spectrum of human experience (Smalley & Warren, 2012; Warren & Smalley, 2014). Rural environments create a unique culture that influences bio-psycho-social-spiritual parts of human becoming. For those living in rural areas, culture is shaped by internal/external forces and objective/subjective phenomena (Fawcett, 1993; Molinari & Guo, 2018; Smalley & Warren, 2012; Stroud, 2015).
Economic, religious, historical, and geographic factors combine to create a unique rural culture that impacts and influences health outcomes and behaviors (Smalley & Warren, 2012). People living in rural areas face additional disparities and inequities different from their urban counterparts, including access to care and chronic disease self-management. Rural dwellers also possess strengths and health-seeking behaviors such as resiliency, hardiness, and independence (Winters & Lee, 2018).

Rurality, and more specifically, older adults living in rural areas, should be addressed as a unique culture where economic, religious, historical, and geographic factors combine, which has been shown to influence health, health behaviors, and well-being (Smalley & Warren, 2012). Further, those living in rural areas possess strengths and health-seeking behaviors such as resilience and independence (Molinari & Guo, 2018; Winters & Lee, 2018). Essential elements of chronic disease self-management, including HTN and medication adherence, can be significantly influenced by place and context. The terms ‘place’ and ‘context’ are viewed in a variety of ways. Place has been defined as a complex cultural and symbolic phenomenon constructed through relationships between people and their settings (Andrews & Moon, 2005). For purposes of this study, ‘place’ refers to the rural context. Understanding the environment involves compositional and contextual effects of areas (Thurston & Meadows, 2004). Individual-level variables, namely socioeconomic status and educational level pertain to the compositional impacts, while contextual effects include geographical areas and ecological attributes (Thurston & Meadows, 2004). Attitudes, actions, and responses are impacted by a person’s geographical place of residence. Furthermore, location becomes not just a point in space but a context in which the individual resides (Andrews, 2003). An individual’s response to care can be
influenced dramatically by residence, and evidence in the literature suggests local environments can be related to health outcomes (Hawe & Shiell, 2000; Link & Phelan, 1995).

Other Factors that Impact Medication Adherence

There are other factors associated with medication nonadherence among older adults in various settings and populations. These include patient factors (e.g., age, gender, low education level, health literacy), medication factors (e.g., the complexity of medication regimen, high medication costs), patient-provider relationship factors (dissatisfaction with health care providers, lack of trust, & lack of patient involvement), and health care system factors (e.g., inability or difficulty in accessing pharmacy) (Holt et al., 2010; Morris et al., 2006; Perna et al., 2012; Yap et al., 2016). Due to polypharmacy and increased comorbidities, older adults are at an increased risk of poor adherence to antihypertensive medications (Hargrove et al., 2017).

Additional factors associated with nonadherence identified in a meta-analysis include female gender, low income, comorbidities, and cognitive impairment (Lemstra & Alsabagh, 2014).

Conceptual Framework

Self-Determination Theory

A theory for understanding the roots of human motivation, emotion, and behavior in the social context (Deci & Ryan, 2000; Ryan & Deci, 2017), self-determination theory (SDT) will be the theoretical framework for this cross-sectional study. SDT has demonstrated efficacy in predicting motivated behavior for a variety of health behaviors (Deci & Ryan, 1985; Ryan & Deci, 2017), including physical activity, smoking cessation, and medication adherence (Ng et al., 2012; Ntoumanis et al., 2020; Ryan & Deci, 2017; Williams, Mcgregor et al., 2006; Williams, Niemiec et al., 2009; Williams, Rodin et al., 1998). SDT posits that health behavior involves a
biopsychosocial process for facilitating and maintaining healthy behaviors (Ryan, 2000). All individuals, regardless of gender, age, ethnicity, or socioeconomic status, are inherently proactive and engaged with their environment, continuously seeking growth-oriented activities. Yet, SDT also recognizes that individuals are vulnerable to passivity and disharmony, mainly due to social conditions that fail to be supportive of their inherent growth tendencies. Therefore, SDT addresses how individuals’ psychological needs and inherent growth tendencies interact with social factors in their impact on health behavior functioning and well-being (Ryan & Deci, 2017).

A unique aspect of SDT is the focus on the quality of motivation rather than quantity alone. The kind of motivation that drives people's behavior is emphasized, alongside considerations of how much they are motivated. Furthermore, there is a distinction between self-determined or autonomous and non-self-determined or controlled forms of motivation (Deci & Ryan, 2000; Ryan & Deci, 2017). As described in the SDT theory, motivating factors form a continuum with intrinsic (autonomous) motivation and amotivation at opposite ends of a spectrum and extrinsic (controlled) motivation in the middle of the two extremes. Intrinsic motivation stems from personal interest and enjoyment of activities. This type of motivation does not require outside reinforcement and results in feelings of well-being, perceived competence, positive coping, and personal growth (Deci & Ryan, 2000; Ryan & Deci, 2017).

In contrast, amotivation is described as diminished or lack of motivation to participate in an activity. Between these two extremes, extrinsic motivation is generated by external forces such as the desire to enhance one’s physical appearance or to avoid ill health (Williams et al., 2002). If an individual is primarily driven to participate in activities by extrinsic factors, SDT
predicts that adherence will be compromised (Deci et al., 1999; Deci & Ryan, 2000). Across numerous health contexts, research has found that autonomous forms of motivation are associated with healthier psychological and physical outcomes (Ng et al., 2012; Ntoumanis et al., 2020; Vansteenkiste et al., 2020).

Central to SDT is the concept of three basic psychological needs assumed to the innate and universal. According to the theory, these needs—the needs for competence, autonomy, and relatedness—must be ongoingly satisfied for people to develop and function in healthy or optimal ways (Deci & Ryan, 2000). The quality of motivation experienced by individuals is determined by how they view their actions to be consistent with these needs (Ryan & Deci, 2017). The need for autonomy reflects actions as freely chosen and self-endorsed, indicating the need for individuals to experience ownership and responsibility for their actions. Competence is the experience of being effective in one’s sociocultural contexts and perceiving sufficient capacity to perform actions. The need to feel accepted and respected and gain a sense of connectedness with important others refers to relatedness. Studies have shown that satisfaction of the needs mediates the associations between autonomous motivation and health behavior change (Ng et al., 2012). Frustration of the needs has been shown to mediate the associations between controlled forms of motivation, lower well-being, and behavioral disengagement (Ntoumanis et al., 2020; Vansteenkiste et al., 2020).

Satisfaction of these basic needs is mainly dependent on the extent to which the person's relationships and surrounding environment support or thwart these needs (Deci & Ryan, 1985). Social agents (e.g., healthcare providers, nurses, peers, & family members) functioning in an individual’s social environment can support or thwart psychological needs through the behaviors
displayed or messages provided. Suppose these social agents’ behaviors or messages support the satisfaction of a person’s needs. In that case, the individual is more likely to experience their actions as autonomously motivated and may engage with and maintain health behaviors (Ntoumanis et al., 2020). On the other hand, in environmental conditions that thwart basic needs, well-being is lowered, and motivation is pressured or controlled. Controlled individuals often incur stress because they either fail to identify environments that provide basic psychological need satisfaction or select themselves into stress-producing situations and may be more prone to experience stress. There is research indicating that autonomy, relatedness, and competence supports from the environment enhance wellness, whereas thwarting these needs leads to ill-being (Ng et al., 2012; Ryan & Deci, 2000; Vansteenkiste et al., 2020).

The distinction between intrinsic and extrinsic motivations and the importance of autonomy, competence, and relatedness are particularly relevant in adherence to antihypertensive medications among rural older adults. For example, appealing to fear of HTN-related health consequences is an extrinsic mechanism that may intimidate older adults without helping them to internalize values that promote actual healthy behavior choices. Primary reliance on extrinsic motivation thus may not lead to desired health outcomes (Rimando, 2013).

Ryan et al. (2008) proposed an integrative process model that draws together the critical components of SDT. The model specifies the theory-based processes that need supportive actions and messages, and other dispositional factors relate to health behavior participation and outcomes (Ryan et al., 2008). Social agents’ (e.g., healthcare providers, family members, and friends) behaviors and messages that support the basic psychological needs determine whether these needs are supported or thwarted. The extent to which the needs are satisfied or frustrated
will determine the type of motivation experienced and how the individual engages in health-related behaviors (e.g., chronic disease self-management, medication use).

Research indicates SDT concepts are associated with a change in medication adherence behaviors, suggesting autonomous motivation, perceived competence, and autonomy support play an important role in behavior and health outcomes (Kennedy et al., 2004; Williams, Freedman et al., 1998; Williams, Patrick et al., 2009; Williams, Rodin et al., 1998). Further, patients who take an active role in planning their treatment with their provider by communicating their beliefs about treatment have improved medication adherence and feel empowered to make their own choices regarding their health care (Williams, Freedman et al., 1998; Williams, Rodin et al., 1998). Attitudes toward adherence are likely to improve if the individual feels they can freely choose to participate in pharmacologic treatment at their own volition and because it is important (Williams et al., 2000). A critical gap in the literature persists. In a review of 12 papers (2008-2020) with SDT and medication adherence, we did not find any studies among older adults, rural older adults, or rural older adults prescribed antihypertensive medications.

**Resilience**

Vulnerable populations, such as rural community-dwelling older adults, face varying types of adversity. Health disparities, health inequities, chronic health conditions, and rural-specific factors, as explained above (e.g., distance, lack of access to care), all represent adversities, which can be stressful to the individual (Marenco, 2020). Resilience is an important concept related to vulnerable populations and health disparities and inequities. Over the past several decades, resilience has become a key area in health research, practice, and policy due to its potential to positively affect the quality of life and well-being. Resilience is a dynamic
process of negotiation and navigation of internal and external forces within individuals, changing or adapting over time in response to life experiences (Hardy et al., 2004; Richardson, 2002; Richardson et al., 1990). Protective factors of resilience include optimism, meaning, purpose, and social and emotional support (Singer & Ryff, 2001). Strength-based approaches to resilience focus on health promotion, well-being, and the ability to impact lifestyle factors (Wagnild, 2003).

The American Psychological Association (APA) defines resilience as “the process of adapting well in the face of adversity, trauma, tragedy, threats, or significant sources of stress,” or “bouncing back” from difficult experiences (APA, 2015). The APA’s definition of a process versus a stable personality trait (often termed resiliency) suggests that people can build and demonstrate resilience, regardless of their socioeconomic backgrounds, personal experiences, or social environments. Although the debate surrounding resilience as a process versus a trait persists, the more common perspective emphasizes an adaptive process that can be developed (Harris, 2008; Luthar & Cicchetti, 2000; Manning, 2013).

Research findings have identified that resilience positively correlates with an individual’s subjective sense of well-being (Perlman et al., 2018). According to SDT, resilience is a function of personal and situational factors. For example, individuals bring much to the table concerning how they respond to prevent stressors, but contextual supports can also greatly facilitate adaptive stress responses (Lazarus, 1999). In part, autonomous motivation and intrinsic aspirations act on stress regulation by their impact on vitality or the perceived positive energy available to the self (Ryan & Deci, 2008). Therefore, the satisfaction of the three basic needs results in better regulation and more active coping and boosts vitality and energy, which adds to resilience (Ryan
et al., 2008). Resnick (2018) identified similar factors associated with resilience and motivation among older adults, including self-determination, self-efficacy (i.e., competence), openness and willingness to experience new things, and social support.

Further, there are traits and characteristics associated with resilience and motivation, including external factors that impact motivation and resilience as individuals respond to challenges in their lives (Resnick, 2018). The resilience scale (RS) includes perseverance, equanimity, purpose, self-reliance, and existential aloneness (Wagnild & Young, 1993). These five characteristics constitute the resilience core, the foundation of the model of resilience. Additional testing and factor analysis of the scale in a sample of 810 middle-aged and older adults indicated that the resilience scale has two significant factors, which were named “acceptance of self and life” and “individual competence” (Wagnild, 2003; Wagnild, 2009; Wagnild & Young, 1993). Personal competence suggests determination, independence, self-reliance, and resourcefulness. Acceptance of life represents adaptability, balance, flexibility.

Traditionally, in many western cultures, older age has been viewed negatively as a time of frailty, disability, declining function, and more significant physical and mental limitations (Bowling & Iliffe, 2011; Hamarat et al., 2002; Kinsel, 2005). However, research suggests many older adults experience high well-being and quality of life, low stress, recovery from adversities, and consider themselves to be aging successfully despite the onset of chronic conditions (Bowling & Iliffe, 2011; Hamarat et al., 2002; Kinsel, 2005; Nygren et al., 2005). In some studies, adults age 85 and older appear to have the same or greater capacity for resilience as those who are younger (Gooding et al., 2012; Hamarat et al., 2002; Netuveli et al., 2008; Nygren et al., 2005), suggesting that resilience may also support longevity.
Several common characteristics of resilience among older adults have been identified, including mental, social, and physical components (Gooding et al., 2012; Hamarat et al., 2002; Hildon et al., 2009; Kinsel, 2005; Lamond et al., 2008; Netuveli & Blane, 2008; Netuveli et al., 2008; Ong et al., 2009; Wells, 2009; Wells, 2014), indicating that resilience is multidimensional. High resilience later in life has been associated with optimal outcomes, such as reduced depression and mortality risk (Bowling & Iliffe, 2011; Gooding et al., 2012; Hildon et al., 2009; Martin et al., 2014; Smith & Hollinger-Smith, 2014), as well as better self-perceptions of aging successfully (Jeste et al., 2013; Montross et al., 2006), increased quality of life, and improved lifestyle behaviors (Bowling & Iliffe, 2011; Hildon et al., 2009; Netuveli & Blane, 2008; Nygren et al., 2005; Smith & Hollinger-Smith, 2014; Wells, 2009).

Rural Nursing Theory

Nearly 30 years ago, the rural nursing theory (RNT) started to evolve because of a recognized need for a framework that considered the unique perceptions and needs of rural persons compared to the care of persons living in urban environments (Winters & Lee, 2018). Subcultural values, norms, and beliefs play vital roles in how rural people define health and from whom they seek advice and care. The theory for rural nursing contains three statements and their related concepts. The first statement addresses health from the perspective of the rural dweller, which is the ability to work, be productive, and do usual tasks (Long & Weinert, 1989). Key concepts are work beliefs and health beliefs. Based on ethnographic data, the theorists indicate that rural persons place little emphasis on the comfort, cosmetic, and life-prolonging aspects of health (Long & Weinert, 1989; Winters & Lee, 2018). The concept of health was further refined (Bales, 2006; Bales et al., 2006; Lee & Winters, 2004; Moran, 2005; Thomlinson et al., 2004;
Winters et al., 2006b) to a more holistic approach inclusive of being physically, emotionally, and mentally fit along with the ability to play.

