

**Psychosocial Determinants of Self-Management Behaviors
and Health Outcomes among Older Adults**

BY

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THESIS

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thank you for sharing your experience with me.
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LIST OF ABBREVIATIONS

ABLE	Asthma Beliefs and Literacy in the Elderly
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
CHAOS	Confusion, Hubbub and Order Scale
ED	Emergency Department
HIV	Human Immunodeficiency Virus
LitCog	Health Literacy and Cognitive Function among Older Adults
LSNS	Lubben Social Network Scale
M	Mean
MARS	Medication Adherence Reporting Scale
MMSE	Mini Mental State Exam
MPED	Martin and Park Environmental Demands Questionnaire
NIH	National Institutes of Health
OR	Odds Ratio
PROMIS	Patient Reported Outcomes Measurement Information Service
SD	Standard Deviation
SDoH	Social Determinants of Health
SEP	Socioeconomic Position
SMMS	Support with Medication Management Scale
S-TOFHLA	Short Test of Functional Health Literacy in Adults
TOFHLA	Test of Functional Health Literacy in Adults

SUMMARY

Chronic conditions have emerged as the primary cause of morbidity and mortality in the United States (US), and the prevalence of individuals contending with multiple chronic conditions, the co-occurrence of two or more chronic conditions, is increasing. Engaging in self-management behaviors is a core mechanism to promote health outcomes and prevent chronic disease complications. Over the past several decades a sizable body of evidence has identified a number of psychosocial determinants of proper chronic disease self-management and health outcomes, but despite this evidence, there has been slow progress in addressing these psychosocial risk factors to support proper self-management. This may be due to a lack of attention to the requisite skills individuals must employ to engage in self-care behaviors, and a lack of appreciation for the role which external contextual factors exert in health management. Self-management behaviors occur within the context of individuals' everyday lives, and therefore must be integrated within existing responsibilities. Individuals facing significant hardship (such as housing instability, food insecurity, exposure to violence) must simultaneously take action to minimize these stressors, which challenges consistent engagement in self-management behaviors. Therefore, an ecological approach with particular attention to the role of social determinants of health was applied in the investigation of two understudied psychosocial factors a daily routine and tangible social support.

As part of this dissertation I conducted three secondary data analyses (subsequently referred to as studies) with two National Institutes of Health (NIH) cohort studies of older adults. The first study examined associations between the presence of a daily routine and older adults' health status and urgent health care utilization, and determined whether a higher level of daily routine mediates associations between socioeconomic position (SEP) and health outcomes. The second study investigated associations between structural and functional aspects of social

SUMMARY (continued)

relationships and medication adherence in older adults with asthma. The third study evaluated the association between unmet, tangible social support needs and older adults' health status and urgent health care utilization.

At the individual level, greater levels of daily routine were associated with better health status, but I did not observe an association between daily routine and urgent health care utilization. I did not observe strong evidence in support of the hypothesis that daily routine would mediate the association between SEP and health outcomes, except with regards to the association between SEP and depressive symptoms. At the interpersonal level, the analyses related to social relationships underscored the multidimensional and complex nature of social support. Contrary to my hypothesis, the second study observed a negative association between the frequency of functional support and adherence to asthma medications. Functional support was measured as support that was received, regardless of whether an individual perceived they could manage the tasks independently. Conversely, the third study observed findings consistent with its hypothesis that unmet tangible support needs would be associated with worse health status and greater urgent health care utilization, and assessed social support by first identifying whether participants self-reported a need for tangible assistance, and subsequently inquired about the perceived adequacy of the support. Together, these two studies suggest that it is important to first isolate a need for tangible assistance in managing one's health, and then examine perceptions related to the support's availability and adequacy.

In summary, there is increasing recognition of the importance of comprehensively understanding and responding to social determinants of health in order to improve health outcomes. As we seek to promote healthy aging, findings from this dissertation shed light on two

SUMMARY (continued)

psychosocial factors, a daily routine and unmet tangible social support needs, which could be leveraged, but also suggests that they must be acted on with simultaneous systemic changes.

I. INTRODUCTION

A. Significance: Chronic Conditions, Aging, and Health Inequities

1. Epidemiology of Chronic Illness

Chronic conditions have emerged as the primary cause of morbidity and mortality in the United States (US),¹⁻⁴ and the prevalence of individuals contending with multiple chronic conditions, the co-occurrence of two or more chronic conditions, is increasing.^{5,6} Half of all US adults are living with one chronic condition and nearly one third are living with multiple chronic conditions.⁷ The most common conditions (and respective prevalence) among the US adult population include hypertension (27%), hyperlipidemia (22%), arthritis (13%), mood disorders (depression and bipolar) (11%), diabetes (10%), and respiratory conditions (asthma and chronic obstructive pulmonary disorder (COPD)) (10%).⁷ Chronic conditions account for 86% of the two trillion dollars spent on healthcare,^{7,8} and 95% of health care costs among older adults.⁹ In addition to financial costs, greater morbidity due to chronic illness decreases an individual's overall quality of life.^{10,11} The burden of chronic disease will continue to increase for numerous reasons including changes in US demographics, advances in medical treatment that extend life expectancy,¹² and existing health inequities.¹³

2. Changing Demographics in the United States

The demographics in the US are changing in several ways. The proportion of older adults (65 and older) is increasing and is expected to double in size from 43.1 million to 83.7 million by 2050, and will comprise 20% of the population.¹⁴ This is notable, as the prevalence of chronic disease increases with age. Half of adults ages 45-64 have multiple chronic conditions and 80%

of adults over the age of 65 have multiple chronic conditions.⁷ Among Medicare beneficiaries ages 65 and older, 58% are diagnosed with high blood pressure, 45% high cholesterol, 31% ischemic heart disease, 28% diabetes, and 17% asthma and COPD.¹⁵ In addition to an aging population, life expectancy at birth in the US has also increased to an average of 79 years due to public health and medical advances.¹⁶ With increases in both disease incidence and morbidity, the population will experience an increase in individuals who are living longer with greater morbidity.¹⁷ Additionally, the racial and ethnic makeup of the US population is also rapidly changing, with the population becoming more diverse. In 2014, racial and ethnic minority populations comprised more than one third (38%) of the US population, and are projected to increase to more than half of the US population (56%) by 2050.¹⁸ Furthermore, these demographic changes are occurring in tandem with increasing income and wealth inequities in the US.¹⁹ These changes by race/ethnicity and income are important as we live in a society in which societal values create the differential (often by race/ethnicity or income) access to resources and exposure to health-damaging conditions.²⁰ In sum, the US population will consist of an older and more racially and ethnically diverse population with greater morbidity and fewer means to manage their health.

3. Health Inequities and Chronic Illness

Inequities in chronic disease prevalence, clinical outcomes, and mortality by age, socioeconomic position (SEP), race and ethnicity, and geographical location, have been well documented.^{1,4,21-30} Individuals with lower SEP, less formal education, who identify as Black and Hispanic, and the elderly consistently have a greater prevalence and worse disease control of diabetes, hypertension and asthma than their counterparts.^{1,21,23-30} Within the context of asthma for example, individuals with lower SEP experience greater asthma morbidity,^{31,32} Black and Puerto Rican individuals report poorer asthma control than White individuals,^{32,33} and older adults

experience higher rates of asthma mortality compared with their younger counterparts.^{23,34} These inequities persist across all health conditions and even continue to grow,^{1,26,35-37} despite systematic efforts to eliminate.³⁸

B. Addressing the Burden of Chronic Conditions

1. Self-management of Chronic Illness

Self-management, “the ability of the individual, in conjunction with family, community, and health care professionals, to manage symptoms, treatments, lifestyle changes, and psychosocial, cultural, and spiritual consequences associated with a chronic illness,”³⁹ is a core mechanism to promote health outcomes and prevent chronic disease complications.^{40,41} Adults who adhere to prescribed drug regimens, maintain recommended diets, engage in physical activity, self-monitor symptoms, and keep routine appointments with health care providers have greater quality of life, improved clinical outcomes and reduced risk of hospitalization and mortality.⁴²⁻⁴⁹ Despite these benefits, it is estimated that only half of all adults use their medications consistently⁵⁰⁻⁵² and engage in recommended amounts of physical activity,^{53,54} and only 10% follow guideline recommended diets.⁵⁴ Furthermore, these rates are even lower for older adults and populations who experience high levels of economic and social adversity including low income adults and racial and ethnic minorities.^{52,54-58}

2. Psychosocial Determinants of Self-Management Behaviors

A sizable body of evidence over several decades has identified a number of psychosocial determinants of proper chronic disease self-management.⁵⁹ At the individual level, health literacy and cognitive abilities have been repeatedly linked to a wide range of self-care behaviors, including medication adherence, self-monitoring of symptoms, and maintenance of a healthy diet.^{22,58,60-64}

An individual's beliefs related to the effectiveness of a medication or concerns about medications have been repeatedly associated with medication adherence,⁶⁵ and an individual's ability to cope with stressful or negative life events are also related to consistent engagement in self-care behaviors.^{66,67} Beyond the individual, social relationships and the support they provide are another psychosocial factor with well-established associations with health outcomes and some growing evidence with self-management behaviors.⁶⁸⁻⁷³ Despite this evidence, there has been slow progress in addressing these psychosocial risk factors to support proper self-management.^{51,74,75}

C. Rethinking Determinants of Self-Management Behaviors

There is a lack of effective and/or sustainable strategies that address these psychosocial risk factors to promote self-management behaviors.^{74,75} This may be due to a lack of attention to the requisite skills individuals must employ to engage in self-care behaviors. As a result, there is a continued need to refine our operational understanding of the precise psychosocial needs that support achievement of desired outcomes. For example, interventions that seek to mitigate the effects of limited health literacy commonly revise print documents;⁷⁴ this response does not account for the many skills, such as health related knowledge, critical thinking, organization, and planning, that individuals must utilize when carrying out self-management behaviors.⁷⁶ Furthermore, interventions that aim to address a lack of social support seek to improve social skills and develop an individual's social network;⁷⁵ yet this approach fails to consider the specific functional aspects of support which could be most beneficial to the establishment and maintenance of self-management behaviors.

1. Routine

At an individual level, adults with chronic illness must engage in self-management behaviors every day, which requires the incorporation of these behaviors into one's daily routine.

Individuals may be knowledgeable and capable of managing their chronic conditions, but if they are unable to establish a pattern of organizing these behaviors they may be less likely to sustain them. This may be especially important among older adults who have multiple complex self-care regimens and low income, racial and ethnic minority adults who are disproportionately exposed to external social and economic stressors.^{20,77} Facilitating the creation and maintenance of a daily routine in which self-management behaviors can be integrated within is a possible intervention target.

2. Tangible Social Support

With regards to social factors, social relationships are conceptualized by their structural (degree of integration in one's social network) and functional aspects (functions provided by or perceived to be available from social relationships).⁷¹ Most research studies to date have evaluated structural aspects of social relationships and health,^{68,69} and as a results responses have targeted structural aspects of social relationships by helping individuals develop social skills and expand their social network.⁷⁸ Alternatively, functional aspects may be most beneficial to adults with chronic conditions. One domain of functional support that may be particularly relevant is tangible social support, the provision of direct material aid or other concrete assistance, and can be construed as a more modifiable construct that could be addressed by self-management support programs.

D. Conceptual Framework: Incorporation of Contextual Factors

In the conceptualization of the proposed psychosocial determinants described above it is important that they are grounded in a social ecological perspective.^{79,80} Self-management behaviors function within and are influenced by the surrounding environmental and social

contexts,⁸¹ and a lack of appreciation for the role these factors play may mask the roots of disparities in self-management behaviors. The Social Ecological Model posits that individual behavior is determined by five inter-related levels: 1) intrapersonal factors, 2) interpersonal processes and primary groups, 3) organizational factors, 4) community and physical environmental factors, and 5) public policy.^{82,83} Routine and tangible social support attend to intrapersonal and interpersonal factors, but the role which these broader levels exert on both constructs should also be considered. Unfortunately, one limitation of this model is the lack of specificity about how different levels influence one another.⁸³ For further guidance on how these different levels interact we can turn to literature on social determinants of health.

1. Social Determinants of Health

Social determinants of health, the “social characteristics within which living takes place,”²⁰ have been recognized as important predictors of health outcomes for the past three decades in the public health field, and are becoming increasingly more recognized in the field of medicine and chronic disease management.⁸⁴⁻⁹³ The World Health Organization (WHO) developed an updated framework to advance the scientific understanding of the mechanisms through which social determinants of health impact health and well-being, specifically drawing attention to structural determinants that shape social determinants.²⁰

Briefly, structural determinants are rooted in political, economic and social systems that inform the way in which we govern as a society. These in turn give rise to a set of social groups and socioeconomic positions, in which populations are stratified according to income, education, occupation, race and ethnicity. These social positions in turn shape intermediary determinants of health, which encompass material circumstances, psychosocial factors, behavioral and biological factors, and the health system, which ultimately leads to health outcomes. Social capital is overlaid

and informed by both structural and intermediary determinants of health and encompass the resources that flow through and emerge from social networks.⁹⁴ This framework emphasizes the social production of health inequities, and therefore intervention should modify social processes, rather than building individual coping skills or health literacy, for example.

As described in this framework, it is important to consider the role these larger structural determinants of health play in the production of intermediary psychosocial and behavioral factors.

2. Application of Structural Determinants to Routine and Tangible Social Support

Structural determinants of health result in differential exposure by social position to significant stressors, such as financial insecurity, housing and employment instability, violence and trauma⁹⁵⁻⁹⁷ and reduced opportunities and resources which in turn results in lives that are marked by extraordinary unpredictability. This unpredictability challenges the formation of daily routines in which individuals can follow through with self-care recommendations. As individuals of lower socioeconomic positions experience a disproportionate burden of these stressors, the resulting unpredictability within their lives may mediate the relationship between socioeconomic position and poor health outcomes.

The adequacy of tangible social support is also influenced by structural determinants, which produces differential access to quality support.^{20,69} Social support is commonly assessed as present or absent, and little attention is paid to the adequacy of the support that is provided.^{69,98} Literature on social capital details the composition of social ties and provides a complimentary understanding towards differential access to adequate support. Social capital encompasses trusting and cooperative relations among network members, but distinguishes three types of social capital based on the network members' identities.^{99,100} *Bonding* social capital refers to co-operative

relations between members of shared social identity, while *bridging* is among individuals who are not of the same social identity; *linking* social capital occurs across formalized lines of power.⁹⁹ Without strong bridging or linking social capital, individuals may only have cooperative relations with individuals of similar social identity, who may also be in poor health and lack relevant self-care skills and resources.^{101,102} Therefore, while an individual may have an extensive social network, but within a limited sphere of bonding social capital, that network may be unable to provide the sufficient level of assistance an individual may require to adhere to self-management behaviors, resulting in unmet tangible social support needs.

In summary, research is needed to further understand the role that a daily routine and tangible social support play with self-management behaviors and health outcomes among an older populations, especially as the US population will consist of an older and more racially and ethnically diverse population with greater morbidity and fewer means to manage their health.

E. Research Objectives

Study 1 Objective: Assess the association between the presence of a daily routine and older adults' health status and urgent health care utilization.

- H_{1a}: Older adults with greater daily routine will have better health status and less urgent health care utilization.
- H_{1b}: Daily routine will mediate associations between socioeconomic position and health status and urgent health care utilization among older adults.

Study 2 Objective: Investigate associations between structural and functional aspects of social relationships and medication adherence in older adults with asthma.

- H_{2a}: Functional support, measured in terms of tangible medication social support, and not structural support, measured in terms of social network size, will be associated with medication adherence in older adults with asthma.
- H_{2b}: Less frequent functional support would be associated with poor medication adherence.

Study 3 Objective: Evaluate the association between unmet, tangible social support needs and older adults' health status and urgent health care utilization.

H₃: Older adults with unmet tangible support needs will have worse physical and mental health outcomes and greater urgent health care utilization.

II. LITERATURE REVIEW

In consideration of the proposed objectives, below I review existing literature on the subjects of routines and social relationships. Research related to social support has a long history, while research on daily routine is more limited. Throughout the review I will present research findings that included the population of interest (older adults, individuals who face high levels of social and economic hardship).

A. Overview of Routine

Many people have established patterns of waking, eating, sleeping and organizing their time; this is often done in the form of a routine to provide a sense of coherence and predictability to one's day. The absence of routine is more readily noticed than its presence.^{103,104} Individuals with chronic illness must engage in self-management behaviors every day, and as a result, these activities must be incorporated into daily routines.^{59,66} The integration of self-management behaviors into a daily routine and has been found to facilitate consistent self-management behaviors.^{66,105-107} For example, among a sample of older adults with asthma, integrating medication taking behaviors into one's daily routine was associated with greater asthma medication adherence.¹⁰⁶ This association was not attenuated when controlling for illness and medication beliefs, depression, anxiety or limited health literacy, which are common determinants of poor medication adherence.¹⁰⁶ The development of a routine presents as a possibility that could overcome some of the well-established barriers to self-management behaviors.

External circumstances can challenge engagement in a consistent routine. Adults who are exposed to significant stressors such as financial insecurity, housing and employment instability, violence and trauma⁹⁵⁻⁹⁷ often experience lives marked by extraordinary stress and

unpredictability. The impact of these stressors on health, as well as the influence they have on one's ability to follow through with self-care recommendations, should be considered in a meaningful way. Although systemic changes are needed, in such areas as housing, safety and food availability, work can be done on an individual basis to assess the individual's ability to plan for the future, stay organized, and maintain a routine.^{108,109} Development of these skills, as well as linkages to outside services as needed, may be an important, and overlooked, strategy to strengthen people's engagement in self-care behaviors. Furthermore, it will be important to work within home and community settings in order to comprehensively identify the array of stressors an individual is contending with that may hinder the formation of a routine.⁸⁹

1. Historical Perspective of Literature on Routine and Chaos

Historically, the topic of daily routines has been researched in the context of children and how its absence, or a lack of routine, impacts childhood development. This body of literature revolves around the use of the Confusion, Hubbub and Order Scale (CHAOS), and as a result the terminology throughout these studies to describe this environment is family chaos. More recently, the CHAOS measure has been used in adult populations to describe life chaos, although in a much more limited manner. For purposes of health promotion intervention, the presence of chaos may be less useful to understand than its reverse, the presence of a daily routine. Therefore, in this research I will approach this topic from an asset based perspective in the formation of routines and daily predictability.^{110,111} While the asset based approach is increasingly recognized in public health, the vast majority of the existing literature does not take this approach, and in order to summarize this existing body of literature I will refer to the work of chaos as it has been previously described.

2. Family Chaos and Child Health

The impact of predictability of daily events within family environments and its subsequent impact of childhood development has been extensively studied.^{97,112-116} Findings have suggested that children living in household environments that experience greater chaos have been found to exhibit greater behavioral problems, a reduced ability to focus and less ability to respond to social cues than their counterparts.^{97,112} The influence of daily unpredictability has been extended to the management of childhood chronic illness, with greater family chaos associated with poorer diabetes clinical outcomes¹¹⁷ and worse medication adherence among children with asthma.¹¹⁸

This literature also takes into account larger systemic factors that may influence the amount of chaos within a household. As indicated earlier, the level of unpredictability within the family environment is often due to significant social stressors; individuals of lower SEP experience a disproportionate burden of these stressors and therefore, the resulting unpredictability within their lives may mediate the relationship between SEP and poor health outcomes. Testing this hypothesis, Chen and colleagues examined mediating factors between the relationship of socioeconomic status and cortisol output. Lower SEP children had a greater increase in daily cortisol output over a two year period than higher SEP children; interestingly, these effects were partially mediated by family chaos. These findings suggest that the way in which SEP is linked to health outcomes is through its effects on family environments.¹¹⁴ Similarly, Evans and colleagues found that some of poverty's impact on socioemotional development was due to chaos within child's home.⁹⁷

3. Chaos and Chronic Illness in Adults

More recently, the influence of life chaos and daily instability has been extended to the management of chronic illness among adult populations with Human Immunodeficiency Virus

(HIV) and heart failure. Among patients with HIV, greater life chaos is associated with worse mental health status, missing routine clinic appointments¹⁰⁹ and worse medication adherence.¹¹⁹ In a different study, focusing on patients recovering from a myocardial infarction, greater life chaos was predictive of worse medication adherence, even when controlling for relevant sociodemographic covariates (race, sex, education, health literacy and financial status).^{108,120}

This literature also considered the role larger systemic factors played in the development of chaos within adult life, but with inconsistent results. The earliest study to examine life chaos in adults did not show variance by race, income, education, or housing insecurity among a sample of HIV patients, contrary to the investigators' hypotheses. However, a more recent study among a similar population, found that life chaos mediated the association between poverty and adherence to antiretroviral therapy.¹¹⁹

All findings considered together suggest that the establishment of predictable routines influence health outcomes positively, among both children and adults with chronic illness. Research on adult populations is preliminary and additional studies is needed.

B. Overview of Social Relationships

Terms such as social support, social networks, social ties, and social integration are often used interchangeably, but each represent distinct concepts that are classified within the overarching construct of social relationships.^{121,122} Social relationships are distinguished by the structure and function of the support provided, and are categorized as structural or functional. Structural aspects of social relationships are defined as “the extent to which individuals are situated within or integrated into social networks”¹²¹ Structural aspects examine the existence of and interconnections among various social ties, examples include marital status, social networks, social

integration, and social isolation. Structural aspects of social relationships are also components of a larger theoretical framework, social network theory, which examines the way in which social network processes and its actors impact health outcomes from a micro and macro perspective.¹²³

Conversely, functional aspects encompass “the specific functions served by relationships and are measured by actual or perceived availability of support, aid or resources provided by these relationships.”¹²¹ Functional support is further classified into four types of social support, which include: 1) emotional, expressions of caring, 2) informational, the provision of information, 3) tangible, the provision of direct material aid or other concrete assistance, and 4) belonging, having others to engage with in social activities.⁷¹

The literature on social support also makes distinctions between perceived versus received support. Perceived support encompasses the perception that others will be available to provide support, if necessary; while received support refers to the actual support provided by others. Perceived support is consistently more predictive of mental and physical health outcomes than received support.^{68,124}

Social capital, while its definition is often contested, is parsimoniously defined as “resources that are accessed by individuals as a result of their membership of a network or a group.”⁹⁴ Social capital is distinct from social support with regards to the proximity of individual network members; where social support is derived from close strong ties that individual maintain, social capital is more commonly derived from weak acquaintances and encompasses the diversity within one’s network.⁹⁴ However, the three distinct types of social capital, bonding, bridging and linking are useful in understanding the composition of supportive relationships. Bonding social capital refers to “trusting and co-operative relations between members of a network who see themselves as being similar”⁹⁹ whereas bridging social capital comprises “relations of respect and

mutuality between people who know they are not alike in some sociodemographic sense.”⁹⁹ Linking social capital further extends this to “the norms of respect and networks of trusting relationships between people who are interacting across explicit, formal or institutionalized power or authority gradients in society”⁹⁹

1. Social Support Models

Developed through an extensive body of literature, the direct effect and stress buffering models describe hypothesized pathways linking social support to health outcomes. The stress buffering model posits that the beneficial health effects of social support result from social support indirectly ‘buffering’ against the negative effects of stress.⁷⁰ Social support decreases an individual’s exposure to stress through a cognitive appraisal process, or the interpretation of the situation and one’s coping resources, which ultimately reduces the association between stress and health-related outcomes.¹²¹ The direct effect model asserts that social support directly results in improved health status, regardless of perceived stress. Both the direct effect and stress-buffering model suggest that social support can operate through health behaviors, which in turn influences health outcomes.

2. Social Relationships and Health Outcomes

The association between social relationships and health outcomes is well established.^{68,69,71,125} The most recent and comprehensive meta-analysis found a 50% increased likelihood of survival among adults with stronger social relationships.⁶⁸ Among the 148 included studies, 63 measured structural aspects, 61 measured both structural and functional aspects, and only 24 measured functional relationships; stratified analyses observed similar likelihood of survival (57%, 44%, 47%, respectively).⁶⁸ The number of deaths attributed to social network size has been found to be comparable to the number of deaths due to lung cancer.¹²⁶ Additionally, socially isolated individuals face similar risk of mortality as traditional risk factors such as

smoking.¹²⁷ Social network size, social integration, and receipt of social support have also been linked to the incidence of chronic conditions, clinical outcomes and overall health status.^{122,125,128-131} Overall, this body of literature has predominantly evaluated structural aspects of social relationships and health outcomes.^{68,69}

3. Social Relationships and Self-Management

As models of social support include pathways of social support leading to health outcomes through health behaviors, a growing body of literature has examined the relationship between social support and self-management behaviors. An early systematic review summarized the literature published between 1990 and 2001. The review included studies that measured both structural and functional support. A total of 22 studies were identified, and the majority included functional measures, specifically tangible and emotional support, and more than half (13) included patients with type 2 diabetes. Among the 13 high quality studies, a total of 6 studies among patients with diabetes found significant positive relationships between functional measures of social support and self-management behaviors. An additional influential meta-analysis examined the relationship between social support and patient adherence to medical treatment among studies published prior to 2001. Practical support, defined as instrumental support, assistance, reminders or organization, was found to have a greater effect than other types of support, including nearly double the effect than emotional support. These findings provide support that simply the presence of another person does not matter as much as the type of services and support provided.⁷³ While both reviews are often cited as clear evidence of the relationship between social support and self-management behaviors, Gallant cautions that the evidence is modest, especially outside of the context of diabetes.⁷² Both reviews also are limited in their generalizability as few of the included studies included a substantial number of non-white participants, which is of great importance given

the changing racial and ethnic makeup of the US population. Overall these reviews provide preliminary evidence that functional support related to self-management behaviors may be most predictive of adherence to self-management behaviors, but should be investigated within other disease contexts with other populations.

More recent investigations on the relationship between social support and self-management have continued to focus on patients with type 2 diabetes and heart failure, but have extended to a more diverse population.¹³²⁻¹⁴⁵ Across these studies the manner which support was assessed varied, but has generally focused on social network size, emotional and tangible support. Task-specific tangible support was consistently associated with self-care behaviors,^{135-137,140,142} while more general tangible assistance, such as help with shopping or financial assistance, did not yield associations with self-management.^{139,141,143} In qualitative interviews, adults with asthma and diabetes identified tangible social support needs.^{139,146} Results were inconclusive regarding the role of emotional support, with an even number of studies finding positive associations with self-management behaviors^{132,136,143} as those that did not.^{132,135} Lastly, elements of structural support were not found to be associated with self-management behaviors.^{141,144,145} There appears to be a growing body of evidence that supports the direct pathway of functional support, and in particular tangible social support, and engagement in self-management behaviors, yet its application to conditions outside of diabetes and heart failure is limited.

4. Adequacy of Social Support

As described earlier, many facets of social relationships have been specified and tested (structural vs. functional, perceived vs. received, direct model vs. stress buffering), but an additional dimension of social relationships that is not widely evaluated is the adequacy of support. The literature on social support has commonly operated under the assumption that if available, the

support that is provided is sufficient to meet an individual's needs.⁹⁸ This aspect is important as the quality of social relationships experienced by individuals are a function of broader social and structural forces.^{20,69,101} Therefore, while an individual may have an extensive social network, that network may be unable to provide the sufficient level of assistance an individual may require to adhere to self-management behaviors, resulting in unmet tangible social support needs. Additionally, home health aides, certified nursing assistants and personal care aides provide the majority of formal care to older adults; however, these positions experience significant attrition and staffing insufficiencies due to low wages, inadequate training and supervision, and perception of the position as zero growth,¹⁴⁷ and as a result these service providers may be inadequately prepared to provide the requisite level of support these older adults need.

When investigated in the empirical literature, the quality of support has been measured in two ways. The first is the occurrence in the form of unsupportive behaviors that hinder engagement in self-management behaviors.^{133,148} For example, a spouse continuing to smoke even though it is a known trigger for the partner's asthma, or nagging about medication non-adherence.^{133,138,139,144} The second, and less studied is whether the support that is provided meets an individual's needs, and thus is perceived to be adequate. As previously described, self-care is quite complex and those providing assistance must have formidable skills and competencies, as well. One study examined whether perceived adequacy of tangible social support was associated with health outcomes among patients with coronary artery disease. Patients who reported a perceived lack of needed assistance had greater rates of mortality and decline in physical functioning than individuals whose needs for assistance were met.¹⁴⁹

All findings considered together suggest that tangible social support likely influences engagement in self-management behaviors. Attention should also be paid to the adequacy of the

support that is provided to identify any remaining unmet tangible social support needs. Research on adult populations and tangible social support outside of the context of diabetes and heart disease is limited and additional studies are needed.