The second statement is that “rural dwellers are self-reliant and resist accepting help or services from those seen as ‘outsiders’ or from agencies seen as national or regional ‘welfare’ programs” (Long & Weinert, 1989, p. 120). It is posited that rural persons prefer to seek health care from persons they are familiar with, termed “insiders.” Old-timer and newcomer are additional key concepts. Furthermore, rural dwellers tend to rely on family, relatives, and close friends for help and support before seeking care from a health care provider (Long & Weinert, 1989).

Focused on health care providers, the third statement of RNT indicates providers practicing in rural areas experience a lack of anonymity and greater role diffusion than providers in urban settings. Lack of anonymity also applies to rural persons seeking health care as all persons in that environment have a limited ability to have private areas in their lives (Long & Weinert, 1989).

Additional concepts necessary in understanding the healthcare-seeking behavior of rural persons are isolation and distance from health care. Specifically, rural residents tend not to feel isolated even though they may reside great distances from the nearest emergency room (Long & Weinert, 1989).

**Besel Model of Medication Adherence among Rural Older Adults**

The unique rural culture and multifactorial contributing factors of hypertension self-management among rural older adults form the Besel model of medication adherence among rural older adults (Besel Model). The Besel Model (Figure 1) is based on SDT, the model of
resilience, and RNT. The Besel Model suppositions a positive relationship between autonomous motivation, perceived competence, resilience, demographic variables, and the outcome of medication adherence. Perceived autonomy support from health care providers and basic psychological needs satisfaction are proximal predictors of perceived competence and autonomous motivation, posited to predict medication adherence.

**Figure 1**

_Besel Model of Medication Adherence among Rural Older Adults_

**Statement of the Problem**

Currently, no studies are examining antihypertensive medication adherence among rural older adults, including motivational factors, basic psychological needs, and resilience.
Purpose and Aims

The purpose of this cross-sectional study was to examine the relationship between adherence to antihypertensive medication, SDT constructs (i.e., motivation, basic psychological needs, perceived competence, perceived autonomy support), and resilience among rural older adults prescribed at least one medication for control of hypertension. The following aims guided the study:

Aim 1: Describe the sample regarding motivation (autonomous, controlled, & amotivation), basic psychological needs (autonomy, competence, & relatedness), perceived competence, perceived autonomy support, resilience, and demographic variables (i.e., distance to pharmacy, financial well-being, regimen complexity, & rurality) and medication adherence.

Aim 2: Examine associations between antihypertensive medication adherence, motivation (autonomous vs. controlled), basic psychological needs (autonomy, competence, & relatedness), perceived competence, perceived autonomy support, resilience, and demographic variables (i.e., distance to pharmacy, financial well-being, regimen complexity, & rurality) among older adults.

Aim 3: Predict adherence to antihypertensive medications using autonomous motivation, perceived competence, resilience, and demographic variables.

Definition of Terms

*Hypertension* is defined as blood pressure (BP) at or above 130/80 mm Hg or currently taking medication to lower high blood pressure (Whelton et al., 2018). The 2017 American
College of Cardiology and the American Heart Association guidelines recommend adults ≥ 65 years of age should aim for a targeted BP of < 130/80 mmHg.

*Older adult* is defined as a male or female individual 65 years of age or older.

*Medication adherence* is the extent to which the persons’ medication taking corresponds with agreed recommendations from a healthcare provider (Brown & Bussell, 2011; Sabaté & Sabaté, 2003).

*Rurality* is defined using the rural-urban commuting area (RUCA) codes, as they are a measurement commonly used in health research. RUCA codes are a classification of US census tracts using population density, urbanization, and daily commuting. Zip codes are used to classify further RUCA codes, which help distinguish metropolitan counties and nonmetropolitan (i.e., rural) counties by the degree of urbanization and adjacency to a metropolitan area (Cromartie, 2013; Cromartie, 2019). RUCA is measured on a 1-10 scale and delineate metropolitan, micropolitan, small town, and rural commuting area. The lowest value represents the most urban areas, and the highest values represent the most rural areas. Selecting appropriate and representative measures of rural-urban status to accurately reflect the conditions distinguishing rural from urban areas is fundamental for this research study (Bethea et al., 2012).

*Basic psychological needs* are the core dimensions of SDT and are referred to as autonomy, competence, and relatedness. Autonomy is the need to experience self-direction and personal endorsement in initiating and regulating one’s behavior. Competence is the need to be effective in one’s interactions with the environment. Relatedness is the need to establish close emotional bonds and attachments with other people (Ryan & Deci, 2017).
Motivation is a complex construct with multiple components, including amotivation, controlled motivation, and autonomous motivation. Amotivation is the state of lacking an intention to act and the individual is neither intrinsically nor extrinsically motivated. Extrinsic motivation refers to pursuing a goal for reasons that are external to the activity itself. Autonomous motivation is the self-determined form of motivation and is the pursuit of a goal or behavior because of the inherent feeling of pleasure and satisfaction with the activity (Ryan & Deci, 2017)

Perceived competence is defined as perceiving oneself as competent to make a change or engaging in an activity at which they feel effective (Williams et al., 1998).

Perceived autonomy support is a person’s perceptions of the degree to which they experience their healthcare provider to be autonomy-supportive versus controlling concerning a specific healthcare issue (Williams et al., 1998).

Resilience is defined as inner strength, competence, optimism, flexibility, and the ability to effectively cope when faced with adversity (Wagnild & Young, 1993)

Summary

HTN is a highly prevalent disease in older adults that can significantly impair quality of life and contributes to premature mortality and morbidity. Antihypertensive medications can effectively treat HTN in older adults, yet adherence remains suboptimal. Despite research about antihypertensive medication adherence in several populations, there is a lack of published literature addressing adherence among rural older adults. Presently, no studies are exploring the associations between motivational factors, psychological needs, resilience, and antihypertensive medication adherence within this population.
CHAPTER II: REVIEW OF LITERATURE

This chapter will focus on current research and knowledge about the risk factors for HTN among older adults, particularly those living in rural areas. Most notably, literature is lacking with regards to older adults with HTN residing in rural areas.

Older Adults in Rural Settings

Healthcare disparities continue to be a significant issue in the US (Penman-Aguilar et al., 2016). Health disparities are operationalized as differential patterns of morbidity and mortality in vulnerable versus advantaged social groups (Flaskerud & Nyamathi, 2002; Flaskerud & Winslow, 1998). The inequality that various groups of Americans face concerning their ability to access timely, quality healthcare is driven by many individuals, societal, and environmental factors such as race/ethnicity, socioeconomic status, educational attainment, provider availability, and more. Social determinants of health (SDoH) encompass the place in which people live and their socioeconomic status and barriers to quality healthcare. The vulnerability of rural populations changes with SDoH and the extent of the lack of accessibility to healthcare for individuals and communities (Fahs, 2017). SDoH, such as education, income and poverty, and unemployment, significantly influenced widening rural health disparities (United States Department of Agriculture [USDA], 2016). Rural individuals are more likely to have poorer health and live with more health risk factors and chronic conditions than their urban counterparts (Bolin et al., 2015; Moy et al., 2017). Furthermore, higher rates of HTN, cigarette smoking, and obesity in rural populations than those in urban populations have been found (Garcia et al., 2017).
Rural populations have different health-seeking behaviors than their urban counterparts. This, coupled with varying approaches to patient care among physicians, exacerbates the disparity in expectations and care delivery (Brems et al., 2009). For people living in rural areas, deciding whether to fill a prescription may entail the additional considerations of travel inconvenience and transportation challenges posed by greater distances to pharmacies and all services in rural areas (Slifkin, 2002).

Subgroups within the American population that have an elevated risk for experiencing healthcare disparities are generally described as vulnerable (De Chesnay & Anderson, 2016; Shi & Stevens, 2010). Rural populations, for example, maybe considered a vulnerable population due to their increased likelihood of experiencing barriers to accessing quality healthcare. These healthcare disparities are often accentuated by rural dwellers’ geographic isolation and residence in medically underserved areas (MUA) (Crosby et al., 2012). In a report focusing on the leading nonmetropolitan and metropolitan causes of death in the US, the CDC announced that Americans living in rural areas are more likely to die from five leading causes than their urban counterparts (Garcia et al., 2019).

Older adults have complex medical needs and use more health care and support services, which has created robust demand for a specially trained workforce to care for geriatric clients (Institute of Medicine, 2008). Rural dwellers who have a chronic illness, are older, disabled, smokers, or have substance abuse issues are likely to have increased healthcare needs. When vulnerabilities combine with barriers to receiving quality care, such as poverty, lack of insurance, minority race/ethnicity, and residence in a medically underserved area, healthcare disparities are likely to result. Several studies of the social and medical vulnerability of older adults describe
increased relative risk of mortality and functional decline of older adults who reported high disease burden, poor overall health, poor functional status based on ADL/IADL performance, and lack of social support (Morath, 2010; Naik, Kunik, Cassidy, Nair, & Coverdale, 2010; Saliba et al., 2001).

Cost was a consistent barrier to seeking and accessing health care among rural elderly (Goins et al., 2005). Financial constraints posed considerable obstacles to accessing needed health care among study participants, including health care expense, inadequate health care coverage, income ineligibility for Medicaid, and the high cost of prescription medications. The cost of prescription medications can influence adherence. Individuals in rural communities indicate there were times when they were faced with the dilemma of deciding whether to purchase medicine or food (Goins et al., 2005).

**Hypertension, Quality of Life, and Self-Management among Rural Older Adults**

The quality of life (QOL) of people with HTN is affected by issues related to the disease and its chronic nature; the diagnosis of the disease; its negative impact on the patient’s physical, emotional, and social well-being; and aspects related to pharmacological treatment (Burnier & Egan, 2019; Uchmanowicz et al., 2018). HTN is a significant risk factor for cardiovascular disease (CVD) and stroke. Data from the Framingham heart study indicate that HTN is associated with shorter overall life expectancy; shorter life expectancy free of CVD, and more years lived with CVD. Total life expectancy was 5.1 years longer for normotensive men and 4.9 years longer for normotensive women than for hypertensive people of the same sex at 50 years of age (Franco et al., 2005). Clinical trials that included older adults aged 65 or older have shown that those who receive treatment for high blood pressure have fewer strokes, fewer heart attacks,
and less congestive heart failure than those with untreated HTN (Warwick et al., 2015; Wright et al., 2015). A 20 mmHg increase in systolic blood pressure (BP) among patients aged 40-89 years is associated with a two-fold increase in mortality from ischemic heart disease and stroke (Lewington et al., 2002).

HTN is also a significant risk factor for CVD, the underlying cause of vascular dementia (Ninomiya et al., 2011). Furthermore, there is evidence that lowering blood pressure in people with a prior history of CVD is associated with a reduction in the incidence of further strokes and cognitive decline (Tzourio et al., 2003). The geriatric population is a more vulnerable group as the rate of HTN increases with age (Park et al., 2018). A large study conducted on 35,125 elderly individuals aged 50 years or older from low middle-income countries reported HTN prevalence ranges from 32.3% in India to 77.9% in South Africa (Lloyd-Sherlock et al., 2014). HTN is a major risk factor for several common chronic conditions in the older population, including ischemic heart disease, stroke, dementia, and renal insufficiency (Ferri et al., 2011). Stroke and ischemic heart disease are responsible for more significant mortalities in lower to middle-income areas than high-income areas (Egan et al., 2019).

Older adults (≥65 years old) diagnosed with HTN (N=186) indicated an average to good QOL, and the average score was 3.36 points (SD=0.84) (Uchmanowicz et al., 2018). The results were similar in the patients’ assessments of their health; they assessed their health as average, with the best QOL scores obtained in the psychological domain, slightly worse scores in the environmental and social domains, and the worst scores in the physical domain (Uchmanowicz et al., 2018). Numerous scientific reports confirm the negative effect of HTN on QOL compared to the healthy population (Banegas et al., 2006; Bardage & Isacson, 2001; Li et al., 2005;
Raskeliene et al., 2009; Wang et al., 2009). Lower QOL scores in hypertensive patients in the physical domain and total QOL score were found (Wang et al., 2009). Other investigations among individuals with HTN have reported a lower level of the total QOL score than persons with normotension (Raskeliene et al., 2009). It has also been shown that lowering blood pressure values improves the patient’s QOL (Sung et al., 2014). Findings illustrate) that QOL in hypertensive patients and people in the general population decrease with age (Finestone, 2014; Rockwood & Howlett, 2011).

**Rurality and Medication Adherence**

A cross-sectional study of 1159 rural patients with HTN described factors associated with medication adherence (Ma, 2016). The following variables were associated with medication adherence: age, household income, duration of diagnosis, number of antihypertensive tablets taken in each dose, daily frequency of taking medication, and social support. Participants who adhered to their antihypertensive medications were more than 45 years old (OR = 1.29, 95% CI [1.13–1.56]), had a higher household income (OR = 1.04, 95% CI [0.98–1.28]), shorter HTN duration (OR = 0.68, 95% CI [0.59–0.74]), took a smaller number of antihypertensive tablets each time (OR = 0.82, 95% CI [0.70–1.06]), received a lower frequency of medication per day (OR = 0.54, 95% CI [0.32–0.59]), and had more social support (OR = 1.37, 95% CI [1.21–1.55]). Higher social support was associated with better adherence, with the average total scores of social support for the adherents were higher than those of the non-adherents (32.17 ± 6.30 vs. 28.63 ± 5.96); this difference was statistically significant (p = 0.021) (Ma, 2016).

In a randomized controlled trial, a rural community-based intervention designed to improve medication adherence among low-income, rural adults with HTN (N=434) receiving
medication at no charge from a public health department or a federally qualified health center (FQHC). Significant barriers included “forgetting to take medication” and “difficulty getting to the clinic for medications.” Participants receiving the intervention did not differ from individuals in the control group (51% vs. 49% adherent, respectively; \( p = .67 \)). Clinic type predicted adherence (\( p < .0001 \)), as did forgetting to take medications (\( p = .01 \)) and difficulty getting to the clinic to obtain medications (\( p < .001 \)) (Martin et al., 2011).