III.METHODOLOGY

A. Methods Overview

To answer the three study objectives, I conducted a secondary data analysis with two National Institutes of Health (NIH) cohort studies of older adults; one cohort is among older adults with asthma (R01HL096612), and the other examines community-dwelling older adults (R01AG030611). Both include relatively large sample sizes for these patient groups (n=452 and n=470, respectively), and are diverse in terms of race/ethnicity and socioeconomic status. I have been involved in these studies for the past nine years, and my role has ranged from a research coordinator conducting interviews with participants, to a clinical research associate, managing the research studies and participating in the formulation of overall study design. Conducting patient interviews provided me the opportunity to get to know participants and their challenges and to consider additional constructs that may inform health outcomes. Based on these experiences, as I became more involved in the studies' design, I was able to incorporate additional items into the surveys that provided data on several of the key variables for my proposed studies. Additional detail about both cohort studies, my personal history with these datasets, and methodology follow.

B. Data Sources

1. Health Literacy and Cognitive Function among Older Adults (LitCog) Study

The 'Health Literacy and Cognitive Function among Older Adults' (R01AG030611, referred to as 'LitCog') study is an ongoing prospective cohort study investigating changes in health literacy over time and its relation to cognitive function and performance on health care tasks.⁷⁶ Participants were recruited from one academic general internal medicine practice and six federally qualified health centers in Chicago, Illinois between August 2008 and August 2015.

English speaking adults who sought regular care (defined as two clinic visits within the past two years) from study sites were identified through practice records. Patients were eligible if they (1) were between the ages of 55 and 74, (2) spoke English, and (3) had adequate cognitive capacity, as defined by ≤ 2 errors on the 6-item screener.¹⁵⁰ A total of 900 patients completed the in-person baseline interview (T₁) and were invited to complete follow-up interviews three (T₂) six (T₃) and nine (T₄) years following the baseline interview. A total of 615, 470, and 170 participants have completed the T₂, T₃ and T₄ interviews, respectively.

2. Asthma Beliefs and Literacy in the Elderly (ABLE) Study

The ‘Asthma Beliefs and Literacy in the Elderly’ (ABLE; R01HL096612) study is the largest prospective cohort study of older adults with asthma which investigated associations of health literacy, asthma-related beliefs with asthma outcomes and self-management behaviors⁶¹ The sample was recruited from outpatient primary care and pulmonary practices in New York City, New York and Chicago, Illinois from December 2009 through May 2012. Patients were eligible to participate if they: 1) were aged 60 years and older, 2) spoke English or Spanish, and 3) had moderate or severe persistent asthma as defined by the National Heart, Lung and Blood Institute's Expert Panel on Asthma.⁴⁸ Exclusion criteria included a chart-documented or self-reported diagnosis of chronic obstructive pulmonary disease (COPD) or other chronic respiratory illness or self-reported smoking history of <10 pack-years because they are at increased risk of COPD. A total of 452 participants were enrolled and provided written consent. Follow-up interviews were conducted at three, twelve, and eighteen months after the baseline interview. A total of 436 (97%), 404 (91%), 344 (88%) participants completed the three, twelve, and eighteen month follow-up interviews, respectively.

C. Researcher History

I have worked as a researcher at Northwestern University Feinberg School of Medicine within the Health Literacy and Learning Program (HeLP) over the past nine years which collected and owns the two datasets used for these studies. During this time I have become acquainted with many chronically ill older adults who sought primary care at one academic medical center and multiple community health centers throughout Chicago. The internal medicine practice at Northwestern Medicine serves a predominantly affluent patient population, which starkly contrasts the socioeconomic makeup of patients who seek care at Access Community Health Network, Mercy Family Health Center and Erie Family Health Center. While our research interviews contain structured questions, in my experience, when you present as genuinely interested in the information that someone is relaying, they will share deeply personal information that you may not even directly inquire about. Not surprisingly, the number and complexity of stressors of patients from community health centers were vastly greater than the patients from Northwestern. Engaging in one-on-one dialogue with individuals from contrasting SEPs and backgrounds underscored the manner in which external stressors shape health outcomes, and created the foundation on which I developed my dissertation.

Further informing my dissertation topic were common anecdotes on how participants managed their health but were not captured by our research interviews. When conducting interviews for the LitCog study I often heard detailed descriptions about the assistance that participants received from family members (or provided others) in managing their health. Overtime I began working on the ABLE cohort study, and another cohort study with COPD patients, which both assessed the manner which different forms of social support impacted self-care. The study with COPD patients also included supplemental interviews with patients'

caregivers, which allowed me to observe a range of involvement, training and condition-specific knowledge that each caregiver possessed. I came to understand social support to be a multidimensional construct that could be comprised of different types of support, and that the mere presence of an individual was an oversimplified conceptualization of the manner which social support exerts its influence. I was interested in further understanding which types of social support were most relevant, and examining perceptions of adequacy. As the asthma cohort study included measures of different dimensions of social support, this provided me the opportunity to investigate this further. Additionally, as the third time point for the LitCog study was beginning, this allowed me to include a new measure related to the perceived adequacy of tangible social support.

An additional aspect that I gathered during my time conducting research interviews was the role of a daily routine. Our research interviews regularly collect data on medication adherence in which we ask a series of questions related to how patients take their medications. Upon asking these questions some participants become frustrated with the repetition of the questions and would proclaim that they take their medications every day and proceed to describe their morning or evening processes, often in the form of a routine, that facilitated their regular adherence to medications. As the third time point for the LitCog cohort was beginning, this presented an opportunity to incorporate a measure related to daily routine within the study battery.

In sum, my experiences completing research interviews with chronically ill older adults from varying socioeconomic backgrounds has been foundational to the exploration of my dissertation aims.

D. Methods Rationale and Limitations

Informed by my interactions with older patients in ongoing cohort studies I developed working hypotheses related to other psychosocial process that may impact health behaviors and

outcomes. Quantitative study designs are the best method for testing hypotheses, which I therefore pursued.

I conducted a cross-sectional secondary data analysis to examine my research objectives. Secondary data analyses are analyses that are conducted with previously collected data for purposes other than the original study aims and hypotheses.¹⁵¹ One of the main benefits of conducting a secondary data analysis is the possibility to pose high-impact research questions with significantly fewer resources and a faster amount of time.¹⁵¹ However, the main challenges of conducting a secondary data analysis is familiarizing oneself with the data, and relying on existing measures. I employed a hybrid-secondary data analysis approach to this dissertation, in that I was able to incorporate new measures, unrelated to the primary study aims, for secondary analysis. Additionally, as I was actively involved in the data collection, I was keenly aware of the data and its various nuances. While I was working with cohorts that contained longitudinal data, these newly introduced measures were only available at a single time point. The cross-sectional analyses limit inferences about causality and cannot provide on the direction of the findings.

1. Study 1: Daily Routine

The objectives of Study 1 were to examine associations between the presence of a daily routine and older adults' health status and urgent health care utilization, and determine whether a higher level of daily routine mediates associations between SEP and health outcomes. The proposed pathways appear in Figure 1.

a. Independent and Dependent Variables

Daily routine was the primary independent variable and was assessed by the routine subscale of the Martin and Park Environmental Demands (MPED) Questionnaire. The MPED is

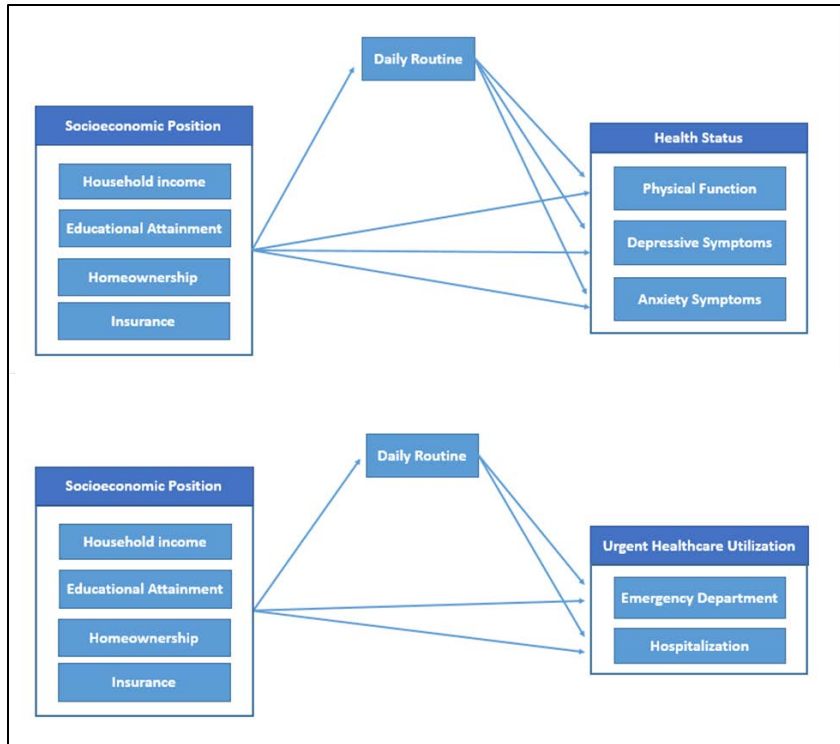


Figure 1. Study 1: Analytic Pathway

a brief instrument which was developed to evaluate self-reported environmental demands in the form of daily busyness and routine within an individual's daily life.¹⁵² The daily routine subscale includes four items that measure the frequency which an individual follows a regular routine in his or her behaviors every day. This scale was chosen based on expert recommendation and that the items are general in nature, rather than target a specific condition, and would be applicable to the LitCog cohort.

Functional health status and urgent health care utilization were the outcomes assessed for these analyses. Engaging in regular self-care slows the progression of chronic illness, which preserves health status, and reduces the need to seek urgent health care utilization.⁵⁹ Functional

health status is commonly measured by assessments of physical functioning and mental health status.^{11,153} Physical functioning measures provide indications of the severity of chronic illnesses across a general population,¹⁵³ and mental health assessments provides indications of emotional well-being and are often measured in the form of depressive and anxiety symptoms.¹¹ Functional health status was assessed using Patient Reported Outcomes Measurement Information Service (PROMIS) short-form instruments of physical function, depression and anxiety.¹¹ The PROMIS measures were developed for use among a general population of adults and adults with chronic illness. The short form instruments ask questions that are universal in nature, rather than condition specific. Urgent health care utilization was assessed by self-report of emergency department (ED) visits and inpatient hospitalizations.

The National Academy of Medicine report ‘Accounting for Social Risk Factors in Medicare Payment’ identified income, education, dual Medicare and Medicaid eligibility, and wealth as indicators of socioeconomic position (SEP) among older adults.¹⁵⁴ Measures of these four domains were used to create a single factor score of SEP.

b. Statistical Analyses

Differences between participant characteristics and daily routine score (measured continuously) were analyzed using analysis of variance (ANOVA); ANOVA was then used to examine differences in health status (physical function, depressive symptoms, anxiety symptoms) by level of daily routine, and chi-square tests were used to examine differences in urgent health care utilization (ED visits, hospitalization) by level of daily routine. Linear and logistic regression models were conducted to identify the association of routine with each health status and urgent health care utilization outcome, while controlling for SEP, age, gender and number of chronic conditions.

To investigate whether the presence of a daily routine mediated associations between SEP and health outcomes, a series of linear and logistic regression models were conducted, following methods presented by Baron and Kenny¹⁵⁵ and Iacobucci, to accommodate categorical variables.¹⁵⁶ All multivariable models were adjusted for age, gender, and number of chronic conditions. First, the direct path between SEP and each of the health status and urgent health care utilization outcomes were tested with linear and logistic models. Second, the association between SEP and routine was assessed using linear regression. Lastly, mediation by routine was examined in models using tertiles of SEP to predict health status and urgent health care utilization.

2. Study 2: Structural and Functional Social Support

The objective of the second study was to investigate associations between structural and functional aspects of social relationships and medication adherence in older adults with asthma. The proposed pathways and operationalization of each construct appear in Figure 2.

a. Independent and Dependent Variables

Adherence to asthma controller medicines was the primary study outcome. Adherence was measured through a review of the analog dose counters on participants' dry powder and metered dose inhalers over a 30-day period, which is recognized as a gold standard for collecting medication adherence. Medication adherence was also collected via self-report with the Medication Adherence Reporting Scale (MARS). The MARS is a validated, 10-item measure previously adapted to assess adherence with asthma medications and is correlated with an objective electronic monitoring measure of adherence.¹⁵⁷

Predictors of medication adherence included measures of structural and functional support. Structural support was assessed by the size of an individual's social network using the

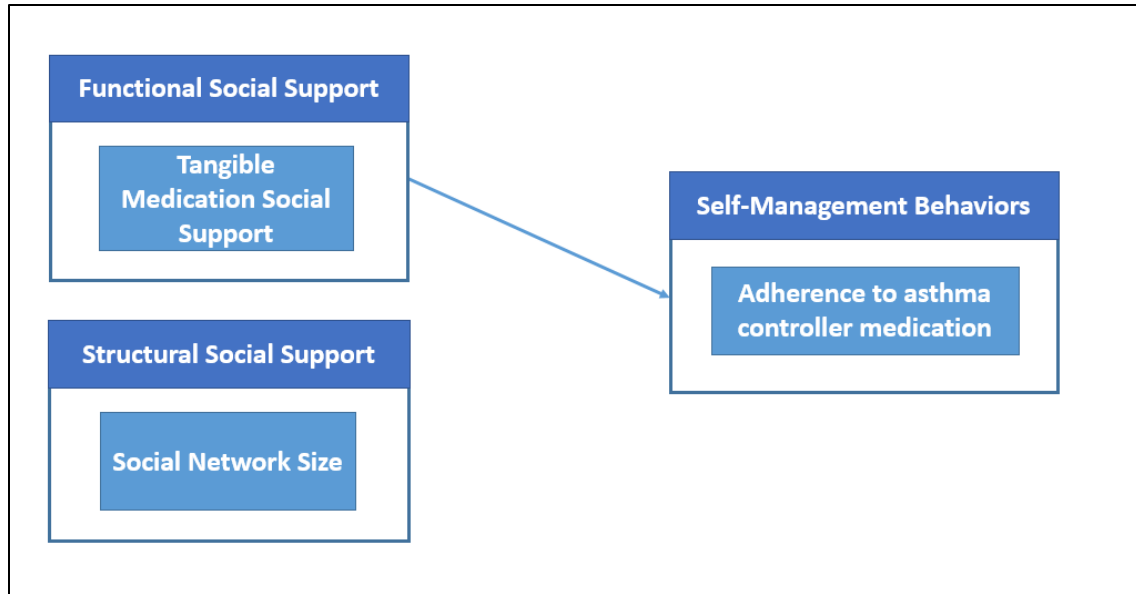


Figure 2. Study 2: Analytic Pathway

abbreviated (6-item) Lubben Social Network Scale (LSNS).¹⁵⁸ The LSNS was developed to evaluate the number of familial and friendship ties maintained by an older adult population.¹⁵⁹ Functional support was measured as the frequency of tangible medication social support with the Support with Medication Management Scale (SMMS). The SMMS was developed by the study team to assess the extent which participants receive tangible assistance from family, friends, or paid caregivers in managing their health and taking medicines. A new scale was developed after identifying a void in existing assessments that capture the frequency of supportive behaviors related to medication self-management. Beliefs about asthma medications, health literacy, and sociodemographic factors that have previously documented associations with medication adherence were included as covariates. I also included a measure of health status to account for variations in level of assistance that participants may require.

b. Statistical Analysis

Chi square and analysis of variance (ANOVA) tests to examine differences in the independent variables (structural support, functional support) and demographic and health status measures. Next, we conducted chi square analyses to examine the relationship between structural support, functional support and adherence to asthma controller medication (measured via dose counts and self-report). Unadjusted and adjusted logistic regression models were conducted to examine the independent associations of structural and function support and adherence to asthma controller medications. Good adherence was the referent category. Adjusted analyses included age, gender, race/ethnicity, income, health literacy, comorbidity, limitations in activities of daily living, length of time with asthma and beliefs about asthma medications as covariates. In order to account for potential confounding of differences in health status we repeated the analysis stratified by the poor health status indicator. We subsequently conducted a Mantel-Haenszel test for homogeneity of odds ratio to test if the association of functional support with medication adherence was significantly different by health status.