**Medication Adherence among Older Adults**

Medication adherence of older adults with HTN varies due to the influence of several factors. Understanding factors explaining medication adherence is a prelude to the development of interventions for enhancing older adults’ adherence, leading to better HTN control (Burnier & Egan, 2019). Multiple studies have documented the factors affecting medication adherence of older people with HTN, including medication regimen complexity (Burnier & Egan, 2019; Jin et al., 2016), physical function (Namwong et al., 2015), social support (Burnier & Egan, 2019; Meinema et al., 2015), health literacy (Saqlain et al., 2019; Wannasirikul et al., 2016), patient-provider communication (Yap et al., 2016), health belief (Al-Noumani et al., 2019; Lo et al., 2016; Namwong et al., 2015; Yang et al., 2016; Yue et al., 2015), and self-efficacy (Al-Noumani et al., 2019; Meinema et al., 2015; Namwong et al., 2015; Yang et al., 2016; Yue et al., 2015). Furthermore, older age, low risk for cardiovascular events, competing for health problems, low socioeconomic status, complexity (e.g., multiple dosing), side effects, and cost of medication regimen predict noncompliance (Foody et al., 2007).

Medication adherence and its associated factors among geriatric hypertensive participants were explored using a cross-sectional survey-based study. Of the total 262 participants, about
38.9% (n = 102) were considered adherent while 61.1% (n = 160) were considered as non-adherent. In logistic regression analysis, self-reported moderate (OR = 3.538, p = 0.009) and good subjective health (OR = 4.249, p = 0.008), adequate health literacy (OR = 3.369, p < 0.001) and independence in performing activities of daily living (OR = 2.968, p = 0.002) were found to be independent predictors of medication adherence among older hypertensive patients (Saqlain et al., 2019).

A cross-sectional study by Thuy and colleagues (2020) revealed significant factors influencing medication adherence of older adults living with HTN. Among the four elements, self-efficacy and health belief (patient-related factors) played an important role in explaining the variance of medication adherence. Participants showed high confidence in their ability to take the antihypertensive medication in different circumstances. High confidence may have helped them generate motivation and increase intention to take prescribed drugs, resulting in their better adherence to medication. Furthermore, patient-provider communication was significantly associated with medication adherence. Unlike Ma’s (2016) results, there was no significant correlation between social support and medication adherence (Thuy et al., 2020).

A systematic review and meta-analysis were conducted to estimate medication adherence and explore potential determinants of adherence among patients 60 years of age or older prescribed antihypertensive medications (Uchmanowicz et al., 2019). Some 13 studies, including 5,247 patients, were included, and the pooled percentage of adherence was 68.86% (95% CI: 57.80–79.92%). In all the studies, medication adherence was measured using the Morisky medication adherence scale (MMAS-8) or the Morisky Green Levine medication adherence scale (MGL). Subgroup analysis did not demonstrate a significant difference in the adherence
measured with the MMAS-8 and the MGL (68.31 vs. 70.39%, \( P = 0.773 \)). The adherence of patients from western countries (Europe, US) turned out to be significantly higher than in other patients (83.87 vs. 54.30%, \( P = 0.004 \)). The significant determinants of better adherence identified in more than one study were older age, retirement/unemployment, duration of hypertension >10 years, and a lower number of prescribed drugs.

**Medication Adherence among Rural Older Adults**

In a cross-sectional study of rural adults \( \geq 65 \) years of age (N=401) taking antihypertensive drugs, individual cognitive components, such as necessity and concern and self-efficacy, and other related factors, were compared according to adherence groups (Bae et al., 2016). Researchers used the self-regulatory model to frame the study and the beliefs about medicines questionnaire (BMQ) to assess beliefs about medications versus beliefs about the illness (Horne et al., 1999; Leventhal et al., 2016). In this model, adherence is more likely if it makes sense within the individual’s concept of the illness. Participant self-report measured medication adherence. Of the 401 subjects, 182 (45.6%) were in the adherence group. Necessity and self-efficacy were found to have a significant direct influence on unintentional nonadherence behaviors (necessity \( \beta = 0.171 \), \( P = 0.019 \); self-efficacy \( \beta = 0.433 \), \( P = 0.001 \)) (Bae et al., 2016).

**SDT and Medication Adherence**

To date, few studies on SDT, motivation, and basic psychological need satisfaction have been conducted among older adults. There are no studies on SDT or basic psychological need satisfaction and medication adherence among rural older adults to the best of our knowledge. Most SDT research concern the elderly in nursing homes and has focused on different viewpoints (Custers et al., 2012).
A meta-analysis of SDT-informed intervention studies in the health domain found they positively affect indices of health behavior or support health treatments (e.g., medication adherence) partly due to increases in autonomous motivation and perceived autonomy support (Ntoumanis et al., 2020). Ng et al. (2012) evaluated relationships between perceived autonomy support of healthcare providers and patients’ experience of psychological need satisfaction and relations between these SDT constructs and physical health in a meta-analysis. Results showed positive associations of psychological need satisfaction and autonomous motivation as beneficial to health outcomes. Additional variables, including age and study design, were tested as potential moderators.

Researchers used a cross-sectional study design to assess associations between perceived autonomy support, medication adherence, and socioeconomic factors among participants (N=377) with end-stage renal disease (Umeukeje et al., 2016). The health care climate questionnaire (HCCQ) assessed subjects’ perception of their providers’ autonomy support for medication use, and the self-reported MMAS assessed adherence. The average age of the subjects was 55 years (SD 15.3), 49% were men, and 63% were non-white. Some 27% of the subjects had private health insurance, 47% reported having high school education or less, and only 3% of the participants reported having excellent or very good health. The mean MMAS score was 4.8 (SD=2.1). Medication adherence was positively associated with HCCQ scores (p=0.008). Medication adherence for participants with a higher HCCQ score was significantly higher than those with lower scores (p<0.01). Associations were stronger after adjusting for race, age, gender, study site, and insurance. Perceived autonomy support did not differ by gender;
however, the mean overall HCCQ score differed significantly by race, with 5.9 for whites versus 5.3 for non-whites (p=0.001).

In another study conducted by nurse scientists, participants with heart failure (N=117) and a family member were randomized to a family partnership intervention, patient-family education, or usual care groups (Stamp et al., 2016). Measures of a patient’s perceived family functioning, confidence (i.e., competence), motivation for medications, and following a low-sodium diet were analysed. Data were collected at baseline, four and eight months. Perceived competence for diet and medication adherence was measured with the perceived competence scale (PCS). Motivation for medication and low-sodium diet adherence was measured with the treatment self-regulation questionnaire (TSRQ). Family functioning was significantly related to autonomous motivation for adhering to medications (p=0.05). Furthermore, the intervention group demonstrated significantly improved perceived competence (p=0.05), measured with the PCS, and motivation to medications (p=0.004) after four months. The researchers concluded that perceived competence and motivation for self-care were enhanced by family partnership intervention, regardless of family functioning.

Adult outpatients on long-term medication regimens for various health conditions, including HTN, completed assessments of their autonomy and healthcare provider’s autonomy support (Williams, Rodin et al., 1998). Self-reports and pill counts assessed medication adherence. Results of the study indicated that patients’ perceptions of the autonomy supportiveness of their healthcare providers predicted their autonomous motivation for following their prescriptions, which in turn predicted their adherence to the medication regimen. Autonomous motivation mediated the link between perceived autonomy support and adherence.
In a randomized trial, patients’ autonomous motivation led them to be more adherent to using smoking cessation medication, leading to greater smoking cessation and abstinence (Williams, McGregor et al., 2006). In a cross-sectional study, Williams et al. (2009) applied the self-determination theory model of health behavior to predict medication adherence, quality of life, and physiological outcomes among patients with diabetes. Patients with diabetes (N=2973) were administered telephone-and-mail surveys assessing perceived autonomy support from health care providers, autonomous self-regulation for medication use, perceived competence for diabetes self-management, medication adherence, and quality of life. Perceived autonomy support from providers related positively to TSRQ for medication use, which also related positively to perceived competence for diabetes self-management. Perceived competence related positively to the quality of life and medication adherence.

Adherence to antiviral therapy was assessed among HIV-positive patients by Kennedy and colleagues (2004). Participants completed questionnaires including measures of autonomy support, autonomous motivation, and perceived competence. Adherence was assessed with self-report measures and pharmacy refill logs. Results confirmed the hypothesis that patients’ perceptions of autonomy-supportiveness of healthcare providers and their families predicted autonomous motivation for taking their medication. Autonomous motivation predicted patients’ perceived competence to adhere to the regimen, and perceived competence predicted medication adherence (Kennedy et al., 2004).

SDT-based mobile phone applications were employed in four of the six interventional studies reviewed (Chandler et al., 2019; Davidson et al., 2015; Gatwood et al., 2016; Sieverdes et al., 2013). Of the four researchers in three of the studies developed culturally sensitive mobile
phone applications using SDT as the theoretical framework (Chandler et al., 2019; Davidson et al., 2015; Sieverdes et al., 2013). Overall, the evidence for a relationship between motivational orientations and medication adherence is mixed. A pharmacist-based pilot study assessed TSRQ and PCS at baseline and the end of the study among adults aged 21-64 years with diabetes (N=75) (Gatwood et al., 2016). The purpose of this pilot study was to test the effectiveness of tailored text messages focusing on improving medication adherence and health beliefs in adults with diabetes. Text messages were tailored based on the health belief model (HBM) and self-determination theory (SDT). The impact on medication adherence was evaluated using pharmacy claims by calculating the percent of days covered (PDC). While participants in the intervention group reported improved perceived competence, there were no significant changes in autonomous motivation, external regulation, or medication adherence. Mean PDC at baseline was comparable between cohorts (84.4% & 87.1%, respectively).

Guided by SDT, a culturally sensitive, patient-centered, and provider-centered mobile health medication and blood pressure self-management program for Hispanic adults (N=12) with hypertension was developed (Sieverdes et al., 2013). Electronic medication trays provided reminder signals for patients to take medications and smartphone messaging reminders for at-home blood pressure monitoring. Motivational texts were sent based on medication adherence rates and blood pressure levels. Adherence to taking prescribed medication in the intervention group was high at 97.2% (SD 2.8%), and a three-month reduction in resting BP changes between groups was statistically significant at months two (p=0.016) and three (p=0.008). This study supports the potential benefits of a culturally sensitive, SDT-based mobile health intervention (Sieverdes et al., 2013).
Another study evaluated a mHealth, SDT informed, a medication self-management program for African Americans (N=18) and Hispanics (N=20) with HTN (Davidson et al., 2015). Electronic medication trays provided reminder signals, and short message service [SMS] messaging reminded subjects to monitor BP with Bluetooth-enabled monitors. Like the study by Sieverdes et al. (2013), participants in this randomized controlled trial (RCT) were provided motivational text messages based upon levels of medication adherence. Some 70% of participants in the intervention group reached BP control versus 15.8% in the control group. Furthermore, African American and Hispanic participants in the intervention group demonstrated high medication adherence across the trial.

The effectiveness of a culturally attuned, SDT-guided, mHealth program on adherence was supported in an RCT involving 54 Hispanics with HTN and poor medication adherence (Chandler et al., 2019). The researchers attempted to promote increased autonomous motivation by linking participants' behavioral changes (i.e., improved medication adherence) to their values, beliefs, and goals. Motivational domains of family, faith, friends, community, and work were also considered. At 1-, 3-, 6-, and 9-month time points, systolic blood pressure averages were significantly lower in the intervention versus control groups (p<0.01). Additionally, more significant increases in medication adherence were found in the intervention group.

Heart failure patients (N=117) and a family member were randomized to a family-partnership intervention, patient-family education, or usual care groups in an RCT by Stamp et al. (2016). Competence (p=0.05) and motivation (p=0.004) for medication adherence was significantly improved at four months for the intervention group, whereas the patient-family education group and usual care did not change. Researchers concluded that perceived
competence and motivation for self-care were enhanced by a family partnership intervention and suggest that family functioning should be assessed to guide tailored interventions for better outcomes among patients with chronic disease (Stamp et al., 2016).

**Summary**

Antihypertensive medications are commonly used to treat hypertension among older adults, and control of hypertension is associated with improved QOL and a reduction in risk factors. However, there is a lack of literature on adherence to antihypertensive medication among rural older adults.

To date, few studies on SDT, motivation, and basic psychological need satisfaction have been conducted among older adults. There are no studies on SDT or basic psychological need satisfaction and medication adherence among rural older adults to the best of our knowledge. Therefore, the purpose of this research study is to address this knowledge gap.
CHAPTER III: METHODOLOGY

Methods

Study Design

A descriptive, cross-sectional design was used to describe the relationship between SDT constructs (i.e., motivation, basic psychological needs, perceived autonomy support, perceived competence), resilience, and medication adherence among rural older adults. This design was chosen to improve the current understanding of this relationship to inform future interventional research.

Setting and Sample

A convenience sample was recruited from outpatient primary care and cardiology clinics serving rural older adults. Annually, Billings Clinic diagnoses and treats approximately 52,000 patients with hypertension, 53% of whom reside in rural areas. Due to experience working with this population, it was anticipated that many rural older adults with prescribed antihypertensive medication would enroll in the study. Eligible participants included older adults (≥65 years of age) self-managing at least one medication for hypertension. Exclusion criteria for this study included older adults residing in a long-term care facility or assisted living where assistance for medication taking was provided and residence in an urban area as defined by RUCA codes.

Sample Size

A multiple regression power analysis was completed using G*Power (3.1.9.7). An estimated sample size of 77 participants was needed to meet the requirements of using 80% power, a medium effect size, a significance level of p<0.05, and three predictors given the
outcome of interest, medication adherence. The three predictors included 1) autonomous motivation, 2) perceived competence, and 3) resilience.

**Measures**

Five instruments measured the primary constructs examined in this study: motivational factors and resilience. The dependent variable, medication adherence, was assessed using the Hill-Bone medication adherence scale (HB-MAS).

**Hill-Bone Medication Adherence Scale (HB-MAS)**

The Hill-Bone medication adherence scale (HB-MAS) is a 9-item scale for self-assessment of medication adherence and may be self-administered or interviewer-administered. Derived from the 14-item Hill-Bone compliance to high blood pressure therapy scale (HB-HBP), the HB-MAS has been used across various chronic diseases and conditions, including hypertension, diabetes, and stroke (Kim et al., 2000). Responses range from 1-4, with ‘1’ indicating “all of the time” and ‘4’ meaning “none of the time.” Scores are calculated by summing individual items, with higher scores indicating higher adherence. The scale can be self- and interviewer-administered and takes about five minutes to complete. Criterion validity and internal consistency for the HB-MAS were demonstrated in hypertensive patients (standardized Cronbach alpha was 0.74-0.84) (Lambert et al., 2006). Developed with National Institutes of Health (NIH) funds, the scale is free to use; however, permission was granted from the Hill-Bone scales team at Johns Hopkins School of Nursing.

**Resilience Scale (RS14)**

The resilience scale (RS14) is a self-report measure that rates five characteristics of resilience on a 7-point Likert scale, with ‘1’ indicating “strongly disagree” and ‘7’ indicating
“strongly agree.” Developed by Wagnild and Young (2009) from the original 25-item resilience scale (Wagnild & Young, 1993), the RS14 has been used with a wide range of populations and in a variety of settings. A review of 12 completed studies that used the resilience scale reported Cronbach’s alpha coefficients ranging from 0.72 to 0.94, supporting internal consistency reliability. Construct validity was demonstrated with positive correlations between RS14 scores and psychological well-being, health-promoting activities, purpose in life, sense of coherence, morale, and forgiveness (Wagnild, 2009). The RS14 can be completed in about 3-4 minutes. Permission to use the RS-14 was granted by the original author, Dr. Gail Wagnild, and the questionnaire was purchased specifically for this study.

**Instruments Used to Measure Motivation and Basic Needs Satisfaction**

Several tools have been developed to quantitatively measure motivational factors and basic needs satisfaction, including (1) the treatment self-regulation questionnaire (TSRQ) (Levesque et al., 2007; Williams et al., 1996), (2) the perceived competence scale (PCS) (Williams et al., 2006), (3) the health care climate questionnaire (HCCQ) (Williams et al., 2007), and (4) the basic psychological need satisfaction scale (BPNS) (Deci & Ryan, 2000; Gagné, 2003). The TSRQ, PCS, HCCQ, and BPNS were adapted to assess motivational factors and basic needs satisfaction among patients prescribed antihypertensive medications. Adaptation occurred under the guidance of the original author, Dr. Geoffrey Williams, who granted and permission to use the questionnaires.

The health care climate questionnaire (HCCQ) measured perceived support from health care providers for adherence to specific health behaviors (Williams et al., 1996). The 6-item questionnaire was modified for this study to address antihypertensive medication use.
Participants responded to six statements describing perceived support from healthcare providers (e.g., “I feel that my health care provider has provided me choices and options.”) using a 7-point Likert-type scale. It has been used in studies of various health behaviors, including medication adherence with the high internal consistency of Cronbach’s α=0.94 to 0.96 (Williams, Rodin et al., 1998; Williams, Gagne et al., 1999). Scores were calculated by averaging the individual item scores. Higher average scores represented a higher quality of perceived autonomy support.

The treatment self-regulation questionnaire (TSRQ) assessed the degree to which a person's motivation for a behavior is relatively autonomous or self-determined. The TSRQ comprises subscales evaluating different forms of motivation: amotivation, autonomous, and controlled (Ryan & Connell, 1989). The questionnaire has been used to study behavior change in health care settings with demonstrated high internal consistency (Cronbach’s α=0.86-0.91) (Levesque et al., 2007). Scale items were modified for this study to address medication use. Participants rated their agreement with 15 items describing why they would take their medications as recommended to them using a 7-point Likert scale (1 = ‘strongly disagree;’ 7 = ‘strongly agree’). Responses on the autonomous items were averaged to form the reflection of autonomous motivation. The responses on the controlled items were averaged to create the reflection of controlled motivation for medication use. Three items were averaged to form the reflection of amotivation.

The perceived competence scale (PCS) is a four-item questionnaire that assessed participants’ beliefs in their ability to behave in healthy ways (e.g., “I feel confident in my ability to manage my medications”) (Williams et al., 1998). Participants rated their response on a 7-point Likert scale (‘1’ = ‘not at all true;’ ‘7’ = ‘very true’). Williams et al. (1998) used the PSC
to study the management of glucose levels among patients with diabetes. The alpha coefficient of internal consistency was reported to be >0.90 (Williams et al., 1998). A participant’s score on the PCS was calculated by averaging his or her responses on the four items.

The basic psychological needs satisfaction scale (BPNS) addressed need satisfaction in one’s life and was adapted from a broadly used measure of need satisfaction at work (Deci et al., 2016; Ilardi et al., 1993; Kasser et al., 1992). More recently, the scale was adapted to reflect needs satisfaction and need frustration in general (Deci & Ryan, 2000; Gagné, 2003). The alpha coefficient was reported to be 0.89 (Gagné, 2003). Participants rated their response on a 21-point Likert scale (‘1’ = ‘not at all true;’ ‘7’ = ‘very true’). Items were reversed scored then averaged, reflecting the level of autonomy, competence, and relatedness. An overall score, called the global BPNS, was calculated by averaging the three subscales (autonomy, competence, and relatedness).

**Procedures**

Approval for the study was obtained from the Institutional Review Board (IRB) at the University of Arizona and Advarra IRB before proceeding. HIPAA compliance measures were maintained. Patients considered for this study were selected based on previously scheduled provider appointments, diagnosis of hypertension, and rural status (i.e., zip codes & RUCA). Potential participants were identified through the population builder data analytics tool within a Magnet-designated healthcare organization in the northwest. Before proceeding, the principal investigator (PI) obtained written permission from five rural clinics embedded within the healthcare organization. The PI notified patients of the opportunity to participate in a letter. The letter introduced the PI, briefly explained the study, and provided a phone number and email for
potential participants to contact the PI for questions about study participation. Study questionnaires were sent along with the letter, including a self-addressed envelope. Therefore, potential participants could choose to complete the questions over the telephone or by mail.

Within the letter, the study was described as seeking information about how rural older adults take medications for high blood pressure (HBP) and how their motivations impact taking their medications. Interest in the study was expressed by calling or emailing the PI using the provided phone number and email address or returning the questions using the self-addressed stamped envelope. If the participant chose to complete the questions over the phone, the PI provided further information about the study over the phone. All participants in this study decided to return questionnaires through the mail; therefore, none were completed over the phone. Informed consent was indicated by returning completed questionnaires. A copy of the informed consent was available via email or hard copy upon request. Upon completion and return of the demographic form and questionnaire packet, participants were thanked for their participation and were mailed a $25 gift card in appreciation for their time. It was anticipated that participants would spend approximately 30 minutes during data collection (Table 1). Participants could opt-out of the study at any time and were not required to provide a mailing address.
Table 1

Survey Tools

<table>
<thead>
<tr>
<th>Measure</th>
<th>Construct Measured:</th>
<th>Items</th>
<th>Psychometric Properties</th>
<th>Completion Time (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCCQ (Williams et al., 1996)</td>
<td>Perceived autonomy support</td>
<td>6</td>
<td>Cronbach's α=0.95</td>
<td>5</td>
</tr>
<tr>
<td>TSRQ (Levesque et al., 2007; Ryan &amp; Connell, 1989)</td>
<td>Autonomous motivation, Controlled motivation, Amotivation</td>
<td>15</td>
<td>Cronbach's α=0.86-0.91</td>
<td>5-10</td>
</tr>
<tr>
<td>PCS (Williams, Freedman et al., 1998)</td>
<td>Perceived competence</td>
<td>4</td>
<td>Cronbach's α=0.90</td>
<td>3</td>
</tr>
<tr>
<td>BPNS (Deci &amp; Ryan, 2000)</td>
<td>Autonomy, competence, and relatedness</td>
<td>21</td>
<td>Cronbach's α=0.89</td>
<td>5-10</td>
</tr>
<tr>
<td>RS14 (Wagnild, 2009)</td>
<td>Resilience</td>
<td>14</td>
<td>Cronbach's α=0.72-0.94</td>
<td>5</td>
</tr>
<tr>
<td>HB-MAS (Kim et al., 2000)</td>
<td>Medication adherence</td>
<td>9</td>
<td>Cronbach's α=0.84</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>28-35</td>
</tr>
</tbody>
</table>

The PI stored written data in a locked file drawer in a locked office. The PI assigned a code for each participant and coded all forms and questionnaires. Written data were transferred into Statistical Package for Social Sciences (SPSS) application (V22.0). Only the PI had access to individually identifiable private participant information, and this information was destroyed after data analysis was complete.

Data Collection

Participants completed the measures in the following order: demographic questions, Hill-Bone medication adherence scale (HB-MAS), health care climate questionnaire (HCCQ),
perceived competence scale (PCS), treatment self-regulation questionnaire (TSRQ), basic psychological needs satisfaction scale (BPNS), and resilience scale (RS14).

**Demographic Questionnaire**

Socio-demographic and clinical characteristics obtained by participant self-report included: marital status, age, race, ethnicity, comorbid conditions, educational attainment, duration of hypertension diagnosis, duration taking prescribed antihypertensive medications, names of antihypertensive medications, daily frequency of medication, self-monitoring of blood pressure, side effects of medication, forgetting to take medication, and intentionally missed doses due to cost. Participants were asked if they could tell if their BP is low or high. Additional data obtained by self-report included zip code to determine RUCA codes, distance to the nearest pharmacy and health care clinic, medication coverage, living arrangement, preference for medical information delivery, mode of prescription refills, healthcare provider continuity, and financial well-being. Age was measured as years at the time of questionnaire completion. Sex was self-reported and dichotomous, categorized as male or female. Marital status was classified as “single,” “married,” “partnered,” “divorced,” or “widowed.” Education was measured as the total number of years of education. Financial well-being was categorical for “cannot make ends meet,” “barely make ends meet,” “have enough money to make ends meet with a little leftover,” and “have enough money to do whatever I want.” To assess cost, we included a question, “In the last year, have you ended up taking less antihypertensive medication than was prescribed because of the cost?” The single item literacy screener (SILS) question assessed health literacy (Morris et al., 2006), “How often do you need to have someone help you when you read instructions, pamphlets, or other written material from your doctor or pharmacy?”
Data Analysis

All data were analyzed using the Statistical Package for Social Sciences (SPSS) application (V22.0). Descriptive statistics and regression analysis were explored. Aim 1 was to describe the sample in relation to motivation, perceived competence, perceived autonomy support, basic psychological needs, resilience, demographic variables, and medication adherence. Descriptive statistics summarized demographic variables, motivation (autonomous, controlled, & amotivation), perceived competence, autonomy support, basic psychologic needs (autonomy, competence, & relatedness), resilience, and medication adherence. Frequencies and percentages were analyzed for categorical variables and mean, standard deviation, quartiles, and ranges for continuous variables. Distributional and normality characteristics were addressed graphically using histograms and scatterplots. Aim 2 examined associations between antihypertensive medication adherence, motivation (autonomous & controlled), perceived competence, perceived autonomy support, basic psychological needs (autonomy, competence, & relatedness), resilience, and demographic variables among older adults. For Aim 2, Pearson product moment correlations were assessed based on the results of the descriptive statistics in Aim 1. Based on correlation findings in Aim 2, multiple regression was used to address Aim 3 with a hierarchical approach. Aim 3 was to predict adherence to antihypertensive medications using autonomous motivation, perceived competence, resilience, and demographic variables. A simultaneous entry was used for TSRQ, PCS, and RS14.

Protection of Human Subjects

The application was made to the human subjects protection committee, and minimal risks were associated with this study. Every effort was made to maintain the confidentiality of
personal health information (PHI). The Institutional Review Board (IRB) and the regulatory authorities will be granted direct access to original medical records for verification of data, without violating patient confidentiality, to the extent permitted by the applicable laws and regulations. Access to participant information was restricted to the researcher.

Potential risks included fatigue during the completion of the questionnaires and demographic data collection. Participants completing questionnaires at home and their own pace minimized fatigue.

The researcher obtained approval from the University of Arizona IRB and the Advarra IRB. The participants were be identified in reports or publications that resulted from this study. Aggregate data of study findings were shared with the clinics.
CHAPTER IV: FINDINGS

This chapter presents the study findings. The specific aims of this study were to: 1) describe the sample including motivation (autonomous, controlled, & amotivation), perceived competence, perceived autonomy support, basic psychological needs (autonomy, competence, & relatedness), resilience, and demographic variables (i.e., age, financial well-being, cost of medications, regimen complexity, distance to pharmacy, rurality, education, & healthcare literacy) and medication adherence; 2) examine associations between antihypertensive medication adherence, motivation (autonomous vs. controlled), perceived competence, perceived autonomy support, basic psychological needs (autonomy, competence, & relatedness), resilience, and demographic variables (i.e., age, financial well-being, cost of medications, regimen complexity, distance to pharmacy, rurality, education, & healthcare literacy) among rural older adults; and, 3) predict adherence to antihypertensive medications using autonomous motivation, perceived competence, resilience, and select demographic variables (age, financial well-being, cost of medications, regimen complexity, distance to pharmacy, rurality, education, & healthcare literacy) among rural older adults.

Recruitment letters and questionnaires were sent to 250 potential participants from March 24, 2021, thru April 24, 2021. Potential participants were identified through the population builder data analytics tool within a fully integrated healthcare system in the rural northwest. Participants completed and returned the questionnaires using a postage-paid envelope provided by the PI. A $25 gift card was mailed to participants who completed and returned the questionnaires within four weeks. Out of 83 returned questionnaires, three did not meet inclusion
criteria of taking at least one antihypertensive medication, yielding 80 questionnaires used in this data analysis (32% response rate).

**Description of the Sample: Research Aim 1**

Some 80 rural older adults prescribed at least one medication used to treat hypertension participated. Table 2 outlines the demographic variables.