3. Study 3: Unmet Needs for Social Support

The third study sought to evaluate the association between unmet, tangible social support needs and older adults' health status and urgent health care utilization. The proposed analytic pathway and constructs appear in Figure 3.

a. Independent and Dependent Variables

Adequacy of tangible social support was the independent variable and measured using a brief, validated scale to identify whether an individual needed assistance managing his or her health, and if this need for assistance was met.¹⁴⁹ Health status and urgent health care utilization were the

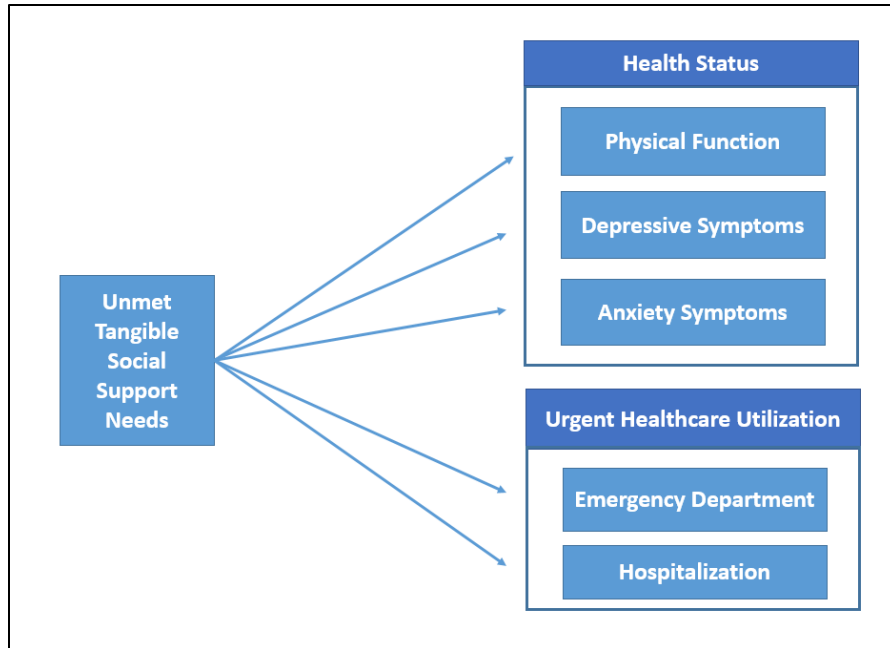


Figure 3. Study 3 Analytic Pathway

outcomes assessed for these analyses. Engaging in regular self-care slows the progression of chronic illness, which preserves health status, and reduces the need to seek urgent health care utilization.⁵⁹ Health status is commonly measured by assessments of physical functioning and mental health status.^{11,153} Physical functioning measures provide indications of the severity of chronic illnesses across a general population,¹⁵³ and mental health assessments provides indications of emotional well-being and are often measured in the form of depressive and anxiety symptoms.¹¹ Health status was assessed using Patient Reported Outcomes Measurement Information Service (PROMIS) short-form instruments of physical function, depression and anxiety.¹¹ The PROMIS measures were developed for use among a general population of adults

and adults with chronic illness. Urgent health care utilization was assessed by self-report of emergency department (ED) visits and inpatient hospitalization.

A number of covariates that have well established associated with the outcomes of interest were also collected including health literacy (Test of Functional Health Literacy in Adults),¹⁶⁰ cognitive abilities (The Mini Mental State Exam), morbidity (number of self-reported prescription medications and chronic conditions), and demographic characteristics (gender, age, race, household income, and highest degree of education received).

b. Statistical Analyses

T-tests and chi-square statistics were conducted to examine differences in demographic characteristics and study outcomes (health status, urgent health care utilization) by unmet tangible support needs (met vs. unmet), as appropriate. Multivariable linear and logistic regression models were conducted to examine predictors of health status (physical function, depressive symptoms, anxiety symptoms) and urgent health care utilization (ED visits, hospitalization). All models included unmet need, health literacy, cognitive ability, self-reported age, race, number of chronic conditions, gender, income, and educational attainment.

IV. STUDIES

A. Daily Routine: Associations with health status and urgent health care utilization

1. Introduction

Many people have established patterns of waking, eating, sleeping and organizing their time; this is often done in the form of a routine to provide a sense of coherence and predictability to one's day.^{103,104} Adults with chronic illness must engage in a range of self-management behaviors every day, which requires the incorporation of these activities into one's daily routine. Individuals may be knowledgeable and capable of managing their conditions, but if they are unable to establish a pattern of organizing these behaviors they may be less likely to sustain them. The salience of adhering to a consistent self-care schedule has frequently been described by chronically ill adults as a primary facilitating mechanism to adopt and maintain these behaviors.^{66,161-163}

While the importance of a daily routine has repeatedly been described by patients, few studies have assessed the degree to which individuals have established daily patterns, and the extent to which having a routine affects self-care behaviors and health outcomes.¹⁰³ In one study where this was examined, integrating medication taking behaviors into one's daily routine was associated with greater medication adherence among a sample of older adults with asthma.¹⁰⁶ This association remained when controlling for illness and medication beliefs, depression, anxiety, and health literacy.¹⁰⁶ A similar body of literature has examined the role that life chaos can exert on engagement in self-management behaviors. Greater life chaos, defined as variability in daily routine, inability to plan and anticipate the future, and lack of punctuality, was associated with worse medication adherence among patients with HIV and a history of myocardial infarction.^{108,119,120} A single study among patients with HIV has extended the analyses to distal

outcomes including health status and emergency department visits and only observed associations with mental health outcomes.¹⁰⁹

Social and economic hardship make it difficult to engage in a consistent routine. Adults who are exposed to significant stressors such as financial insecurity, housing and employment instability, violence and trauma often contend with lives marked by extraordinary unpredictability.⁹⁵⁻⁹⁷ The pressing nature of these stressors requires immediate attention and as a result, the postponement of planned less urgent activities. Individuals of lower socioeconomic position (SEP) are disproportionately exposed to these stressors due to the social stratification of power, prestige and access to resources,²⁰ and the resulting unpredictability within their lives may challenge the formation of regular routines. Therefore, this lack of routine may be a contributing factor in the longstanding pathway through which SEP produces poor health outcomes. Literature exploring the role of life chaos on health outcomes has examined whether life chaos acts as a mediator between poverty and self-management behaviors, but has found inconsistent results.^{109,119}

Considered together, the development of a daily routine may be an overlooked, potentially modifiable social determinant of health that might explain disparities in health outcomes and urgent health care utilization. The objectives of this study were to examine associations between the presence of a daily routine and older adults' health status and urgent health care utilization, and determine whether a higher level of daily routine mediates associations between SEP and health outcomes. It was hypothesized that older adults with greater daily routine would have better health status and less urgent health care utilization, and that daily routine would mediate the associations between SEP and these outcomes.

2. Methods

a. Participants and Procedures

I conducted a secondary data analysis using cross-sectional data from a National Institute of Aging cohort study entitled ‘Health Literacy and Cognitive Function among Older Adults’ (referred to as ‘LitCog’). LitCog is a prospective cohort study investigating changes in health literacy over time and its relation to cognitive function and performance on health-related tasks.⁷⁶ A total of 900 patients were recruited from one academic general internal medicine practice and six federally qualified health centers in Chicago, Illinois between August 2008 and August 2015. English speaking adults who sought regular care (defined as two clinic visits within the past two years) from study sites were identified through practice records, and research coordinators contacted potential participants by telephone to screen for eligibility. Patients were eligible if they (1) were between the ages of 55 and 74, (2) spoke English, and (3) had adequate cognitive capacity, as defined by ≤ 2 errors on the 6-item screener.¹⁵⁰ Participants were invited to participate in follow-up interviews every three years. In the current study, cross-sectional data from the third time point were used, with a total of 470 completed individual interviews. The study was approved by the Institutional Review Board at Northwestern University Feinberg School of Medicine.

b. Measurement

i. Independent Variables

(a) Routine

Daily routine was assessed by the routine subscale of the Martin and Park Environmental Demands (MPED) Questionnaire. The MPED is a brief instrument which was developed to

evaluate self-reported environmental demands in the form of daily busyness and routine within an individual's daily life.¹⁵² The daily routine subscale includes four items that measure the frequency which an individual follows a regular routine in his or her behaviors every day. These items capture the frequency someone engages in daily activities at the same time, including getting up in the morning and going to bed in the evening, eating meals, and engaging in activities at home; the final item asks participants to describe how often their days follows a basic routine. Each item is rated on a 5-point Likert scale with responses ranging from never to always. Scores range from 4-20, with higher scores indicating greater routine. The scale demonstrated good reliability among our sample ($\alpha=0.68$).

(b) Socioeconomic Position

The National Academy of Medicine report 'Accounting for Social Risk Factors in Medicare Payment' identified income, education, dual Medicare and Medicaid eligibility, and wealth as indicators of socioeconomic position (SEP) among older adults.¹⁵⁴ In our study, annual household income (<\$10,000, \$10,000-\$24,999, \$25,000-\$49,000, >\$50,000), and education (less than high school, high school graduate, some college, college graduate, graduate degree) were self-reported. Our sample included adults between the ages of 60-82, and as a result not all participants were eligible for Medicare. We expanded the potential health insurance categories beyond dual-eligibility status to reflect our population (Medicaid or Medicaid + Medicare, Medicare, Private or Medicare + Private) in order to accurately reflect available health-related resources.^{154,164,165} Lastly, a measure of wealth was assessed by homeownership status (own, rent), as homeownership is one of the primary mechanisms with which wealth is created within the United States.¹⁶⁶

ii. **Outcomes**

Functional health status and urgent health care utilization were the outcomes assessed for these analyses. Engaging in regular self-care slows the progression of chronic illness, which preserves health status, and reduces the need to seek urgent health care utilization.⁵⁹ Functional health status is commonly measured by assessments of physical functioning and mental health status.^{11,153} Physical functioning measures provide indications of the severity of chronic illnesses across a general population,¹⁵³ and mental health assessments provides indications of emotional well-being and are often measured in the form of depressive and anxiety symptoms.¹¹

(a) **Functional Health Status**

Functional health status was assessed using Patient Reported Outcomes Measurement Information Service (PROMIS) short-form instruments of physical function, depression and anxiety.¹¹ The PROMIS measures were developed for use among a general population of adults and adults with chronic illness. The short form instruments ask questions that are universal in nature, rather than condition specific. Physical function was measured using the 10-item short form physical function scale, which assesses an individual's ability to carry out a range of activities that require physical capability, from activities of daily living to more vigorous activities such as climbing stairs. Depressive and anxiety symptoms were measured with the coinciding 8-item short form PROMIS scales, which includes items on negative mood, decrease in positive affect, and negative views of self. Anxiety symptoms were assessed with the 8-item short form anxiety scale, which includes aspects of fear, worry, dread, and hyperarousal. A raw score was calculated for each of the three scales with high scores indicating greater ability or more symptoms. Raw scores were translated into a corresponding t-score, which rescales the raw score into a standardized score with a mean of 50 and standard deviation of 10.¹¹

(b) Health Care Utilization

Urgent health care utilization was assessed by self-report of emergency department (ED) visits and inpatient hospitalizations. During the interviews, patients were asked to self-report if they (1) visited the emergency department in the past 12 months, and (2) were hospitalized in the past 12 months. Questions were phrased to incorporate the boundary of the past 12 months (e.g. since last May 1st) to aid patient recall. Patients also reported the purpose, and approximate month and year of their visit. Due to the large number of ED and hospital facilities within the Chicago area self-report was considered the most accurate method to obtain these outcomes. Any reported ED visits that resulted in inpatient stays were counted only as an inpatient hospitalization.

iii. Covariates

During the interview age (60-65, 66-74, 75+), gender, race (White, Black, Other) and number of chronic conditions, were self-reported. Chronic conditions that were assessed included: arthritis, asthma, cancer, chronic obstructive pulmonary disease, congestive heart failure, coronary vascular disease, depression, diabetes, hypertension, hypercholesterolemia and stroke. These data were categorized as 0-1, 2, or 3 or more chronic conditions.

c. Analysis Plan

First, exploratory principal component analysis was conducted with the four SEP variables to identify the number of factors, yielding a single factor. A single factor score was created using maximum likelihood methods to represent SEP, taking into account the four distinct, but related components. In order to categorize the daily routine and SEP scores, tertiles were calculated (low, moderate, high). Tertiles were used due to the well-documented gradient effect of SEP on health outcomes.¹⁶⁷ Second, differences between participant characteristics and daily routine score (measured continuously) were analyzed using analysis of variance (ANOVA); ANOVA was then

used to examine differences in health status (physical function, depressive symptoms, anxiety symptoms) by level of daily routine (low, moderate, high). Post-hoc comparisons using the Tukey honest significant difference (HSD) test were subsequently conducted. Chi-square tests were used to examine differences in urgent health care utilization (ED visits, hospitalization) by the three levels of daily routine. Linear and logistic regression models were conducted to identify the association of routine with each health status and urgent health care utilization outcome, while controlling for SEP, age, gender and number of chronic conditions.