**Table 2**

*Descriptive Statistics of the Study Variables*

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Range = 65-89, Mean = 74.04, SD =6.18)</td>
<td></td>
</tr>
<tr>
<td>65-75</td>
<td>47 (58.8)</td>
</tr>
<tr>
<td>76-85</td>
<td>31 (38.8)</td>
</tr>
<tr>
<td>&gt;85</td>
<td>2 (2.5)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>41 (51.2)</td>
</tr>
<tr>
<td>Male</td>
<td>39 (48.8)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>77 (96.3)</td>
</tr>
<tr>
<td>NA/Al/AN</td>
<td>1 (1.3)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (2.5)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>80 (100)</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>0</td>
</tr>
<tr>
<td>Language</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>80 (100)</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Single/Widowed/Divorced</td>
<td>24 (30)</td>
</tr>
<tr>
<td>Married/Partnered</td>
<td>56 (70)</td>
</tr>
<tr>
<td>Living arrangement</td>
<td></td>
</tr>
<tr>
<td>Living alone</td>
<td>21 (26.3)</td>
</tr>
<tr>
<td>Living with roommate</td>
<td>2 (2.5)</td>
</tr>
<tr>
<td>Living spouse or immediate/extended family</td>
<td>55 (68.8)</td>
</tr>
<tr>
<td>Financial well-being</td>
<td></td>
</tr>
<tr>
<td>Not able to make ends meet</td>
<td>0</td>
</tr>
<tr>
<td>Barely make ends meet</td>
<td>3 (3.8)</td>
</tr>
<tr>
<td>Enough money to make ends meet with a little left over</td>
<td>45 (56.3)</td>
</tr>
<tr>
<td>Enough money to do whatever I want</td>
<td>31 (38.8)</td>
</tr>
<tr>
<td>Need help with reading healthcare material, instructions</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>61 (76.3)</td>
</tr>
<tr>
<td>Rarely</td>
<td>11 (13.8)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>7 (8.8)</td>
</tr>
</tbody>
</table>
Table 2 – Continued

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education, years completed (Range = 7-26, Mean = 14.10, SD = 3.08)</td>
<td></td>
</tr>
<tr>
<td>Miles to pharmacy (Range = 0.5-42, Mean = 8.15, SD = 10.36)</td>
<td></td>
</tr>
<tr>
<td>Miles to HCP (Range = 0.25-100), Mean = 13.08, SD = 19.78)</td>
<td></td>
</tr>
<tr>
<td>RUCA</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>37 (46.3)</td>
</tr>
<tr>
<td>8</td>
<td>3 (3.8)</td>
</tr>
<tr>
<td>10</td>
<td>40 (50.0)</td>
</tr>
<tr>
<td>Duration of HTN, years (Range = 2-60, Mean = 18.41, SD = 12.14)</td>
<td></td>
</tr>
<tr>
<td>Number of antihypertensive medications taken per day (Range = 1-4, Mean = 1.5, SD = 0.71)</td>
<td></td>
</tr>
<tr>
<td>Regimen complexity (frequency of antihypertensive medication used/day)</td>
<td></td>
</tr>
<tr>
<td>1 time</td>
<td>63 (78.8)</td>
</tr>
<tr>
<td>2 times</td>
<td>17 (21.3)</td>
</tr>
<tr>
<td>Types of antihypertensive medication*</td>
<td></td>
</tr>
<tr>
<td>Angiotensin II receptor blocker</td>
<td>22 (27.5)</td>
</tr>
<tr>
<td>Calcium channel blocker</td>
<td>23 (28.7)</td>
</tr>
<tr>
<td>Diuretic</td>
<td>19 (23.8)</td>
</tr>
<tr>
<td>Beta-adrenergic blocker</td>
<td>26 (32.5)</td>
</tr>
<tr>
<td>Angiotensin-converting enzyme inhibitor</td>
<td>27 (33.8)</td>
</tr>
<tr>
<td>Alpha blocker</td>
<td>2 (2.5)</td>
</tr>
<tr>
<td>Combination type of antihypertensive medication</td>
<td>1 (1.3)</td>
</tr>
<tr>
<td>Can tell if BP is high</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>36 (45)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>36 (45)</td>
</tr>
<tr>
<td>Always</td>
<td>8 (10)</td>
</tr>
<tr>
<td>Can tell if BP is low</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>47 (58.8)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>27 (33.8)</td>
</tr>
<tr>
<td>Always</td>
<td>6 (7.5)</td>
</tr>
<tr>
<td>Side effects from antihypertensive medication</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>71 (88.8)</td>
</tr>
<tr>
<td>Yes</td>
<td>9 (11.3)</td>
</tr>
<tr>
<td>Self-monitor BP at home</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>17 (21.3)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>51 (63.7)</td>
</tr>
<tr>
<td>Always</td>
<td>12 (15)</td>
</tr>
<tr>
<td>Take less antihypertensive medication because of cost</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>76 (96.3)</td>
</tr>
<tr>
<td>Yes</td>
<td>2 (2.5)</td>
</tr>
<tr>
<td>Forget to take antihypertensive medication</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>69 (86.3)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>11 (13.8)</td>
</tr>
<tr>
<td>Obtain antihypertensive medication prescriptions</td>
<td></td>
</tr>
<tr>
<td>Mail order</td>
<td>18 (22.5)</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>57 (71.3)</td>
</tr>
<tr>
<td>Both</td>
<td>5 (6.3)</td>
</tr>
</tbody>
</table>
Table 2 – Continued

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>See same HCP each visit</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>4 (5.0)</td>
</tr>
<tr>
<td>Yes</td>
<td>65 (81.3)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>11 (13.8)</td>
</tr>
</tbody>
</table>

HCP (healthcare provider), RUCA (Rural-Urban Commuting Area)
Note: *Participants answered more than once

The mean age of participants was 74.04 (SD = 6.18), and 51.2% were female.
Approximately 96.3% (N=77) were white, with all participants (N=80) listing English as their preferred language. Most participants were married or partnered (70%; N=56) and living with their spouse/partner or immediate/extended family (68.8%; N=55). The mean years of education completed were 14.1 (SD=3.08), and over three-quarters (76.3%, N=61) stated they never require help with reading healthcare material or instructions. Over one-half (56.3%, N = 45) described their financial well-being as having enough money to make ends meet with a little leftover. Almost one-half (46.3%; N=37) lived in a rural area identified as a “7” on the Rural-Urban Commuting Area (RUCA) code with 50% (N=40) designated as a “10.” On average, participants travel 8.15 (SD = 10.36) miles to the nearest pharmacy to fill most of their antihypertensive prescriptions (71.3%; N=57). Over 81% (N=65) see the same HCP at each visit and travel 13.08 (SD = 19.78) miles to the clinic. The average duration of HTN was 18.41 (SD = 12.14) years. Rural older adults took an average of 1.5 (SD = .71) tablets of antihypertensive medications per day at a frequency of once daily (78.8%; N = 63). The three most prescribed types of antihypertensive medications were angiotensin-converting enzyme inhibitors (33.8%; N=27), beta-adrenergic blockers (32.5%; N=26), and calcium channel blockers (28.7%; N=23). Side-effects from antihypertensive medications were reported by 11.3% (N = 9) of the
participants. Sixty-nine (86.3%) participants said they never forget to take their antihypertensive medication, with only two (2.5%) stating they take less because of cost. Over 33% (N = 27) of participants can sometimes tell if their BP is low, and 45% (N = 36) can sometimes tell if their BP is high. Nearly one-quarter never self-monitor their BP at home (21.3%, N=17).

**Measurement Scales**

Descriptive statistics were calculated before examining the research questions. Mean scores, standard deviations, minimum scores, maximum scores, range of scores, skewness, and kurtosis for all scales are outlined in Table 3.

The Hill-Bone medication adherence scale (HB-MAS) (modified) possible scores ranged from 6-24, with higher scores indicating higher medication adherence (Kim et al., 2000). When comparing the mean 23.58 (SD = 1.08) score with the possible range of the scale, medication adherence of the participants was high.

The TSRQ subscales were autonomous motivation, controlled motivation, and amotivation, with possible scores ranging from ‘1’ to ‘7’ for each. The mean score for autonomous motivation was 6.43 (SD = .95). Controlled motivation and amotivation mean scores were 3.29 (SD=1.76) and 3.08 (SD=1.51), respectively. These scores reflect that the participants had a high level of autonomous motivation for adhering to their antihypertensive medication treatment. They reported having moderate levels of controlled motivation and amotivation.

The 4-item PCS assessed the degree to which participants felt confident in their ability to adhere to their medication regimen, with possible scores ranging from ‘1’ to ‘7.’ Participants’
mean perceived competence was 6.25 (SD=1.26), indicating they felt highly competent toward adhering to their antihypertensive medication treatment.

The 6-item HCCQ was used to assess participants’ perceptions of the degree to which their healthcare provider is autonomy supportive. Possible scores ranged from ‘1’ to ‘7.’ Mean perceived autonomy support was 5.52 (SD=1.54). Compared with the possible range of ‘1’ to ‘7,’ the participants’ mean score indicates they felt their autonomy was moderately well supported by the prescribed medications.

The BPNS possible scores for each subscale ranged from ‘1’ to ‘7.’ Subscale means were 5.84 (SD=0.84) for autonomy satisfaction, 5.34 (SD=1.04) for competence satisfaction, and 5.76 (SD=0.90) for relatedness satisfaction. The three subscales were averaged to create the global BPNS score mean of 5.65 (SD = 0.73). Overall, these scores reflect a high level of basic psychological needs satisfaction.

RS14 possible scores ranged from 14-98, with scores greater than 90 indicating high resilience, 82-90 indicating moderately high, 65-81 indicating moderately low to moderate, and scores 64 and less indicating low resilience (Wagnild & Young, 1993). Participants’ mean resilience score was 86.49 (SD=10.19) indicating a moderately high resilience level.

Table 3

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum Score</th>
<th>Maximum Score</th>
<th>Range Score/Poss. Range</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
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<td>Range Score/Poss. Range</td>
<td>Skewness</td>
<td>Kurtosis</td>
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*r* (Pearson correlation)

*p* (significance)

Note: *p*<0.05, **p*<0.01 (2-tailed)

Internal consistency reliabilities (i.e., Cronbach’s alpha) for the instruments are outlined in the reliability analysis in Table 4. Over one-half of the instruments had Cronbach’s alpha >0.70 (Taber, 2018). They included: treatment self-regulation questionnaire (TSRQ); autonomous motivation subscale; controlled motivation subscale; amotivation subscale; perceived competence scale (PCS); health care climate questionnaire (HCCQ); basic psychological needs satisfaction scale (BPNS); relatedness and global subscale; and, the resilience scale-14 (RS14). Instruments with Cronbach’s alpha <0.70 were basic psychological needs satisfaction (BPNS); autonomy and competence subscales, and Hill-Bone medication adherence scale (HB-MAS). After removing item numbers 2, 4, and 8 from the HB-MAS, the Cronbach’s alpha was .62. This modified version was the scale used for the analysis.

Amotivation is not an SDT-based clinical target therefore this variable was removed from further analysis.
Table 4

Scale Reliability Analysis Matrix

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HB-M (Hill-Bone Medication Adherence Scale, Modified), TSRQ: A (autonomous motivation), TSRQ: C (controlled motivation), TSRQ: AM (amotivation), PCS (perceived competence), HCCQ (perceived autonomy support), BPNS: A (autonomy satisfaction), BPNS: C (competence satisfaction), BPNS: R (relatedness satisfaction), BPNS: G (global satisfaction), RS-14 (resilience)

Correlations: Research Aim 2

Aim 2 was to examine associations between antihypertensive medication adherence, motivation (autonomous & controlled), basic psychological needs satisfaction, perceived competence, perceived autonomy support, resilience, and demographic variables (i.e., age, financial well-being, cost of medications, regimen complexity, distance to pharmacy, rurality, education, & healthcare literacy) among rural older adults. See Tables 5 and 6 for a review of correlations.
## Table 5

*Correlation between Medication Adherence and the Study Variables (N=80)*

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</table>


$r$ (Pearson correlation)

$p$ (significance)

Note: *$p<0.05$, **$p<0.01$ (2-tailed)*

### Motivation

The association between antihypertensive medication adherence and autonomous motivation were in the predicted direction but was not statistically significant ($r = .15, p=.19$). Similarly, the relationship between autonomous motivation and resilience was not statistically significant ($r = .16, p=.16$).

Autonomous motivation was strongly and significantly associated with perceived competence ($r = .63, p<.0001$) and perceived autonomy support ($r = .56, p < .0001$). These
findings indicate that higher levels of autonomous motivation were associated with higher perceived competence toward medication adherence. Higher levels of autonomous motivation were also associated with higher participant perceptions of autonomy support from their healthcare provider. These findings are consistent with the SDT model for health behavior (Ng et al., 2012) and somewhat stronger than found in some health studies based on SDT (Ntoumanis et al., 2020).

**Perceived Competence**

The association between antihypertensive medication adherence and perceived competence was in the predicted direction, but not statistically significant ($r=.20, p=.08$). While all correlations were in the expected direction, there was no statistically significant association between perceived competence and autonomy satisfaction ($r=.19, p=.08$), competence satisfaction ($r = .13, p=.26$), or relatedness satisfaction ($r = .06, p = .63$).

A strong relationship was found between perceived competence and perceived autonomy support that was statistically significant ($r = .66, p < .0001$), indicating a strong positive association between perceived competence for managing their HTN and perceived autonomy support from the healthcare provider. Perceived competence and resilience were also positively correlated ($r=.25, p<.05$), indicating higher perceived competence is associated with a higher level of resilience.

**Perceived Autonomy Support**

The associations between perceived autonomy support and relatedness satisfaction ($r = .12, p=.28$) and competence satisfaction ($r=.19, p=.09$) were not statistically significant.
Medication adherence and perceived autonomy support were significantly associated ($r = .25, p < .05$). There was a moderate, positive association between perceived autonomy support and several SDT variables including: autonomy satisfaction ($r = .30, p < .001$) and global need satisfaction ($r = .26, p < .05$). Furthermore, perceived autonomy support and resilience were positively associated ($r = .24, p < .05$). As participants’ perceptions of autonomy support from their healthcare provider increased, their global need satisfaction and autonomy need satisfaction increased. Participants with a higher perceived autonomy support were also more likely to have higher resilience.

**Basic Psychological Needs Satisfaction**

The associations between medication adherence and basic needs satisfaction were not significant. The association of medication adherence and needs satisfaction were as follows: global ($r = .18, p = .12$), competence ($r = .15, p = .20$), and relatedness ($r = .07, p = .85$). The relationship between medication adherence and autonomy satisfaction showed a trend in the predicted direction but was not statistically significant ($r = .20, p = .07$).

There was a strong positive relationship between autonomy satisfaction and competence satisfaction ($r = .52, p < .0001$). A higher level of autonomy satisfaction was associated with a higher level of competence satisfaction. There was a moderate positive correlation between autonomy satisfaction and relatedness satisfaction ($r = .406, p < .0001$). Higher levels of autonomy satisfaction were associated with a higher relatedness satisfaction. A strong, significant association between autonomy satisfaction and resilience ($r = .502, p < .0001$) indicated a higher-level autonomy satisfaction is associated with higher resilience.
The relationship between competence satisfaction, global need satisfaction ($r=.82$, $p<.0001$), and relatedness satisfaction ($r=.35$, $p<.0001$) were moderately positive. Similarly, the relationship between competence satisfaction and resilience was significant ($r=.50$, $p<.0001$), indicating a higher competence satisfaction was associated with higher resilience.

Relatedness satisfaction was strongly correlated with global need satisfaction ($r=.74$, $p<.0001$) and resilience ($r=.53$, $p<.0001$). As the level of relatedness satisfaction increased, resilience also increased.

**Resilience**

The associations between resilience and the SDT constructs of autonomous motivation ($r=.16$, $p=.16$) or controlled motivation ($r=-.04$, $p=.73$) were not statistically significant.

Aside from autonomous and controlled motivation, resilience was significantly associated with the remaining SDT constructs. There was a positive association between resilience and perceived competence ($r=.25$, $p<.05$) and perceived autonomy support ($r=.24$, $p<.05$). As resilience increased, the likelihood of a higher level of perceived competence or higher perceived autonomy support increased. There was a moderate positive association between resilience and autonomy satisfaction ($r=.50$, $p<.0001$) and competence satisfaction ($r=.50$, $p<.0001$). This indicated that as resilience increased, so did the level of autonomy satisfaction. Increased resilience was also associated with a higher level of competence satisfaction. Resilience was significantly associated with relatedness satisfaction ($r=.53$, $p<.0001$) and global needs satisfaction ($r=.65$, $p<.0001$). With a strong positive relationship, as resilience increased, relatedness satisfaction or global needs satisfaction increased. Finally, there was a weak, statistically significant association between medication adherence and resilience ($r=.29$, $p<.01$).
Demographic Variables and SDT

Several demographic variables were associated with SDT constructs, including controlled motivation, autonomy satisfaction, and perceived competence, and are presented in Table 6. Education, age, and the frequency of antihypertensive medications taken each day (regimen complexity) demonstrated relationships. There was a weak, negative association between controlled motivation and the total years of education (r=-.29, p<.01), indicating that fewer years of education were more likely associated with controlled motivation. The relationship between controlled motivation and regimen complexity was positively significant (r=.25, p<.05), indicating as medication regimen complexity increased, so did the likelihood of controlled motivation toward adherence. Age and controlled motivation had a positive significant relationship (r=.35, p<.001), suggesting that participants experience more controlled motivation as they age.

Perceived competence and financial well-being were positively correlated (r=.38, p<.0001), which suggested that a higher level of financial well-being increased the likelihood of higher perceived competence. There was an inverse relationship between autonomy satisfaction and regimen complexity (r=-.23, p<.05), indicating that as the complexity of the medication regimen increased, autonomy satisfaction decreased.

Demographic Variables

The associations between antihypertensive medication adherence and cost (r = -.39, p < .001) and medication adherence and regimen complexity (r = -.30, p < .01) were statistically significant. These moderate, negative associations indicated that adherence is more likely to
increase as the cost of medications and the regimen complexity decreased. Demographic correlations are presented in Table 6.

The associations between medication adherence and age ($r = .14, p = .31$), medication adherence and finances ($r = .05, p = .70$), adherence and total number of antihypertensive medications ($r = -.19, p = .10$), adherence and distance to the pharmacy ($r = -.19, p = .09$), adherence and RUCA ($r = .13, p = .27$), medication adherence and total number of years of education completed ($r = .15, p = .20$), and adherence and health literacy ($r = -.14, p = .22$) were not statistically significant.

There was a weak-moderate positive association between age and the total number of antihypertensive medications ($r = .28, p < .01$). As age increased, the number of antihypertensive medications was likely to increase. A moderate negative association existed between age and years of education completed ($r = -.32, p < .01$). Increased age was associated with fewer years of education completed.

Financial well-being and years of education demonstrated a moderate positive relationship ($r = .39, p < .0001$). Greater financial well-being was associated with more years of education completed. The cost of medications was negatively associated with years of education ($r = -.27, p < .05$). Fewer total years of education are associated with the likelihood of taking fewer hypertensive medications because of the cost. There was a statistically significant relationship between years of education and health literacy ($r = -.37, p < .001$). Fewer years of total education was associated with the likelihood of requiring assistance reading healthcare information.
There was a moderate-strong positive association between the total number of antihypertensive medications and regimen complexity ($r = .41, p < .0001$). This indicated that as the number of medications increased, the medication regimen became more complex (i.e., medications taken more times during the day).

There was a moderate-weak positive relationship between miles to the nearest pharmacy and RUCA ($r = .27, p < .05$). As the number of miles required reaching the nearest pharmacy increased, there was an increased likelihood of a higher RUCA code (i.e., increased rurality).
Table 6

Demographic, Medication Adherence, and Study Variables

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<td>.67</td>
<td>.54</td>
<td>.82</td>
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<td>13. HCCQ</td>
<td>r</td>
<td>.25*</td>
<td>.09</td>
<td>.16</td>
<td>-.02</td>
<td>-.18</td>
<td>-.06</td>
<td>.10</td>
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<td>.42</td>
<td>.17</td>
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<td>14. BPNS: Autonomy</td>
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<td>.20</td>
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<td>.06</td>
<td>-.16</td>
<td>-.23*</td>
<td>-.10</td>
<td>.02</td>
<td>.03</td>
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<tr>
<td></td>
<td>( p )</td>
<td>.07</td>
<td>.31</td>
<td>.26</td>
<td>.62</td>
<td>.16</td>
<td>.04</td>
<td>.38</td>
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<td>.77</td>
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<td>15. BPNS: Comp</td>
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<td>-.20</td>
<td>.15</td>
<td>-.08</td>
<td>-.10</td>
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<td>-.09</td>
<td>-.01</td>
<td>.03</td>
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<td></td>
<td>( p )</td>
<td>.20</td>
<td>.08</td>
<td>.19</td>
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<td>.25</td>
<td>.45</td>
<td>.90</td>
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<td>16. BPNS: Related</td>
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<td>.10</td>
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<td>.02</td>
<td>-.03</td>
<td>-.13</td>
<td>-.03</td>
<td>-.12</td>
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<tr>
<td></td>
<td>( p )</td>
<td>.52</td>
<td>.51</td>
<td>.37</td>
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<td>.80</td>
<td>.25</td>
<td>.76</td>
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<td>17. BPNS: Global</td>
<td>( r )</td>
<td>.18</td>
<td>-.11</td>
<td>.16</td>
<td>-.05</td>
<td>-.10</td>
<td>-.16</td>
<td>-.13</td>
<td>-.01</td>
<td>-.03</td>
</tr>
<tr>
<td></td>
<td>( p )</td>
<td>.12</td>
<td>.35</td>
<td>.15</td>
<td>.67</td>
<td>.36</td>
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<td>.83</td>
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<td>18. RS-14</td>
<td>( r )</td>
<td>.29**</td>
<td>.10</td>
<td>.15</td>
<td>-.02</td>
<td>-.09</td>
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<td>.06</td>
<td>-.06</td>
<td>-.05</td>
</tr>
<tr>
<td></td>
<td>( p )</td>
<td>.01</td>
<td>.38</td>
<td>.18</td>
<td>.85</td>
<td>.44</td>
<td>.50</td>
<td>.60</td>
<td>.61</td>
<td>.64</td>
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</table>

*HB-M* (Hill-Bone Medication Adherence Scale, Modified), *Age* (Age in years), *Finances* (Financial well-being), *Cost* (Ended up taking less hypertensive medication because of the cost), #Meds (Total number of antihypertensive medications), *Regimen* (Medication regimen complexity, frequency of antihypertensive medication taken each day), *Pharm* (Miles to the nearest pharmacy from home), *RUCA* (Rural-Urban Commuting Area), *Edu* (Total number of years education completed), *Literacy* (Health literacy; How often need help with reading healthcare instructions, materials)

\( r \) (Pearson correlation)

\( p \) (significance)

Note: *p<0.05, **p<0.01 (2-tailed)*
Medication Adherence

Adherence to antihypertensive medication was measured using a modified version of the Hill-Bone medication adherence scale (HB-MAS). The relationship between medication adherence and resilience was statistically significant ($r = .29, p < .01$), indicating that more resilient individuals were likelier to adhere to their antihypertensive medications. There were no significant associations between antihypertensive medication adherence and any of the SDT constructs used in this study, including autonomous motivation, controlled motivation, perceived competence, perceived autonomy support, and basic psychological needs satisfaction.

The associations between antihypertensive medication adherence and cost ($r = -.39, p < .001$) and medication adherence and regimen complexity ($r = -.30, p < .01$) were statistically significant. These moderate, inverse relationships indicated that adherence was more likely to increase as the cost of medications or regimen complexity decreased.

The internal reliability of the 9-item HB-MAS was .55 with item-total correlations ranging from $r = -.05$ for item 8 (How often do you take someone else’s high BP pills) to $r = .59$ for item 1 (How often do you forget to take your high BP medications). Item-total correlations for the 9-item scale are listed in Table 7.

The internal reliability increased from .55 to .62 when item numbers 2 (‘How often do you decide not to take your high blood pressure medicine?’), 4 (‘How often do you run out of high blood pressure pills?’), and 8 (‘How often do you take someone else’s high blood pressure pills?’) were removed from the original scale. The item to total correlations for the modified HB-MAS 6-item scale ranged from $r = .17$ for item 5 (‘How often do you skip your high BP medication before you go to the doctor?’) to $r = .64$ for item 9 (‘How often do you miss taking
your high BP pills when you are careless?'). The conceptual reason to remove items 2, 4, and 8 was three-fold: 1) modified versions of the HB-MAS have been used in other research examining adherence to antihypertensive medications (Kim et al., 2007), 2) the Cronbach’s alpha increased from .55 to .62, and 2) items 2 and 8 did not seem relevant to participants living in a rural area. Therefore, all analyses used in this study were based on the 6-item modified version of the HB-MAS.

Table 7

Hill-Bone Medication Adherence Scale 9-Item (Item-Total Correlations (N=80)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>9</th>
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<tbody>
<tr>
<td>HB-MAS</td>
<td>r</td>
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<td>.254</td>
<td>.290</td>
<td>.148</td>
<td>.193</td>
<td>.404</td>
<td>.199</td>
<td>-.054</td>
</tr>
<tr>
<td>HB-MMAS</td>
<td>r</td>
<td>.393</td>
<td>.503</td>
<td>.171</td>
<td>.512</td>
<td>.274</td>
<td>.640</td>
<td></td>
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</tbody>
</table>

*HB-MAS* (Hill-Bone Medication Adherence Scale, 9-item)

*HB-MMAS* (Hill-Bone Modified Medication Adherence Scale, 6-item)

Multiple Regression: Research Aim 3

Aim 3 was to predict adherence to antihypertensive medications using autonomous motivation, perceived competence, resilience, and select demographic variables.

Autonomous Motivation, Perceived Competence, and Resilience

Hierarchical multiple regression was run to predict medication adherence from autonomous motivation, perceived competence, resilience, and demographic variables (i.e., cost & regimen complexity) (Table 8). Of the predictor variables, resilience and the demographic variables of cost and frequency of medications contributed significantly to the variance in the medication adherence measure. In Model 1, perceived competence and autonomous motivation did not significantly predict medication adherence, $F(2,77) = 1.61, p=0.21, R^2= .04$. The
Regression model indicated that 4% of the variance in medication adherence could be predicted from autonomous motivation and perceived competence. In Model 2, resilience was added to perceived competence and autonomous motivation, which significantly predicted medication adherence, F(3,75)=2.8, \( p<.05 \), \( R^2 = .10 \). Regression Model 2 indicated that 10% of the variance in medication adherence could be predicted from resilience, perceived competence, and autonomous motivation. Demographic variables of cost and regimen complexity were added to perceived competence, autonomous motivation, and resilience (Model 3), which significantly predicted medication adherence, F(5,73)=3.9, \( p<.01 \), \( R^2 = .21 \). Model 3 indicated that 21% of the variance in medication adherence could be predicted from cost, regimen complexity, resilience, perceived competence, and autonomous motivation.

**Table 8**

*Summary of Hierarchical Regression Analysis for Variables Predicting Medication Adherence (N=80)*

<table>
<thead>
<tr>
<th>Model*</th>
<th>( B )</th>
<th>SE ( B )</th>
<th>( \beta )</th>
<th>( t )</th>
<th>( p)-value</th>
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</thead>
<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(Constant)</td>
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<td>.83</td>
<td>26.81</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>1. Autonomous motivation</td>
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<td>.29</td>
<td>.77</td>
</tr>
<tr>
<td>2. Perceived competence</td>
<td>.15</td>
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<td>.17</td>
<td>1.19</td>
<td>.24</td>
</tr>
<tr>
<td>( R^2 = .04 ), ( F(2,76) = 1.61 ), ( p = .21 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>20.37</td>
<td>1.2</td>
<td>26.81</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>1. Autonomous motivation</td>
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<td>.16</td>
<td>.04</td>
<td>.27</td>
<td>.79</td>
</tr>
<tr>
<td>2. Perceived competence</td>
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<td>.12</td>
<td>.11</td>
<td>.78</td>
<td>.44</td>
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<tr>
<td>3. Resilience</td>
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<td>.01</td>
<td>.25</td>
<td>2.24</td>
<td>.03</td>
</tr>
<tr>
<td>( R^2 = .10 ), ( F(3,75) = 2.8 ), ( p &lt; .05 )</td>
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Table 8 – Continued

<table>
<thead>
<tr>
<th>Model*</th>
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<th>SE $B$</th>
<th>$\beta$</th>
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<td>.08</td>
<td>.56</td>
<td>.58</td>
</tr>
<tr>
<td>2. Perceived competence</td>
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<td>.51</td>
</tr>
<tr>
<td>3. Resilience</td>
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<td>.01</td>
<td>.23</td>
<td>2.14</td>
<td>.04</td>
</tr>
<tr>
<td>4. Cost</td>
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<td>.72</td>
<td>-.20</td>
<td>-1.91</td>
<td>.06</td>
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<tr>
<td>5. Regimen Complexity</td>
<td>-.64</td>
<td>.28</td>
<td>-.25</td>
<td>-2.34</td>
<td>.02</td>
</tr>
</tbody>
</table>

Cost (Take less BP medication because of cost); Regimen Complexity (Complexity of medication regimen, frequency of antihypertensive medications per day)
Note: *Dependent variable: Hill-Bone Medication Adherence Scale, modified

Perceived Autonomy Support and Resilience

To further explore the significant relations between these variables, hierarchical multiple regression was run to predict medication adherence from perceived autonomy support and resilience and to determine if resilience mediates the relation between perceived autonomy support and adherence (Table 9). In Model 1, perceived autonomy support significantly predicted medication adherence, $F(1,79) = 5.19$, $p < .05$, $R^2 = .05$. The regression model indicated that 5% of the variance in medication adherence could be predicted from perceived autonomy support. In Model 2, resilience was added to perceived autonomy support which significantly predicted medication adherence, $F(2,77) = 4.95$, $p < .01$, $R^2 = .12$. Regression Model 2 indicated that 12% of the variance in medication adherence could be predicted from resilience and perceived autonomy support. The relation between perceived autonomy support and adherence fell to non-significance thus confirming that resilience fully mediates perceived autonomy support’s effect on adherence (Figure 2).
Table 9

Summary of Multiple Regression Analysis for Variables Predicting Medication Adherence (N=80)

<table>
<thead>
<tr>
<th>Variable</th>
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<tr>
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<td>B</td>
<td>SE B</td>
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<tr>
<td>HCCQ</td>
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<td>.08</td>
</tr>
<tr>
<td>RS14</td>
<td></td>
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<tr>
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<td>.12</td>
</tr>
<tr>
<td>F for change in R²</td>
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</table>

HCCQ (perceived autonomy support), RS14 (resilience)
*p < .05, **p < .01

Figure 2

Autonomy Support, Resilience, and Medication Adherence

Logistic Regression

A sensitivity analysis using a scatterplot revealed inferential points and possible outliers.