To investigate whether the presence of a daily routine mediated associations between SEP and health outcomes, a series of linear and logistic regression models were conducted, following methods presented by Baron and Kenny¹⁵⁵ and Iacobucci, to accommodate categorical variables.¹⁵⁶ The independent variable, SEP (low, moderate, high), was an ordinal variable and the highest tertile was classified as the referent value. Daily routine was the mediating variable and was measured continuously. All multivariable models were adjusted for age, gender, and number of chronic conditions. First, the direct path between SEP and each of the five outcomes were tested with linear and logistic models. Second, the association between SEP and routine was assessed using linear regression. Lastly, mediation by routine was examined in models using tertiles of SEP to predict health status and urgent health care utilization. As SEP is ordinal, mediation was tested using regression parameters from the lowest tertile relative to the highest (referent) following methods presented by Iacobucci to calculate the $Z_{(\text{mediation})}$ score. The percentage attenuation was subsequently calculated for models in which routine was found to be a significant mediator. All statistical analyses were performed using STATA 13.1 (College Station, TX).

3. **Results**

A total of 461 participants had complete data and were included in these analyses. The mean age of participants was 69 years (Standard Deviation (SD) 5.3; range 60-82 years). Participants were mostly female (71.2%), self-identified as White (52.7%) or Black (37.5%), and were living with three or more chronic conditions (59.0%) (Table I). There was socioeconomic variation, a third (31.5%) reported annual household incomes <\$25,000, and 20% reported incomes between \$25,000 and \$49,999; the majority of the sample had a high school (34.1%) or college degree (56.1%), and owned their home (61.2%). A total of 17.4% had Medicaid insurance (either as their sole form, or in combination with Medicare), 25.2% had only Medicare, and the majority (57.4%) had some form of private insurance (either as their sole form, or in combination with Medicare). The average physical function, depression and anxiety scores were 47.5 (SD=9.1), 51.1 (SD=8.8), and 46.1 (SD=8.2), respectively, and 19.5% had visited the emergency department and 16.3% had been hospitalized in the past 12 months.

The average daily routine score was 13.5 and ranged from 4 to 20. Variation in mean (*M*) routine score by tertile was: low daily routine: (*M*= 10.1, SD=2.1, range 4-12); moderate daily routine: (*M*=14.0, S=0.8, range 13-15); high daily routine: (*M*=16.8, SD=1.2, range 16-20). Routine did not vary by age or gender, but individuals diagnosed with three or more chronic conditions reported lower levels of daily routine than those with fewer conditions ($p=0.05$). Mean daily routine score varied by SEP levels ($p<0.001$), and post hoc tests indicated that the mean score for individuals of low SEP (*M*=12.4, SD=3.4) was significantly different than those of moderate (*M*=13.9, SD=2.9) and high (*M*=14.2, SD=2.3) SEP, but daily routine scores did not differ between individuals of moderate and high SEP.

TABLE I. PARTICIPANT CHARACTERISTICS AND DAILY ROUTINE

Characteristic	n (%)	Routine	
		Mean (SD)	p value
Age			0.14
60-64	128 (27.8)	13.0 (2.8)	
65-74	255 (55.3)	13.6 (3.0)	
75+	78 (16.9)	13.8 (3.1)	
Gender			0.53
Male	133 (28.9)	13.6 (3.1)	
Female	328 (71.2)	13.4 (3.0)	
Chronic conditions			0.05
0 – 1	90 (19.5)	13.9 (2.7)	
2	99 (21.5)	13.9 (2.7)	
3+	273 (59.0)	13.2 (3.2)	
SEP Tertile			<0.001
1 (Low)	156 (33.8)	12.4 (3.3)	
2	165 (35.8)	13.9 (2.9)	
3 (High)	140 (30.4)	14.1 (2.3)	
Education Attainment			<0.001
Less than High School	45 (9.8)	11.9 (3.9)	
High School Graduate	55 (11.9)	12.5 (3.2)	
Some College	102 (22.2)	13.0 (3.2)	
College	91 (19.7)	14.1 (2.5)	
Graduate Degree	168 (36.4)	14.1 (2.5)	
Income			<0.001
<\$10,000	43 (9.3)	11.4 (3.3)	
\$10,000 – \$24,999	102 (22.1)	13.2 (3.2)	
\$25,000 – \$49,999	92 (20.0)	13.3 (3.3)	
>\$50,000	224 (48.6)	14.1 (2.5)	
Homeownership			<0.001
Rent	179 (38.8)	12.6 (3.5)	
Own	282 (61.2)	14.0 (2.5)	
Insurance Status			<0.001
Medicaid, Dual Eligibility	80 (17.4)	12.1 (3.6)	
Medicare	116 (25.2)	13.2 (3.0)	
Private, Private + Medicare	265 (57.4)	14.0 (2.7)	

^aSEP Tertile is comprised of educational attainment, income, homeownership and insurance status

Patient reported health outcomes varied by level of daily routine (Table II). Patient reported physical function demonstrated a graded relationship with level of daily routine [High: $M=50.3$ (SD=9.1); Moderate: $M=47.8$ (SD=8.5), Low: $M=45.3$ (SD=9.0)], with significant post hoc differences between groups (p 's<0.05). Individuals with the lowest level of daily routine reported greater anxiety symptoms ($M=52.8$ SD=9.0 vs. $M=49.0$ SD=9.1) and depressive symptoms ($M=48.3$ SD=9.0 vs. $M=44.2$ SD=7.4) than those classified as demonstrating the highest level of daily routine. Similar results were found in adjusted models (Table III), individuals reporting low and moderate levels of daily routine reported worse physical function scores (Low: β -2.34; 95% CI -4.18, -0.50; Moderate: β -2.07; 95% CI -3.81, -0.34) compared with those with the highest level of daily routine. Additionally, those with a low level of daily routine reported greater anxiety symptoms (β 2.73; 95% CI 0.68, 4.78) and depressive symptoms (β 2.83; 95% CI 0.94, 4.74) than those with the highest level of daily routine. In unadjusted analyses individuals with a low level of daily routine reported greater ED use compared to those with moderate level of routine (27.7% vs. 13.8%, $p=0.005$), and no differences were found in hospitalization. Adjusted analyses did not yield any significant differences in urgent health care utilization by level of daily routine.

a. Mediational Analysis

To investigate whether routine functioned as a mediator of the association between SEP and health outcomes, I first tested the association of SEP and each outcome. SEP demonstrated a similar relationship with health outcomes in unadjusted analyses as routine, and was also not associated with hospitalization (Table II). In analyses adjusted for participant characteristics, compared to individuals in the highest SEP, individuals in the lowest SEP had worse physical function (β -7.33; 95% CI -9.14, -5.52) greater depressive symptoms (β 2.15; 95% CI 0.28, 4.02) and greater rates of ED use in the past 12 months (Odds Ratio (OR) 3.76; 95% CI 1.86, 7.62). No

TABLE II. HEALTH OUTCOMES ACROSS THREE ROUTINE AND SOCIOECONOMIC POSITION TERTILES (MEANS WITH STANDARD DEVIATIONS AND PERCENTAGES)

	Routine Tertile			Overall P Value
	Low Routine (n=155)	Medium Routine (n=181)	High Routine (n=125)	
Health Status, mean (SD)				
Physical Function	45.3 (9.0)	47.8 (8.5)	50.3 (9.1)	<0.001
Anxiety	52.8 (8.9)	51.1 (8.3)	49.0 (9.1)	0.002
Depression	48.3 (9.0)	45.6 (7.5)	44.2 (7.4)	<0.001
Urgent Health Care Utilization, %				
Emergency Department	27.7	13.8	17.6	0.005
Hospitalization	19.5	16.0	12.8	0.32
	SEP Tertile			Overall P Value
	Low SEP (n=156)	Medium SEP (n=165)	High SEP (n=140)	
Health Status, mean (SD)				
Physical Function	42.2 (7.9)	49.3 (8.8)	51.8 (7.6)	<0.001
Anxiety	52.5 (8.8)	50.0 (9.2)	50.9 (8.2)	0.04
Depression	48.3 (8.8)	45.0 (8.0)	45.0 (7.2)	<0.001
Urgent Health Care Utilization, %				
Emergency Department	30.8	18.2	8.6	<0.001
Hospitalization	21.2	15.2	12.1	0.09

relationship was found with anxiety symptoms or hospitalization (Table III). Subsequently, the association between the independent variable and the mediating variable was confirmed, individuals within the lowest SEP group reported less daily routine than those of the highest SEP group (β 1.60; 95% CI 0.90, 2.29). Lastly, daily routine partially mediated the association between SEP and physical function (z_{routine} -2.67, $p=0.008$, percentage attenuation: 5%), depressive symptoms (z_{routine} 1.98, $p=0.048$, percentage attenuation: 36%), but not emergency department use (z_{routine} 1.53, $p=0.13$).

TABLE III. ADJUSTED REGRESSION ESTIMATES FOR THE ASSOCIATIONS OF ROUTINE AND SOCIOECONOMIC POSITION WITH HEALTH STATUS AND URGENT HEALTH CARE USE.

Outcome	Model 1 SEP	Model 2 Routine	Model 3 Routine + SEP
Health Status	β (95% CI)	β (95% CI)	β (95% CI)
Physical Function Score			
Routine			
Low		-3.79 (-5.72, -1.87) ***	-2.34 (-4.18, -0.50) *
Medium		-2.57 (-4.41, -0.72) **	-2.07 (-3.81, -0.34) *
SEP			
Low	-7.33 (-9.14, -5.52) ***		-7.00 (-8.81, -5.14) ***
Medium	-1.29 (-3.04, 0.47)		-1.25 (-3.00, 0.50)
Anxiety Symptoms			
Routine			
Low		2.78 (0.78, 4.80) **	2.73 (0.68, 4.78) **
Medium		1.73 (-0.19, 3.66)	1.64 (-0.29, 3.58)
SEP			
Low	0.32 (-1.70, 2.33)		-0.17 (-2.21, 1.88)
Medium	-1.17 (-3.11, 0.78)		-1.28 (-3.23, 0.67)
Depressive Symptoms			
Routine			
Low		3.22 (1.35, 5.08) **	2.83 (0.94, 4.74) ***
Medium		1.17 (-0.62, 2.96)	1.01 (-0.78, 2.79)
SEP			
Low	2.15 (0.28, 4.02) *		1.58 (-0.32, 3.48)
Medium	-0.18 (-1.99, 1.63)		-0.37 (-2.18, 1.43)
Urgent Health Care Use	OR (95% CI)	OR (95% CI)	OR (95% CI)
Emergency Department			
Routine			
Low		1.50 (0.83, 2.74)	1.23 (0.67, 2.30)
Medium		0.72 (0.38, 1.36)	0.67 (0.35, 1.29)
SEP			
Low	3.76 (1.86, 7.62) ***		3.51 (1.71, 7.18) ***
Medium	2.13 (1.02, 4.41) *		1.32 (0.96, 4.18)
Hospitalization			
Routine			
Low		1.55 (0.79, 3.04)	1.42 (0.71, 2.84)
Medium		1.37 (0.70, 2.69)	1.34 (0.68, 2.62)
SEP			
Low	1.50 (0.77, 2.91)		1.42 (0.72, 2.80)
Medium	1.06 (0.54, 2.10)		1.06 (0.53, 2.11)

^aAll models were adjusted for age, gender, and number of chronic conditions.

^bThe reference category for was high for daily routine and SEP tertiles.

*=p<0.05; **=p<0.01; ***=p<0.001

4. Discussion

Individuals with chronic illness have repeatedly highlighted the importance of a daily routine in health promotion, but there is a lack of research empirically investigating its role.¹⁰³ Related research has examined the impact of life chaos on health status, but was limited to a homogenous sample of low income adults with HIV, and therefore limited in generalizability to a broader population. Consistent with our hypothesis that greater levels of daily routine would be associated with better physical and mental health status, we found that community-dwelling older adults with a high level of daily routine had better patient reported health outcomes, even after controlling for well documented predictors including SEP, age and comorbidity. Among our sample, while the three levels of routine demonstrated a graded relationship with physical function, overall it appeared that the lowest level of routine was most detrimental, and there were minimal differences in mental health outcomes between the medium and high levels of routine. Individuals classified as having low daily routine responded to the equivalent of sometimes or less across all four questions related to waking, sleeping, eating and overall general routine. These results indicated that individuals whose daily lives tend to follow a basic routine are more likely to report better health outcomes, and suggests a general framework of routine behaviors, rather than rigid adherence to daily routine, is needed to be beneficial.

Contrary to our hypothesis, we did not observe an association between daily routine and urgent health care utilization. These results are consistent with findings related to life chaos, which also did not observe an association with ED visits.¹⁰⁹ Urgent health care utilization may be too distal of an outcome, and the presence of a daily routine may have its greatest effect on more proximal outcomes such as health behaviors and health outcomes.⁵⁹ Future research should be

targeted earlier in the causal pathway to examine the relationship between a daily routine and self-management behaviors.

Our second hypothesis was that routine would mediate the association between SEP and health outcomes, which we did not observe strong evidence in support of. Daily routine only minimally attenuated the relationship between SEP and physical function, which suggests that while individuals of lower SEP had lower levels of daily routine, this only explained a small portion of the relationship with physical functioning. We also found that daily routine mediated the relationship between SEP and depressive symptoms to a greater extent and explained approximately a third of the relationship. Individuals of low SEP are constantly exposed to significant stressors; when stress is overwhelming, depression can be triggered.¹⁶⁸ Responding to an array of stressors in addition engaging in daily behaviors requires significant cognitive resources. A daily routine may help individuals accomplish daily tasks with minimal cognitive effort, and as a result provide a sense of control and self-efficacy, which in turn may alleviate some depressive symptoms.

In addition to macro-level policy changes that affect social factors such as housing, safety and food availability, it may be beneficial to target programs and develop tools to provide support on an individual basis to assess an individual's ability to plan for the future, stay organized, and maintain a routine.^{108,109} This process could occur with allied health professionals or lay health workers and caregivers who engage in action planning with patients. In action planning, patients take part in a process of implementation intention in which they specify how, where and when in the future they will complete a desired behavior.^{169,170} During this discussion, a dialogue, coupled with tools, could facilitate the development of a regular routine that could be integrated within their ongoing life. This process could be coupled with text messages reminders to engage in

routine behaviors, similar strategies have been successful in promoting medication-related behaviors,¹⁷¹ and may be applicable to facilitate other regular behaviors.

Our study should be recognized in the context of several limitations. First, our sample consisted of older adults and may not be generalizable to younger samples. Second, the study design was cross-sectional and we are unable to determine whether greater daily routine leads to improve physical and mental health status, or whether physical and mental health status leads to greater levels of daily routine. It is also plausible that the relationship between daily routine and health status is bidirectional. Future studies should examine routine longitudinally to better understand the direction of the relationship. Additionally, while we used a validated measure of daily routine, our measure only included four items, and therefore may not fully capture variations in daily routine. Our measure assessed the regularity of individual behaviors occurring at the same time of day within the home environment and did not encompass regular interpersonal interactions or activities outside of the home, which may be important dimensions.¹⁰³ Lastly, while we included a composite measure of SEP, we are limited in our measure of wealth. Wealth encompasses an individual's total assets,¹⁷² and despite homeownership being one of the primary mechanism adults within the US build wealth, it does not fully capture an individual's total assets.

These findings provide further support behind the strategies individuals with chronic illness have reported engaging in, a regular routine,^{66,162,163,173} and suggests that a daily routine is associated with improved patient reported outcomes related to physical and mental health. The development of a routine, may be of particular importance to individuals of low SEP in seeking to reduce depressive symptoms. In conjunction with work on a macro level to reduce exposure to significant stressors that may interfere in the development of a regular routine, building the

capacity of people to develop and maintain a daily routine could be a part of self-management programs to improve health outcomes.

B. Structural and Functional Social Support among older adults with Asthma:

Associations with Medication Adherence

1. Introduction

Socially and economically disadvantaged older adults who are known to have low rates of medication adherence,^{50,52,58} due to numerous barriers accessing and taking complex multi-drug regimens^{55,57,63} may benefit from social support as they seek to manage their medications. Social relationships are commonly distinguished by the structure or function of the support provided; structural support refers to the size and extent which individuals are integrated within their social network, while functional support encompasses the specific utility provided by the relationships.⁷¹ The multidimensional nature of social relationships, makes it challenging to identify the most relevant dimension related to medication-taking behaviors to act upon.^{71,154} Further complicating this understanding is the paucity of literature among low-income and racially and ethnically diverse older adults related to social support and medication adherence. A recent systematic review detailing associations between medication adherence and social support only identified a few investigations among older adults, and none were among older adults facing significant adversity.¹⁴⁵ The review overall did not observe consistent associations among the studies that measured structural aspects. Conversely, the few studies that assessed functional support in terms of the provision of tangible assistance observed a consistent positive relationship with medication adherence, but these measures were variable and not always aligning with specific medication-taking behaviors that may be most beneficial to promoting medication adherence.¹⁴⁵

While there is a growing recognition of the benefits functional support may provide in promoting medication adherence, no evaluation to our knowledge has compared functional versus structural support to ascertain what is more likely to facilitate medication adherence among a diverse older sample.^{72,73} The Asthma Beliefs and Literacy in the Elderly (ABLE) cohort provides an opportunity to investigate this as measures of structural and functional support and medication adherence were collected. The cohort is particularly relevant as the sample is comprised of socioeconomically and culturally diverse older adults who were managing multiple chronic conditions, in addition to asthma, and medication adherence for asthma can be particularly challenging due to the array of asthma medications that are used under different circumstances.⁴⁸ Therefore, we sought to investigate associations between structural and functional aspects of social support and medication adherence in the ABLE cohort. It was hypothesized that functional support, and not structural support, would be associated with medication adherence, and that less frequent functional support related to medication management would be associated with poorer medication adherence.

2. Methods

a. Sample

I conducted a cross-sectional secondary data analysis with data from a National Heart Lung and Blood Institute funded study, Asthma Beliefs and Literacy in the Elderly (ABLE; R01HL096612). ABLE is the largest prospective cohort study of older adults with asthma. A full description of the cohort has previously been published.⁶¹ Briefly, the sample was recruited from outpatient practices in New York City, New York and Chicago, Illinois from December 2009 through May 2012. Patients were eligible to participate if they: 1) were aged 60 years and older, 2) spoke English or Spanish, and 3) had moderate or severe persistent asthma as defined by the

National Heart, Lung and Blood Institute's Expert Panel on Asthma.⁴⁸ Exclusion criteria included a chart-documented or self-reported diagnosis of chronic obstructive pulmonary disease (COPD) or other chronic respiratory illness or self-reported smoking history of <10 pack-years because they are at increased risk of COPD. A total of 452 participants were enrolled and provided written consent. The study was approved by the Institutional Review Boards of the Mount Sinai School of Medicine, Lutheran Medical Center, Northwestern University Feinberg School of Medicine, and Mercy Hospital and Medical Center.

b. Measures

Adherence to asthma controller medicines was the primary study outcome. Predictors of medication adherence included measures of structural and functional aspects of support. Beliefs about asthma medications, health literacy, and sociodemographic factors that have previously documented associations with medication adherence were included as covariates. We also included a measure of health status to account for variations in level of assistance that participants may require.

i. Medication Adherence

Adherence was measured through a review of the analog dose counters on participants' dry powder and metered dose inhalers over a 30-day period. Research staff reviewed the device to collect an initial reading during the baseline interview, and then contacted participants by telephone 30 days later to record the number of doses remaining. Research staff also documented whether the participant had started a new device. Research staff attached a Doser CT (MEDITRACK, MA) electronic monitoring device atop metered dose inhalers that did not have counters built into the inhalers. The Doser CT electronically recorded the number of times the device was used each day, and participants returned the electronic device to the study team by

mail. Adherence was calculated by the total doses taken divided by the total doses prescribed during the 30 day period. Poor adherence was defined as 80% or less of expected doses recorded, following a commonly applied threshold.^{174,175}

Medication adherence was also collected via self-report with the Medication Adherence Reporting Scale (MARS). The MARS is a validated, 10-item measure previously adapted to assess adherence with asthma medications and is correlated with an objective electronic monitoring measure of adherence.¹⁵⁷ The scale includes a range of items to examine both intentional and non-intentional aspects of medication adherence, and the questions are framed as a negative statement to minimize social desirability bias. Each item is rated on a 5-point Likert scale with higher scores indicating greater adherence. Participants with a MARS score of less than 4.5 are classified as having poor adherence to controller medications, which is equivalent to sometimes (or more often) forgetting to take the medication.¹⁵⁷

ii. Structural Support

Structural support was assessed by the size of an individual's social network using the abbreviated (6-item) Lubben Social Network Scale (LSNS).¹⁵⁸ The LSNS was developed to evaluate the number of familial and friendship ties maintained by an older adult population.¹⁵⁹ The LSNS poses three questions each about familial and friendship ties, including how many relatives and/or friends one sees or hears from at least monthly, feels close enough with to call on for help, and feels at ease with to talk about private matters. Scores range from 0 to 30; individuals with scores less than 12 are classified as socially isolated, which is equivalent to reporting less than two people available for the six categories.¹⁵⁸

iii. Functional Support

Functional support was measured as the frequency of tangible medication social

support with the Support with Medication Management Scale (SMMS). The SMMS was developed by the study team to assess the extent which participants receive tangible assistance from family, friends, or paid caregivers in managing their health and taking medicines. A new scale was developed after identifying a void in existing assessments that capture the frequency of supportive behaviors related to medication self-management. The original scale included 16 items which assessed support in a range of behaviors related to taking medication, including attending doctor visits, calling the pharmacy, picking up medication, assistance with medication organization, and reminders to medications. Participants were asked the frequency with which they receive assistance for each item; response are on a 5-point Likert scale.

iv. Covariates

Self-reported gender, age, race/ethnicity (White, Black, Hispanic, Other), monthly household income, educational attainment, and marital status were collected. A measure of asthma history (number of years since diagnosis) was also included since long-term experience with asthma could affect asthma self-management behaviors. Beliefs about asthma controller medications were assessed using the Beliefs about Medications Questionnaire (BMQ), a 10-item questionnaire that measures a patient's beliefs about drugs related to two domains: concerns and necessity.¹⁷⁶ The BMQ can be tailored to assess beliefs related to a specific chronic condition and medication, and participants were asked specifically about their prescribed asthma controller medication. Higher scores on the concerns subscale indicate greater worries about dependence and side effects due to the asthma controller medications, while higher scores on the necessity subscale indicate greater belief in the necessity of the asthma controller medication for maintaining one's health.

Health literacy was measured using the Short Test of Functional Health Literacy in Adults

(S-TOFHLA).¹⁷⁷ The S-TOFHLA is composed of a numeracy (4 items) and literacy (36 items) section. The numeracy section evaluates comprehension of information commonly encountered in a medical setting (appointment slip, results from a medical test). The reading section evaluates an individual's ability to read two passages of health care materials, including preparing for a gastrointestinal procedure and completing a Medicaid application. The assessment uses the cloze procedure; every fifth and seventh word in the passage is omitted and four multiple choice options are provided. Scores range from 0 to 100, with higher scores indicating higher health literacy. Scores were dichotomized as adequate (score ≥ 67) and limited (score < 67) health literacy.

Health status was measured via self-reported number of chronic conditions (asthma, diabetes, congestive heart failure, hypertension, arthritis, anxiety, depression, osteoporosis) and limitations in activities of daily living (ADLs) using the Katz Index of ADLs. Participants are asked to rate the level of difficulty in performing six basic ADLs (bathing or showering, dressing, eating, getting in or out of bed or chairs, walking, using the toilet),¹⁷⁸ and those reported being unable to complete one or more of the six activities who were classified as experiencing limitations in ADLs. We also created a composite variable to identify individuals in poor health status, patients were classified as poor health status if they were diagnosed with five or more chronic conditions or were classified as having one or more limitation in ADLs.

c. Statistical Analysis

Analyses were limited to participants who were prescribed an asthma controller medication and had complete functional and structural support assessments (n=338). The distribution of responses for each item in the SMMS was reviewed and any item with minimal variation ($\geq 85\%$ of participants responded never or rarely) was dropped; 8 items were included in the total score. I conducted a factor analysis using orthogonal rotation to confirm the scale was measuring a single

latent variable, and measured Cronbach's alpha to assess internal consistency. I also conducted a confirmatory factor analysis using orthogonal rotation to assess item convergence and discrimination with other scales (ADLs, structural support). The SMMS scores were summed and I used a median split to represent the level of assistance provided (infrequent, frequent).

First, I conducted chi square and analysis of variance (ANOVA) tests to examine differences in the primary independent variables (structural support, functional support) and demographic and health status measures. Next, I conducted chi square analyses to examine the relationship between structural support, functional support and adherence to asthma controller medication (measured via dose counts and self-report). Unadjusted and adjusted logistic regression models were conducted to examine the independent associations of structural and function support and adherence to asthma controller medications. Good adherence was the referent category. Adjusted analyses included age, gender, race/ethnicity, income, health literacy, comorbidity, limitations in activities of daily living, length of time with asthma and beliefs about asthma medications as covariates. In order to account for potential confounding of differences in health status I repeated the analysis stratified by the poor health status indicator. I subsequently conducted a Mantel-Haenszel test for homogeneity of odds ratio to test if the association of functional support with medication adherence was significantly different by health status. All analyses were performed using STATA 13.1 (College Station, TX).

3. Results

The mean age of the sample was 67 (\pm 6.5) years; participants had been diagnosed with asthma for an average of 30 (\pm 20) years. There was racial and ethnic diversity [Hispanic (38.5%), Black (32.8%), White (24.0%)] (Table IV), and the majority of participants were low-income, 52.4% reported monthly incomes \leq \$1350, and female (84%).

TABLE IV. DIFFERENCES IN DEMOGRAPHIC AND HEALTH CHARACTERISTICS BETWEEN FUNCTIONAL AND STRUCTURAL MEASURES OF SOCIAL SUPPORT

	All Participants (n=338)	Structural Support		p-value	Functional Support		p-value
		Socially Connected (n=266)	Socially Isolated (n=72)		Infrequent Support (n=189)	Frequent Support (n=149)	
Age, %				0.54			0.15
60-64	44.5	44.9	43.1		49.2	38.5	
65-69	24.3	25.3	20.8		22.2	27.0	
70+	31.2	29.8	36.1		28.6	34.5	
Sex, Female, %	84.0	83.8	84.7	0.86	79.4	89.9	0.008
Race/Ethnicity, %				0.001			<0.001
Black	32.8	33.8	29.2		31.2	34.9	
White	24.0	27.8	9.7		36.5	8.1	
Hispanic	38.5	34.2	54.2		27.5	52.3	
Other	4.7	4.1	6.9		4.8	4.7	
Education, %				<0.001			<0.001
Less than high school	33.1	28.2	51.4		23.3	45.6	
High school graduate	16.9	15.4	22.2		13.2	21.5	
Some college	20.7	24.1	8.3		23.8	16.8	
College graduate	29.3	32.3	18.1		39.7	16.1	
Monthly income, %				<0.001			<0.001
≤\$1,350	52.4	46.5	74.3		39.8	68.7	
\$1,351 - \$3,000	24.3	26.5	15.7		30.1	16.7	
≥\$3,001	23.3	27.0	10.0		30.1	14.6	
Health Literacy, %				0.001			<0.001
Limited	31.4	28.7	50.0		22.8	47.1	
Adequate	68.6	71.3	50.0		77.2	52.9	
Married, %	31.1	34.2	19.4	0.02	32.3	29.5	0.59
ADL Limitation, %				0.03			<0.001
0	70.3	73.2	59.7		81.9	55.7	
≥ 1	29.7	26.8	40.3		18.1	44.3	
# Chronic Conditions, Mean (SD)	3.8 (1.6)	3.6 (1.5)	4.8 (1.6)	<0.001	3.4 (1.4)	4.4 (1.4)	<0.001
Poor Health Status, %	46.6	41.5	62.3	<0.001	30.9	66.4	<0.001

A quarter (24.6%) preferred communicating in Spanish, and a third (31.4%) were classified as having limited health literacy and were married or living with a partner (31.1%). A quarter (25%) of participants visited the emergency department for an asthma-related visit and 10.5% had been hospitalized for asthma in the past 12 months. Overall, 10% had ever been intubated because of their asthma. There were very low rates of medication adherence to asthma controller medication, with 36.3% reported good adherence when measured via dose counts, and 38.6% reported good adherence by self-report assessments. The agreement between the two forms of collection was 67.7% ($\kappa = 0.32$, $p < 0.001$). There were no significant differences in any demographic variables or outcomes between those who did and did not complete the adherence assessment by dose counts (p 's > 0.05).