In view of the concern for violation of the assumption of normal distribution, the data was reanalyzed using binomial logistic regression to ascertain the effects of autonomous motivation, perceived competence, resilience, cost, and regimen complexity on the likelihood that
participants would adhere to antihypertensive medication (Table 10). The dependent variable, medication adherence, was dichotomized to “more adherent” and “less adherent” based on the median adherence score. Participants with modified HB-MAS of “24” were categorized as “more adherence” and scores <24 were categorized as “less adherence.” Adherence was regressed onto autonomous motivation, perceived competence, resilience, cost, and regimen complexity. The logistic regression model was statistically significant, \( x^2(5) = 12.87, p<.05 \). The model explained 23.2% (Nagelkerke \( R^2 \)) of the variance in medication adherence and correctly classified 82% of cases. Increased regimen complexity was marginally significant with a reduction in the likelihood of higher adherence. However, autonomous motivation, perceived competence, resilience, and cost were not significantly associated with adherence.

**Summary**

Chapter IV described the demographic characteristics of the 80 participants in this study, examined the scales' descriptive statistics, analyzed correlations between antihypertensive medication adherence and scales, analyzed correlations between antihypertensive medication adherence and demographic variables, and identified predictors of medication adherence using hierarchical multiple regression. There was a significant association between antihypertensive medication adherence and the SDT construct of perceived autonomy support and a statistically significant relationship between medication adherence and resilience \( (r=.29, p<.01) \). There were significant inverse relationships between antihypertensive medication adherence and cost \( (r = -.39, p < .001) \) and medication adherence and regimen complexity \( (r = -.30, p < .01) \). Perceived competence and autonomous motivation were not significant predictors of medication adherence. Resilience, cost of medications, and frequency of medications taken per day were predictive of
antihypertensive medication adherence $F(5,73)=3.9, p<.01, R^2=.21$. Perceived autonomy support and resilience predicted medication adherence and resilience mediated perceived autonomy support’s effect on adherence.

Chapter V includes discussing findings, study strengths and limitations, recommendations for future research, and conclusion.
CHAPTER V: DISCUSSION

In this chapter, each research aim is reviewed, and study findings are discussed. Implications of the results and study limitations are presented. Suggestions for future research and implications for nursing conclude the chapter.

This study explored antihypertensive medication adherence among rural older adults. To the best of the author’s knowledge, this was the first known study to explore this topic. The Besel Model, adapted from self-determination theory (SDT), rural nursing theory (RNT), and the model of resilience was used as the guiding theoretical framework. The first aim described the sample regarding motivation (autonomous, controlled, amotivation), perceived competence, perceived autonomy support, basic psychological needs satisfaction, resilience, demographic variables (i.e., age, financial well-being, cost of medications, regimen complexity, distance to pharmacy, rurality, education, & healthcare literacy), and medication adherence among older adults living in a rural area. The second aim examined associations between antihypertensive medication adherence, motivation (autonomous vs. controlled), perceived competence, perceived autonomy support, basic psychological needs satisfaction, resilience, and demographic variables (i.e., age, financial well-being, cost of medications, regimen complexity, distance to pharmacy, rurality, education, & healthcare literacy) among rural older adults. The third aim predicted adherence to antihypertensive medications using autonomous motivation, perceived competence, resilience, and demographic variables (i.e., cost, frequency) among rural older adults.

After adjusting the dependent variable of medication adherence to raise its internal consistency to an acceptable value, the findings supported the hypothesis that there would be a significant correlation between SDT constructs and antihypertensive medication adherence,
specifically perceived autonomy support. The hypothesis was supported that medication adherence and resilience are significantly associated. The demographic variables of cost and regimen complexity were also significantly associated, as were expected. The hypothesis that autonomous motivation, perceived competence, resilience, and select demographic variables would predict medication adherence was supported. Although the overall model was significant, perceived competence and autonomous motivation did not significantly contribute to the medication adherence outcome variance. Rather resilience, cost, and frequency of medications were significant contributors. The exploratory hypothesis that perceived autonomy support and resilience would predict medication adherence, and that resilience would mediate the relationship between autonomy support and adherence were also supported.

**Perceived Competence and Autonomous Motivation**

Rural older adults in this study had a very high level of autonomous motivation for adhering to their antihypertensive medication regimen, with a mean of 6.43. This implies participants freely choose to take their medication, as they believe it may help them reach a valued health goal (Williams et al., 2006). Participants’ mean perceived competence (M=6.25) was also high, indicating they felt highly competent toward attaining medication adherence. These results are like other studies showing that when people are more autonomously motivated, they feel more competent toward obtaining a health outcome (Williams, Freedman et al., 1998; Williams et al., 2004).

Contrary to existing literature, results from the current study found that neither autonomous motivation nor perceived competence was significantly associated with antihypertensive medication adherence. However, both relations were in the predicted direction.
It is possible that in a larger sample these would be significant. In addition, the high mean level of both autonomous motivation and perceived competence likely limited the strength of those correlations. These results are inconsistent with prior studies that reported support for the importance of autonomous motivation and perceived competence as proximal predictors of medication adherence (Ntoumanis et al., 2020; Ng et al., 2012; Kennedy et al., 2004; Williams, Freedman et al., 1998; Williams, Patrick et al., 2009; Williams, Rodin et al., 1998; Williams, Mcgregor, Sharp et al., 2006; Williams, Niemiec et al., 2009). A possible explanation for the contrary findings in this study with those in the extant literature could be the singular measurement of adherence with a self-report measure. Previous studies administered a self-report measure of medication adherence and physiological measurement of blood pressure or pharmacy refill logs to validate the self-reports. It is essential to address the low Cronbach’s alpha of the HB-MAS within the current study, which may have impacted results. Aside from a low Cronbach’s alpha, the items address circumstances where a participant misses their medications. If an individual’s autonomous motivation is low, they may not be as motivated to adhere to their treatment regimen and therefore may miss medications.

Furthermore, the adherence scale items do not appear to focus on volition (autonomy) to take medications to improve health, or ability to achieve blood pressure control (competence) toward medication use but rather seem to speak about following through with taking the antihypertensive medication even when not feeling well, or taking them in challenging situations. For example, item 7 asks, “How often do you miss taking your high blood pressure pills when you feel sick?” The wording in the HB-MAS aligns with resilience characteristics, such as perseverance and finishing what they started. However, they do not address how much the
subject wants to take the medication. In other words, the participant exhibits resilience by “pushing through” hard times. Further studies are called for to include subjects who do not want to take their medications, and do not feel able to achieve BP control with pill counts and blood pressure to examine the full relations between these SDT variables and adherence. Instead, the link between adherence and the SDT model for health behavior was with perceived autonomy support. These limitations indicate additional research is needed to measure medication adherence, such as blood pressure readings, pills counts and pharmacy logs. Research is called for that tests self-report medication adherence scales, actual BP levels achieved and motivation variables within a rural context that includes subjects who want to and do not want to use antihypertensive medications to fully explicate the relations between motivation and adherence.

**Resilience**

Similar to the findings of other studies (Cohen et al., 2018; Wells, 2009), resilience levels of study participants were found to be moderately high (M=86.488). In some studies, adults aged 85 and older appeared to have the same or greater capacity for resilience than younger (Gooding et al., 2012; Hamarat et al., 2002; Netuveli et al., 2008; Nygren et al., 2005). The full range of adherence would be better represented if it included the one-third of subjects who never fill the first prescription.

Resilience was a significant predictor of medication adherence. Perceived competence significantly predicted medication adherence, and resilience mediated this relationship. All the SDT-constructs except autonomous motivation were positively correlated with resilience, with basic psychological needs satisfaction demonstrating the strongest positive relationship. All these findings are remarkable and novel. Ryan and Deci (2008) discussed satisfaction of the basic
needs adding to resilience; however, the authors refer to resilience as the absence of stress, and that empirical evidence is lacking. Higher levels of relatedness need satisfaction significantly predicted resilience (Perlman et al., 2017). However, medication adherence and other SDT-constructs were not measured, further limiting the ability to compare the results. Future research is needed to expand upon the current findings.

**Perceived Autonomy Support and Resilience**

According to SDT, when patients perceive their healthcare providers to be autonomy-supportive, they are more likely to become autonomously motivated and to perceive themselves as competent toward achieving a health outcome. Earlier studies have shown that perceived autonomy support is associated with medication adherence, and its effects are mediated through autonomous motivation (Williams, Mcgregor et al., 2006; Williams, Rodin et al., 1998). However, we found that neither autonomous motivation nor perceived competence was significantly associated with medication adherence. The results of this study did find positive and significant relations between perceived autonomy support, resilience, and medication adherence that were weak to moderate in strength. Furthermore, perceived autonomy support and resilience predicted the outcome of medication adherence, with resilience mediating the relationship between the other two. This suggests that when rural older adults perceive their healthcare providers to be supportive of their autonomy, they are more likely to take their antihypertensive medications consistently. This is potentially important because when subjects experience their health care climate as supporting their needs, they are more likely to achieve their desired outcomes in randomized controlled trials (Ntoumanis et al., 2020). As revealed in rural nursing theory (RNT), rural persons prefer to seek healthcare from persons with whom they are familiar
(Long & Weinert, 1989). It is posited that participants in this study choose to seek care from local healthcare providers with whom they have a clinician-patient relationship. Over 80% of participants in this study see the same healthcare provider at each visit. To the best of our knowledge, there are no reports in the literature of perceived autonomy support and resilience predicting medication adherence; therefore, these relations are novel findings worth exploring further.

**Demographic Variables**

Medication adherence is a crucial component of effective treatment for older adults with hypertension and to reduce negative cardiovascular and renal outcomes. This study found self-reported medication adherence to be high compared to other studies where adherence has been reported as low as 21% among rural older adults (Ma, 2016). One possible reason for this discrepancy is that the older adults who lived in rural China took a more significant number of antihypertensive pills per dose at a higher frequency each day. In contrast, participants in the current study took an average of 1.5 tablets each day, and over 60% took antihypertensive medication once per day. A second reason may be that the study by Ma (2016) included more subjects that did not want to take their medication or did not feel able to manage their hypertension.

Regarding demographic variables (i.e., taking less medication because of cost, regimen complexity), this significantly explained medication adherence among rural older adults in this study. Similar results were found in previous studies reporting an inverse relationship between medication regimen complexity, cost of medications, and medication adherence (Burnier & Egan, 2019; Jin et al., 2016; Ma, 2016; Wimmer et al., 2017; Yap et al., 2016). These study
findings indicate that people who take less antihypertensive medication because of the cost and have a complex medication regimen report lower adherence to their medications. The results imply that healthcare providers discuss the pros and cons of various classes of antihypertensive medications with rural older adults, including the cost of medication regimens and decreasing the frequency of medications required each day, if possible. Another study variable, the distance the nearest pharmacy from home, approached significance and warrants mention. Over 50% of participants obtained prescription medications from a pharmacy and traveled an average of eight miles (range of .5-42 miles) from their home to do so. The results imply policymakers should take adequate measures to address the growing rates of pharmacy closures in rural towns across America. These closures mean some patients in rural areas may need to travel long distances to pick up a prescription or rely on mail-order pharmacy arrangements, limiting valuable in-person access to pharmacists (Todd et al., 2013).

Adherence

In the current study, the antihypertensive medication adherence scores contrasted with findings from other studies that found lower adherence scores among rural older adults. The modified HB-MAS mean scores in the present study indicated a very high level of adherence compared to referenced studies that found a low mean adherence score, indicating lower levels of antihypertensive medication adherence (Kim et al., 2000; Lambert et al., 2006). There are several possible reasons for adherence scores to differ from the literature. While some studies included rural older adults, they were in other countries such as China (Ma, 2016), where rural areas may be vastly different from those in the US. In other studies, using the HB-MAS, either the population or versions of the scale differed. For example, researchers used a modified, 10-
item version of the HB-MAS among Black, urban, hypertensive, South African patients (Lambert et al., 2006). In another study, a modified 4-item HB-MAS was administered to a sample of Korean Americans with hypertension. Nearly 64% of participants aged 50 years or more reported medication adherence (Kim et al., 2007). Therefore, it is difficult to compare the results to a rural older population. Another factor to consider was the low internal reliability of the scale used in the current study when compared to the high internal reliability in previous work.

**Study Limitations**

It is important to mention several limitations related to the methodological issues of this study. The study was a cross-sectional design, and therefore causality cannot be inferred. A longitudinal study or randomized controlled trial of subjects with the full range of adherence testing interventions to enhance autonomy supportiveness, change in resilience, autonomous motivation, and perceived competence to would be helpful determine if they cause greater medication adherence. To see the cardiovascular and renal benefits of adherence to these medications, health behaviors need to be maintained over time, as studies demonstrate that behavior maintenance is facilitated by need support, autonomous motivation, and perceived competence (Ntoumanis et al., 2020).

Generalization of the findings is also limited because of the technique of convenience sampling and the relatively low sample size. The study was conducted at a large healthcare facility in the northwest. Participants were conveniently selected from five rural hospitals within the region rather than randomly sampled; thus, this might further limit the generalizability of the findings. Because there were so few respondents representing other ethnic groups, differences
among ethnicity and race could not be explored. Mailed surveys and employing self-reported responses may not have captured the average level of resilience in rural living older adults. With a response rate of 32%, selection bias may have limited participation by individuals with lower levels of resilience. Those with better health status or resilience may have been more likely to respond. Therefore, further research should validate our results with random sampling and longitudinal design in wider rural areas.

The present study did not explore the relationship between comorbid conditions and subsequent medication regimen complexity. This is important for future analyses as comorbidities may require additional medications and complex regimens. Further, comorbidities may affect resilience in either an adaptive or a detrimental way.