The eight items included in the Support with Medication Management Scale (SMMS), loaded onto one factor (Eigen: 4.37, factor loadings range 0.68 – 0.81). In confirmatory factor analyses with items from the SMMS, LSNS-6 and Katz Index of ADLs, all items from the individual scales loaded onto their respective scales. The Cronbach's alpha for the SMMS was 0.90. The distribution of responses to the SMMS are presented in Table V. A third of participants reported that someone accompanied them to medical appointments and brought prescription medicines to the pharmacy at least some of the time (38.1%, 33.8%, respectively). Nearly half (42.0%) of participants reported that someone else picked up their medicines from the pharmacy at least some of the time. Participants received less assistance in terms of reminders to take medications; most reported that no one ever reminded them to take their asthma controller (75.7%) or other (72.8%) medication. Additionally, less than a quarter received assistance at least some of the time calling the physician when medicines were running low (19.6%), calling the pharmacy for refills (23.4%), or asking a physician what a new medicine is for (16.9%).

TABLE V. DISTRIBUTION OF RESPONSES TO THE SUPPORT WITH MEDICATION MANAGEMENT SCALE ASSESSMENT OF FUNCTIONAL SOCIAL SUPPORT

Question: How often does someone else:	%
Come with to medical appointments	
Always	19.8
Often	4.4
Sometimes	13.9
Rarely	10.4
Never	51.5
Call physician when running out of medicines	
Always	9.8
Often	2.1
Sometimes	7.7
Rarely	4.7
Never	75.7
Call pharmacy for refills	
Always	12.7
Often	2.7
Sometimes	8.0
Rarely	6.5
Never	70.1
Bring prescriptions to pharmacy to be filled	
Always	16.3
Often	4.2
Sometimes	13.3
Rarely	9.2
Never	57.1
Pick up medicines at pharmacy	
Always	19.0
Often	4.0
Sometimes	19.0
Rarely	13.6
Never	44.4
Remind to take asthma controller medicine	
Always	7.1
Often	1.5
Sometimes	8.9
Rarely	6.8
Never	75.7
Remind to take other medicines	
Always	9.6
Often	2.1
Sometimes	9.0
Rarely	6.6
Never	72.8
Ask physician what new medicines is for	
Always	9.2
Often	2.1
Sometimes	5.6
Rarely	4.4
Never	78.7

The mean functional social support score was 6.4 (SD=7.7) (range 0-28). Those who received infrequent functional social support were more likely to identify as White, have higher educational attainment, household income, health literacy; have no ADL impairment; and diagnosed with fewer chronic conditions as compared to individuals who received frequent functional social support (p 's<0.05). No differences by age or marital status were observed by frequency of functional social support.

The mean structural social support score was 16.8 (SD=6.4) (range 0-30), and 21% were classified as socially isolated. Those who were socially isolated were more likely to identify as Hispanic, have lower educational attainment, household income, health literacy, one or more ADL impairment; diagnosed with more chronic conditions; and be unmarried as compared to individuals who were socially connected (p 's<0.05). A weak, yet significant, negative correlation was found between the two measures of structural and functional social support ($r = -0.15$, $p=0.005$), indicating that those with fewer individuals in their social network reported greater frequency of tangible medication social support. A total of 42 (12.4%) individuals who were identified as socially isolated also reported receiving frequent support with managing their medications. Among these 42 individuals, 36 (90.0%) were low-income (<1350/month), 26 (61.9%) had less than a high school education, 26 (61.9%) identified as Hispanic, 12 (28.6%) identified as Black, 22 (61%) had limited health literacy, and 23 (54.8%) had one or more ADL limitation.

Structural support was not associated with either measure of medication adherence (Table VI). However, individuals who reported infrequent functional support had lower rates of poor medication adherence compared to those with frequent assistance managing medications (dose counts: 53.9% vs. 71.1%, $p=0.002$; self-report 56.7% vs. 72.7%, $p=0.007$).

TABLE VI. DIFFERENCES IN ADHERENCE TO ASTHMA CONTROLLER MEDICATIONS BETWEEN MEASURES OF STRUCTURAL AND FUNCTIONAL SUPPORT

Variable	All Participants (n=338)	Structural Support		p- value	Functional Support		p- value
		Socially Connected (n=266)	Socially Isolated (n=72)		Infrequent Support (n=189)	Frequent Support (n=149)	
Adherence via Dose Counts, %				0.21			0.002
Good adherence	36.3	38.2	29.1		46.2	28.9	
Poor adherence	63.7	61.8	70.9		53.9	71.1	
Adherence via Self Report, %				0.17			0.007
Good adherence	38.6	40.6	31.4		43.3	27.4	
Poor adherence	61.4	59.5	68.6		56.7	72.7	

These associations remained in multivariable adjusted analyses (Table VII) for medication adherence assessed by dose counts (OR 0.51, 95% CI 0.26, 0.98), but not by self-report (OR 0.81, 95% CI 0.44, 1.48), indicating that those with infrequent functional support have a decreased odds of non-adherence compared with their counterparts with frequent functional support. We also conducted analyses stratified by health status (Table VII, Figure 4); the test for homogeneity of odds ratio was non-significant (dose counts: $\chi^2 = 0.69$, $p=0.41$; self-report: $\chi^2 = 0.36$, $p=0.57$), indicating that the association between medication adherence and functional social support was not significantly different by health status.

4. Discussion

Theoretical models of social support suggest that social support influences health outcomes through psychological and behavioral pathways.⁷¹ Despite this proposed model, few studies have

TABLE VII. DIFFERENCES IN POOR ADHERENCE TO ASTHMA CONTROLLER MEDICATIONS BETWEEN MEASURES OF STRUCTURAL AND FUNCTIONAL SUPPORT

	Dose Count of Poor Medication Adherence		Self-Report of Poor Medication Adherence	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Structural Social Support				
Socially isolated	1.51 (0.79, 2.87)	1.80 (0.81, 3.99)	1.48 (0.85, 2.61)	0.86 (0.42, 1.77)
Socially connected				
Functional Social Support				
Pooled				
Infrequent support	0.49 (0.29, 0.82) **	0.51 (0.26, 0.98)**	0.47 (0.30, 0.75) [†]	0.81 (0.44, 1.48)
Frequent support				
Stratified by Health Status				
<i>Poor Health Status</i>				
Infrequent support	0.37 (0.15, 0.82)*	0.32 (0.11, 0.92) *	0.67 (0.32, 1.28)	1.18 (0.45, 3.10)
Frequent support				
<i>Adequate Health Status</i>				
Infrequent support	0.59 (0.28, 1.27)	0.47 (0.17, 1.29)	0.47 (0.23, 0.95)*	0.70 (0.29, 1.73)
Frequent support				

^aAdjusted analyses controlling for age, race/ethnicity, income, education, health literacy, number of years with asthma, limitations in activities of daily living and number of chronic conditions, beliefs about asthma controller medications

^bIn order to further account for confounding by health status and subsequent need of functional support we stratified by poor health status (Diagnosed with 5 or more chronic conditions or reported one or more ADL impairment). Adjusted stratified analyses were adjusted for age, race/ethnicity, income, education, health literacy, number of years with asthma, beliefs about asthma controller medications

*=p<0.05, **=<0.01

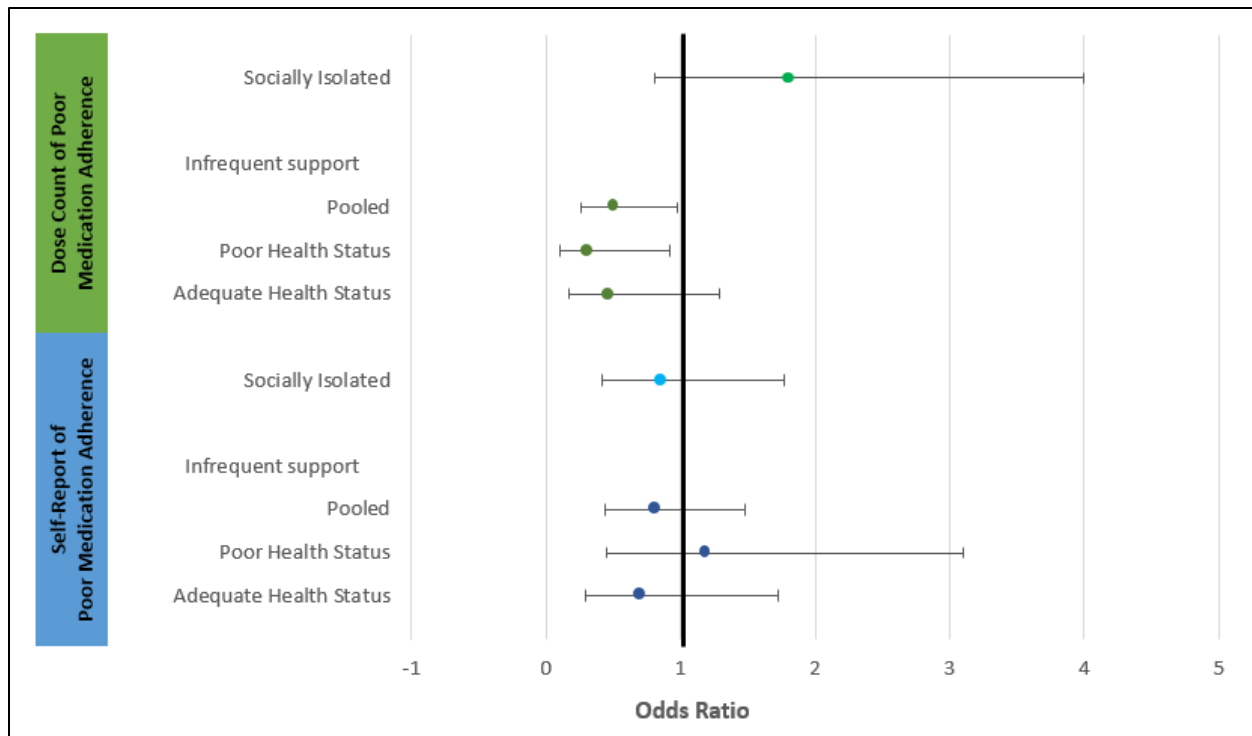


Figure 4. Forest Plot of Odds Ratios and 95% Confidence Intervals of Poor Adherence to Asthma Controller Medication by Measures of Functional and Structural Support

tested the pathway between social support and health behaviors in the form of adherence to medications among socioeconomically and racially/ethnically diverse older adults. Social support may be of great benefit to older adults who frequently manage complex multi-drug regimens; however, the multidimensional nature of social support (conceptualized in structural and functional domains) challenges the identification of the most relevant domains.^{71,154} As few studies have specifically targeted a more socio-economically disadvantaged older population, we tested associations between functional and structural support with adherence to medication among this population.

In a sample of socioeconomically and culturally diverse older adults with asthma we did not observe an association between adherence to asthma controller medications and structural support. Our findings are congruous with related literature that has not observed consistent associations between medication adherence and structural measures of support,¹⁴⁵ as well as broader self-management behaviors.^{72,73} Not surprising, these findings suggest that the presence of individuals within older adults support network, independent of their functional contributions, may be an oversimplification of the mechanism through which social support influences health behaviors.

We hypothesized that infrequent functional support with medication management tasks would be associated with poorer medication adherence. To the contrary, we observed the inverse relationship, that receipt of more frequent functional support with medication management tasks was associated with poorer adherence to asthma controller medications. Reviewing the distribution of responses among the items within the SMMS, we observed that the greatest rates of assistance were among more intensive yet less frequent tasks, such as accompanying participants to medical appointments or picking up medications from the pharmacy. Conversely, tasks that occurred on a daily basis, such as reminding to take the medicines, occurred less often. A series of sequential behaviors must occur to accurately adhere to medications, including filling and picking up a prescription, organizing and planning when to take the medication, and actually taking the correct medication dosage,¹⁷⁹ and older adults may require more regular assistance throughout the continuum of steps.

Our SMMS was designed to measure received functional support, and true to the multidimensional nature of social support, there are distinctions between perceived versus received support. Perceived support encompasses one's potential *access* to social support, while received

support refers to one's *utilization* of support resources.¹²⁴ Previous literature specific to received functional tangible support presents similar findings and potential explanations.⁷¹

One explanation for this inverse relationship is that people who have previously demonstrated poor medication adherence or greater health needs require, and likely receive, more functional support. We observed associations between comorbidity and measures of disability with functional support; however in analyses stratified by health status, we did not observe significant variations in the association between functional social support and medication adherence. Additionally, our pooled analysis included measures of health status to control for potential confounding. While our cross-sectional study design prevents us from understanding the directionality of the relationship or isolate the need for functional support, similar longitudinal investigations have found even when controlling for baseline health status, receipt of tangible support was associated with higher rates of prospective mortality.¹⁸⁰⁻¹⁸² More recent investigations of a cohort study of English civil servants found that greater levels of tangible functional support was associated with poorer physical health.¹⁸³ The authors also tested the possible bidirectional relationship between social support and health, while the results overall provided support for a bidirectional relationship between physical health and social support, this relationships did not remain in within-person analyses.¹⁸³ These findings overall suggest there are other mechanisms at work in addition to prior health status.

We also observed significant associations between socioeconomic factors and functional support. An alternative explanation for our findings may be that individuals who report greater levels of received support are also more likely to experience socioeconomic stressors, which in turn mobilizes the provision of support.^{124,184} Ethnographic research in poor communities has observed among family members or acquaintances a network of reciprocity and mutual obligation

through which resources flow as a means to cope with significant adversity.^{96,185,186} It is therefore possible that among our low-income sample, individuals may receive more assistance in general due to existing practices to cope with repeated stressful circumstances. Considered with the observed negative correlation between social isolation and frequency of functional support, individuals who receive more functional support with their medications are likely relying on only a few people. Our measure did not capture who was providing this support, or the perceived adequacy of the received support, both which may impact its effectiveness, and future research should further examine these dimensions.

These findings should be recognized in the context of several limitations. First, these were cross-sectional analyses and therefore we are limited in understanding directionality of these associations, and we cannot infer causality. Second, we conducted a secondary data analysis of a cohort of urban, predominantly female, older adults with asthma and our findings may not be generalizable to younger populations, in different disease contexts, or among an older male population. In addition, our measure of functional support was not previously validated; however, we were not aware of any medication-specific functional support measures. The SMMS demonstrated high internal reliability and acceptable construct validity. Our questions related to functional and structural support were broad by design and we did not inquire about who provided the support and the patient's perceived adequacy of the received support. Lastly, our outcome measurement of medication adherence had moderate agreement between the subjective and objective measurements.