Moreover, all data were based on a self-report measure of adherence to antihypertensive medications, and the drawbacks of this approach should not be underestimated. The results from the HB-MAS may be subject to social desirability and may have overestimated patient adherence. While all the scales used in this study have demonstrated validity and reliability in several populations, this study is the first time the scales were used with rural older adults. Over 75% of participants had perfect adherence limiting the variance in the outcome. This likely reduced the size of its correlation with the independent variables. Thus, the full range of adherence was not included in this sample. Autonomous motivation is also skewed likely because people that are more motivated and adherent chose to return the questionnaires. Furthermore, the poor reliability of the Hill-Bone medication adherence scale (HB-MAS) reduced the ability to find predicted relations and may have limited the interpretation of the findings.
It is essential to note the role of the COVID-19 pandemic and necessary changes to study procedures. Onsite visits to rural clinics, face-to-face interactions with participants were not possible and therefore in-person administration of questionnaires, and blood pressure measurements did not occur. The PI did not include questions regarding the impact of COVID-19 and medication adherence.

**Study Strengths**

Despite the limitations, this study highlights an increasingly important health care issue of HTN among a rapidly growing rural older adult population and medication adherence challenges. In addition, two theoretical frameworks based on an extensive literature review, and specific research questions were proposed to study the potential predictors of antihypertensive medication adherence. The empirical findings from this study set the foundation for further refining the framework and building interventions for future research.

**Implications for Future Research**

This study found that autonomous motivation, perceived competence, resilience, and demographic variables of cost and frequency predicted medication adherence among older adults with HTN living in rural areas. Although the overall model was significant, autonomous motivation and perceived competence were not found to significantly contribute to the model. Both perceived autonomy support and resilience predicted medication adherence and were found to be significantly related to each other. These novel findings warrant further exploration of how this effect adherence and how SDT models relate to resilience. Other social network-related constructs, such as social connectedness, isolation, and loneliness, should be addressed in future research. Healthcare providers should acknowledge the unique demographic and cultural aspects
of rural living and need to be mindful of the complex nature of factors affecting medication adherence among older adults. Furthermore, nurses and providers should communicate and assess rural older adults with HTN to better understand motivational need support, resilience, and demographic factors that impact medication adherence. Developing a better understanding of resilience among rural older adults and its interrelationships with health behaviors (i.e., medication adherence) can help determine who may struggle to adapt to health-related changes and self-management requirements and ultimately who will experience poorer outcomes.

As adherence behavior to medication may change from time to time, longitudinal studies are necessitated to determine the key determinants of medication adherence, including resilience and SDT constructs. Future research should include samples of rural, urban, and suburban residents better to understand the interplay of these constructs in each subgroup. A revised self-report measure for medication adherence is needed that reflects the unique rural culture. Future research should include multiple medication adherence measures in addition to self-reports such as pharmacy refill records, electronic medication monitoring devices, and physiological measurements, and more distal health outcome events such as heart attacks, heart failure, strokes, and renal failure.

**Conclusions**

Medication adherence among rural older adults with HTN varies considerably due to the influences of several factors. With the rapidly aging rural population, the prevalence of HTN, and the anticipated increase in antihypertensive medication requirements, the results of this study are timely. This study found correlates and predictors between demographic variables, resilience,
perceived autonomy support from healthcare providers, and adherence to antihypertensive medications.

The next steps should include developing and testing interventions to promote autonomy-supportive relationships between patients and providers in rural areas. Cost and medication regimen complexity should be considered when prescribing medication to manage blood pressure among older adults.
APPENDIX A:

THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD APPROVAL LETTER
Date: March 18, 2021
Principal Investigator: Jamie Besel
Protocol Number: 2102509812
Protocol Title: Resilience, Motivational Factors, and Medication Adherence among Rural Older Adults

**Level of Review:** Administrative Review  
**IRB of Record:** Advarra  
**Investigator at Site:** Jamie M. Besel  
**IRB of Record Protocol Number:** 20.011 Pro00048834

**Documents Reviewed Concurrently:**
- Data Collection Tools: Data Collection Tools.docx
- HSPP Forms/Correspondence: Advisor Confirmation Email.pdf
- HSPP Forms/Correspondence: appendix waiver_v2019-08_0.pdf
- HSPP Forms/Correspondence: Besel_UA_IRB_application_2-10-2021.pdf
- HSPP Forms/Correspondence: Besel UA_Research_personnel_1-4-2021.pdf
- Other Approvals and Authorizations: besel coi complete.png
- Other Approvals and Authorizations: Besel Protocol Exempt Determination Notice Jan1421.pdf
- Recruitment Material: Recruitment Flyer.docx
- Recruitment Material: Recruitment Letter.docx
- Recruitment Material: Telephone Script.docx

**Regulatory Determinations/Comments:**
- **Advarra:** When an institution is designated IRB of record, the UA IRB will not review the project. The University of Arizona agrees that it will rely on the review, approval, and continuing oversight of the institution's IRB pursuant to the terms of the Institutional Review Board Authorization Agreement.
• The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).

• All documents referenced in this submission have been reviewed and are filed with the HSPP. The Principal Investigator should notify the IRB immediately of any proposed changes that affect the LOCAL protocol and report any LOCAL unanticipated problems involving risks to participants or others. Please refer to Guidance's *Investigators Responsibility after IRB Approval* and *Reporting Local Information*.

• All research procedures should be conducted according to the approved protocol and the policies and guidance of the IRB of record.
APPENDIX B:

ADVARRA INSTITUTIONAL REVIEW BOARD APPROVAL LETTER
EXEMPT DETERMINATION

DATE: 14 Jan 2021
IO: Jamie Besel, MN, RN
PROJECT: Billings Clinic - 20.011, Resilience, Motivational Factors, and Medication Adherence Among Rural Older Adults (Pro00048834)

DOCUMENTATION REVIEWED:

Protocol Version: Protocol (Not Dated)
Consent Form: Information and Verbal Consent Form (Not Dated)
Recruitment Material: Direct Mailing, Recruitment Letter (Not Dated), Flyer, poster, or bulletin board, Recruitment Flyer (Not Dated)

Using the Department of Health and Human Services regulations found at 45 CFR 46.104(d)(2), the IRB determined that your research project is exempt from IRB oversight. The IRB also completed the necessary additional limited review considerations as set forth under the Revised Common Rule, 45 CFR 46.104(d). All study related documents will be removed from our active files and archived.

Note: You will still be able to access this study via the Advarra CIRBI Platform under the "Archived" tab on your Dashboard for three years. After three years, the study will be removed from the system in accordance with IRB regulations.

Please note the following COVID-19 considerations:
1. Please ensure that you have adequate study staff and resources before you begin conducting the study.
2. Please consider delaying enrollment if your study procedures may be impacted by the pandemic; or please submit a modification to change the procedures.
3. Please note that screening questions relating to COVID-19 are not considered research questions unless you will be collecting data on COVID-19.

The IRB granted this exemption with an understanding of the following:

1. The research project will only be conducted as submitted and presented to the IRB, without additional change in design or scope.
2. Should the nature of the research project change, or any aspect of the study change such that the nature of the study no longer meets the criteria found in 45 CFR 46.104(d)(2), you will resubmit revised materials for IRB review.
3. It is the responsibility of each investigator to ensure that the project meets the ethical standards of the institution. Specifically, the selection of subject is equitable, there are adequate provisions to maintain the confidentiality of any identifiable data collected, and when there are interactions with research subjects, they will be informed that the activity involves research, a description of the procedures, participation is voluntary, and the contact information for the researcher.

The IRB will evaluate the new information and make a determination at that time regarding the research project’s status.

This project is not subject to requirements for continuing review.

If you have any questions or concerns, please use the Contact IRB activity on the Advarra CIRBTM Platform.

Thank you for selecting Advarra IRB to review your research project.
APPENDIX C:

INTELLECTUAL PROPERTY LICENSE AGREEMENT – 14-ITEM RESILIENCE SCALE
INTELLECTUAL PROPERTY LICENSE AGREEMENT

This Intellectual Property License Agreement ("Agreement") is made and effective this 15 January 2021 ("Effective Date") by and between The Resilience Center, PLLP ("Licensor") and Jamie M. Besel ("Licensee").

Licensor has developed and licenses to users its Intellectual Property, marketed under the names “the Resilience Scale,” “RS”, “14-item Resilience Scale,” “RS14,” the “Resilience Scale for Children” and “RS10” (the "Intellectual Property").

Licensee desires to use the Intellectual Property.

NOW, THEREFORE, in consideration of the mutual promises set forth herein, Licensor and Licensee agree as follows:

1. License.
   Licensor hereby grants to Licensee a 1-year, non-exclusive, limited license to use the Intellectual Property as set forth in this Agreement.

2. Restrictions.
   Licensee shall not modify, license or sublicense the Intellectual Property, or transfer or convey the Intellectual Property or any right in the Intellectual Property to anyone else without the prior written consent of Licensor. Licensee may make sufficient copies of the Intellectual Property and the related Scoring Sheets to measure the individual resilience of up to 300 subjects, for non-commercial purposes only.

3. Fee.
   In consideration for the grant of the license and the use of the Intellectual Property, subject to the Restrictions above, Licensee agrees to pay Licensor the sum of US$75.

4. Term.
   This license is valid for twelve months, starting at midnight on the Effective Date.

5. Termination.
   This license will terminate at midnight on the date twelve months after the Effective Date.

6. Warranty of Title.
   Licensor hereby represents and warrants to Licensee that Licensor is the owner of the Intellectual Property or otherwise has the right to grant to Licensee the rights set forth in this Agreement. In the event any breach or threatened breach of the foregoing representation and warranty, Licensee’s sole remedy shall be to require Licensor to do one of the following: i) procure, at Licensor’s expense, the right to use the Intellectual Property, ii) replace the Intellectual Property or any part thereof that is in breach and replace it with Intellectual Property of comparable functionality that does not cause any breach, or iii) refund to Licensee the full amount of the license fee upon the return of the Intellectual Property and all copies thereof to Licensor.

7. Warranty of Functionality.
   Licensee provides to Licensee the Intellectual Property “as is” with no direct or implied warranty.

8. Payment.
   Any payment shall be made in full prior to shipment. Any other amount owed by Licensee to Licensor pursuant to this Agreement shall be paid within thirty (30) days following invoice from Licensor. In the event any overdue amount owed by Licensee is not paid following ten (10) days written notice from Licensor, then in addition to any other amount due, Licensor may impose and Licensee shall pay a late payment charge at the rate of one percent (1%) per month on any overdue amount.

   In addition to all other amounts due hereunder, Licensee shall also pay to Licensor, or reimburse Licensor as appropriate, all amounts due for tax on the Intellectual Property that are measured directly by payments made by Licensee to Licensor. In no event shall Licensee be obligated to pay any tax paid on the income of Licensor or paid for Licensor’s privilege of doing business.

10. Warranty Disclaimer.
   LICENSOR'S WARRANTIES SET FORTH IN THIS AGREEMENT ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
11. Limitation of Liability.
Licensor shall not be responsible for, and shall not pay, any amount of incidental, consequential or other indirect damages, whether based on lost revenue or otherwise, regardless of whether Licensor was advised of the possibility of such losses in advance. In no event shall Licensor’s liability hereunder exceed the amount of license fees paid by Licensee, regardless of whether Licensee’s claim is based on contract, tort, strict liability, product liability, or otherwise.

Licensor agrees to provide limited, e-mail-only support for issues and questions raised by the Licensee that are not answered in the current version of the Resilience Scale User’s Guide, available on www.resiliencescale.com, limited to the term of this Agreement. Licensor will determine which issues and questions are or are not answered in the current User’s Guide.

Any notice required by this Agreement or given in connection with it, shall be in writing and shall be given to the appropriate party by personal delivery or by certified mail, postage prepaid, or recognized overnight delivery services.
If to Licensor:
The Resilience Center
PO Box 313
Worden, MT 59088-0313
If to Licensee:
Name: Jamie M. Besel
The University of Arizona and Billings Clinic (researcher)
Billings, MT
United States of America
Telephone: 406-860-0105
Email: Jbesel@billingsclinic.org

This Agreement shall be construed and enforced in accordance with the laws of the United States and the state of Montana. Licensee expressly consents to the exclusive forum, jurisdiction, and venue of the Courts of the State of Montana and the United States District Court for the District of Montana in any and all actions, disputes, or controversies relating to this Agreement.

15. No Assignment.
Neither this Agreement nor any interest in this Agreement may be assigned by Licensee without the prior express written approval of Licensor.

16. Final Agreement.
This Agreement terminates and supersedes all prior understandings or agreements on the subject matter hereof. This Agreement may be modified only by a further writing that is duly executed by both Parties.

17. Severability.
If any term of this Agreement is held by a court of competent jurisdiction to be invalid or unenforceable, then this Agreement, including all of the remaining terms, will remain in full force and effect as if such invalid or unenforceable term had never been included.

Headings used in this Agreement are provided for convenience only and shall not be used to construe meaning or intent.

IN WITNESS WHEREOF, the Parties hereto have duly caused this Agreement to be executed in its name on its behalf, all as of the day and year first above written.

<table>
<thead>
<tr>
<th>Licensee</th>
<th>The Resilience Center</th>
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<tbody>
<tr>
<td>Signature:</td>
<td></td>
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<tr>
<td>Printed Name: Jamie M. Besel</td>
<td>Gail M. Wagnild, PhD</td>
</tr>
<tr>
<td>Title: Student</td>
<td>Owner and CEO</td>
</tr>
<tr>
<td>Date: 15 January 2021</td>
<td>15 January 2021</td>
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</tbody>
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APPENDIX D:

PERMISSION TO USE HB-MAS SCALES
Hi Jamie,

Please consider this email as permission to use the Hill-Bone Scales.

Attached are the Hill-Bone Scales along with several relevant articles reporting on the validation and use of the scales. Please cite the scale using the references provided. We would appreciate you sharing the findings of your research with us.

In the scoring guide, there is a note under the table that provides instructions on how to obtain a sum score for adherence. We do not recommend specific cut-offs but rather examining adherence on a continuous scale. For instance, for the 9-item HB-MAS, if a participant reports "None of the Time" for all the 9 questions, their total adherence score would be 36 points which indicate higher adherence.

We wish you the very best in your project and please do not hesitate to reach out to us if you have any follow-up questions.

Please do not share these scales with anyone who has not obtained permission for its use.

Kind Regards,
The Hill-Bone Scales Team
APPENDIX E:

PERMISSION TO USE SDT QUESTIONNAIRES
November 30, 2020

Hi Jamie,

You have my permission to use the HCCQ, PCC, and TSRQ AND BNSQ.

Sincerely, Geof Williams MD, PHD
REFERENCES