These findings are an important contribution to the literature on social support and self-management behaviors as very few studies have been conducted in elderly, non-white, or low-income samples.^{72,73} Our findings underscore the complex and multidimensional nature of social

support and the mechanisms in which it operates. Further research is needed to better understand the manner in which functional support operates in relation to medication adherence among older adults.

C. Unmet Needs for Social Support and its Impact on Health Status and Urgent Health

Care use among older adults

1. Introduction

The majority of older adults are managing multiple chronic conditions,^{5,7} which often requires a range of self-management responsibilities in order to maintain one's health. This includes, but is not limited to, adhering to prescribed drug regimens, maintaining recommended diets, engaging in regular physical activity, self-monitoring symptoms and keeping routine appointments with health care providers. These tasks require significant knowledge and skills, as well as an ability to organize and plan, critically think and effectively communicate with health care providers. The long-term persistence of such self-care demands poses significant challenges for patients over time. Thus, any assistance in managing one's daily personal health routine can be of invaluable benefit, especially for older adults given that greater self-care complexity accompanies increasing comorbidity.

Social support is commonly cited as an important determinant of self-management behaviors^{72,73} and health outcomes.⁶⁸ However, social support is multidimensional and influences health outcomes via multiple causal pathways,⁷¹ and due to variation in measurement the evidence is fragmented, making it difficult to discern what dimension of social support is best for chronically ill older adults.^{154,187} Within the context of chronic disease self-management, 'tangible support', the provision of direct material aid or other concrete assistance may be more predictive

of better health outcomes than other forms of support including emotional support or social network size.⁷³ Yet further complicating the utility of available tangible support is the complexity of chronic disease self-management, as those providing assistance must also have formidable skills and competencies.

Surprisingly, few empirical investigations have considered the perceived adequacy of tangible support and its relationship to health outcomes and urgent health care utilization. The studies identified as measuring the subjective perceptions of social support in a recent systematic review of social relationships and health services use among older adults captured perceptions of availability of support and loneliness, rather than the perceptions about the adequacy of the support received.¹⁸⁷ Outside of this review, one investigation that has assessed the perceived adequacy of tangible support and health outcomes; patients with coronary artery disease who perceived lack of needed assistance had greater rates of mortality and decline in physical functioning than individuals whose perceived needs for assistance were met.¹⁴⁹ Unmet needs for social support was also associated with less engagement in diabetes self-care activities among Korean adults with diabetes.¹³⁷ These investigations provide evidence of the importance of considering the adequacy of needed support, but has not been extended to a general population. In order to fill this gap, we sought to evaluate the association between unmet social support needs and older adults' health status and urgent health care utilization.

2. Methods

We conducted a cross-sectional secondary data analysis using data collected from the Health Literacy and Cognitive Function among Older Adults study (R01AG030611, referred to as 'LitCog'). The primary variables of interest are perceived adequacy of tangible support, health

status and urgent health care utilization. The study was approved by the Institutional Review Board at Northwestern University Feinberg School of Medicine.

a. Sample and Procedure

LitCog is a prospective cohort study investigating changes in health literacy over time and its relation to cognitive function and performance on health care tasks.⁷⁶ The sample was recruited from one academic general internal medicine practice and six federally qualified health centers in Chicago, Illinois between August 2008 and August 2015. A description of the systematic recruitment procedures has been previously published.^{76,188} Patients were eligible if they (1) were between the ages of 55 and 74, (2) spoke English, (3) had adequate cognitive capacity, as defined by ≤ 2 errors on the 6-item screener,¹⁵⁰ and (4) sought regular care (defined as 2 clinic visits within the past 2 years) from study sites. Research coordinators administered structured in-person interviews with enrolled participants in a private room. Participants completed follow-up interviews every 3 years and data for these analyses were collected at the third follow-up interview, which took place six years following their baseline interview.

b. Measures

i. Adequacy of Tangible Social Support

Adequacy of tangible social support was measured using a brief, validated scale to identify whether an individual needed assistance managing his or her health, and if this need for assistance was met.¹⁴⁹ Participants were asked two questions; the first question asked “In the last 6 months, have you needed any kind of extra help at home because your health kept you from taking care of yourself or doing what you usually do?” If respondents answered yes, they were asked a follow-up question “Of the help you got at home, would you say you got: all you needed, most you needed,

some you needed, only a little, or none you needed?” To create an overall score, participants were classified as (1) no perceived need for help; (2) received sufficient help (need help, but all needs met); (3) more help needed (most needs for help met); and (4) much more help needed (only some, little, or none of needs for help met). Individuals were further classified as having unmet needs (more help needed, much more help needed) or adequate support (no perceived help needed, received all help needed).

ii. Outcomes

(a) Functional Health Status

Functional health status was assessed in terms of both physical and mental health.¹¹ Functional health status was assessed using Patient Reported Outcomes Measurement Information Service (PROMIS) short-form instruments of physical function, depression and anxiety.¹¹ The PROMIS measures were developed for use among a general population of adults and adults with chronic illness. The short form instruments ask questions that are universal in nature, rather than condition specific. Physical function was measured using the 10-item short form physical function scale, which assesses an individual’s ability to carry out a range of activities that require physical capability, from activities of daily living to more vigorous activities such as climbing stairs. Depressive and anxiety symptoms were measured with the coinciding 8-item short form PROMIS scales, which includes items on negative mood, decrease in positive affect, and negative views of self. Anxiety symptoms were assessed with the 8-item short form anxiety scale, which includes aspects of fear, worry, dread, and hyperarousal. A raw score is calculated for each scale with high scores indicating greater ability or more symptoms. Raw scores are translated into a corresponding t-score, which rescales the raw score into a standardized score with a mean of 50 and standard deviation of 10. Therefore, a person with a t-score of 40 is one standard deviation below the mean

score of the general population of the United States.¹¹ Minimally important differences (MID) have been established to provide clinical context for some of the scales. A MID is defined as a difference in score that are large enough to have implications for a patient's treatment or care.¹⁸⁹ The MIDs range from 4-6 points and 3-4.5 points for the physical functioning and anxiety and depressive scales, respectively.

(b) Urgent Health Care Utilization

Urgent health care utilization was assessed by self-report of emergency department (ED) visits and inpatient hospitalization. During the interviews, patients were asked to self-report if they (1) visited the emergency department in the past 12 months, and (2) were hospitalized in the past 12 months. Questions were phrased to incorporate the boundary of the past 12 months (e.g. since last May 1st) to aid patient recall. Due to the large number of ED and hospital facilities within the Chicago area self-report was considered the most accurate method to obtain these outcomes. Any reported ED visits that resulted in inpatient stays were counted only as an inpatient hospitalization.

iii. Covariates

A number of covariates that have well established associated with the outcomes of interest were also collected. Health literacy was assessed using the Test of Functional Health Literacy in Adults (TOFHLA).¹⁶⁰ The TOFHLA assesses comprehension of actual health information and is composed of a numeracy (17 items) and a literacy section (50 items). Scores range from 0 to 100, with higher scores indicating higher health literacy. Scores are classified as limited (0-74), or adequate (75-100) health literacy. The Mini Mental State Exam (MMSE) is a global measure of cognitive ability and is commonly used in medical settings.¹⁹⁰ The MMSE includes items that assess attention, recall, calculation, orientation, and ability to follow verbal and written commands;

scores range from 0-30, with higher scores indicating greater cognitive ability. Morbidity was defined as the number of self-reported prescription medications and chronic conditions (diabetes, chronic obstructive pulmonary disease, coronary vascular disease, congestive heart failure, asthma, hypertension, hypercholesterolemia, stroke, arthritis, cancer, depression). The number of prescription medications and chronic conditions were categorized as 0-1, 2-4, 5 or more, and 0-1, 2, 3 or more, respectively. Demographic characteristics included self-reported gender, age, race (White, Black, Other), household income (<\$25,000, \$25,000-\$49,000, >\$50,000), and highest degree of education received (less than high school, high school graduate, some college, college graduate). To further characterize participants who identified unmet support needs, we also collected self-reported marital status and a measure of social isolation. Social isolation was assessed using the abbreviated (6-item) Lubben Social Network Scale (LSNS),¹⁵⁸ which evaluates the number of familial and friend ties among an older adult population;¹⁵⁹ scores less than 12 are classified as at risk of social isolation.¹⁵⁸

c. Analysis Plan

T-tests and chi-square statistics were conducted to examine differences in demographic characteristics and study outcomes (health status, urgent health care utilization) by unmet tangible support needs (met vs. unmet), as appropriate. Multivariable linear and logistic regression models were conducted to examine predictors of health status (physical function, depressive symptoms, anxiety symptoms) and urgent health care utilization (ED visits, hospitalization). All models included unmet need, health literacy, cognitive ability, self-reported age, race, number of chronic conditions, gender, income, and educational attainment. All analyses were performed using STATA 13.0 (College Station, TX).

3. **Results**

The mean age of participants was 68.6 (SD = 5.3) years of age and the majority (71%) were female. The sample varied in terms of race and socioeconomic position; approximately half reported household incomes of less than \$50,000 annually and the highest degree of educational attainment as a high school degree or less, and over a third of the sample identified as Black (Table VIII). A quarter of the sample were classified as having low health literacy. Participants had an average of three chronic conditions and were prescribed 4 daily medications. Very few were classified as socially isolated (18%), and less than half (41%) were married.

The majority (76%) of participants reported they did not need assistance managing their health, 8% reported they received sufficient help, 9% reported they need more help, and 7% reported they needed much more help. Overall, 16% identified unmet support needs. Individuals with unmet support needs were more likely to be female (82.4 % vs. 69.1%), lower income (60.9% vs. 26.1%), black race (55.4% vs. 33.9%), have limited health literacy (43.8% vs. 24.5%), diagnosed with 3 or more chronic conditions (79.7% vs. 55.7%), take 5 or more prescription medications (56.8% vs. 28.9%), be unmarried (73.0% vs. 56.5%) or socially isolated (27.1% vs. 16.3%) compared with individuals with adequate support (Table VIII).

Significant difference by unmet support needs were found for all outcomes in unadjusted analyses (Table IX). Participants with unmet support needs had a mean (*M*) physical function score of 39.0 (SD=6.7), which is equivalent to one standard deviation below the general US population norm, and was significantly lower than those with met support needs. Individuals with unmet support needs also reported a greater number of depressive (*M* = 49.9 (SD=8.7) vs. *M* = 45.4 (SD=7.9), $p < 0.001$) and anxiety symptoms (*M* = 55.8 (SD=8.2) vs. *M* = 50.3 (SD=8.7), $p < 0.001$), compared to individuals with adequate support. Individuals with unmet support needs

TABLE VIII. PARTICIPANT DEMOGRAPHICS BY ADEQUACY OF SOCIAL SUPPORT

Variable	All Participants (N=469)	Social Support		P Value
		Adequate (n=395)	Unmet Needs (n=74)	
Female, %	71.2	69.1	82.4	0.02
Age, %				
60-64	28.2	27.3	32.4	0.56
65-74	55.0	55.2	54.1	
75+	16.8	17.5	13.5	
Educational Attainment, %				<0.001
Less than High School	9.8	9.1	13.5	
High School Graduate	12.2	13.4	5.4	
Some College	21.8	17.7	43.2	
College Graduate	56.3	59.8	37.8	
Income, %				<0.001
<\$25,000	31.4	26.1	60.9	
\$25,000 – 49,999	19.9	20.9	14.5	
>\$50,000	48.7	53.0	24.6	
Race, %				0.001
Black	37.4	33.9	55.4	
White	52.8	56.7	32.4	
Other	9.8	9.4	12.2	
MMSE Score, mean (SD)	27.3 (5.1)	27.6 (4.7)	26.1 (6.7)	0.02
Health Literacy, %				0.001
Adequate	72.5	75.5	56.2	
Limited	27.5	24.5	43.8	
# Chronic Conditions, %				0.001
0 – 1	19.4	21.5	8.1	
2	21.1	22.8	12.2	
3+	59.5	55.7	79.7	
# Prescription Medicines, %				<0.001
0-1	25.6	27.9	13.5	
2-4	41.2	43.3	29.7	
5+	33.3	28.9	56.8	
Married, %	40.9	43.5	27.0	0.008
Socially Isolated, %	18.0	16.3	27.1	0.03

TABLE IX. UNADJUSTED ASSOCIATIONS BETWEEN ADEQUACY OF SOCIAL SUPPORT AND HEALTH STATUS AND URGENT HEALTH CARE USE

Variable	All Participants (N=469)	Social Support		P Value
		Adequate (n=395)	Unmet Needs (n=74)	
Health Status (mean, SD)				
Physical Function Score	47.6 (9.1)	49.2 (8.5)	39.0 (6.7)	<0.001
Anxiety Symptoms	51.2 (8.8)	50.3 (8.7)	55.8 (8.2)	<0.001
Depressive Symptoms	46.1 (8.2)	45.4 (7.9)	49.9 (8.7)	<0.001
Urgent Health Care Use (%)				
Emergency Department	19.4	14.4	46.0	<0.001
Hospitalization	16.4	12.2	39.2	<0.001

were more likely to report an emergency department visit (46.0% vs. 14.4%, $p<0.001$), and hospitalization (39.2% vs. 12.2%, $p<0.001$) in the past 12 months compared to individuals with adequate support.

Similar results were found in adjusted analyses (Table X). Compared with individuals with adequate support, those with unmet support needs reported worse physical function (β -6.33; 95% CI -8.31, -4.35, $p<0.001$), more anxiety symptoms (β 3.83; 95% CI 1.51, 6.15, $p=0.001$), and more depressive symptoms (β 2.61; 95% CI 0.45, 4.76, $p=0.02$). Across the three multivariable models of physical and mental health, male gender and higher income remained a significant predictors of better physical function scores and less anxiety or depressive symptoms. Older adults reported fewer anxiety or depressive symptoms compared to adults between the ages of 60 and 64 and those who identified as Black reported fewer depressive symptoms compared to those who identified as

White. Individuals diagnosed with three or more chronic conditions or taking five or more prescription medicines had worse physical function and greater depressive symptoms compared to those with ≤ 1 chronic condition or prescription medication, respectively.

Individuals with unmet support needs also reported greater urgent health care utilization (ED: OR 2.82; 95% CI 1.50, 5.31, $p=0.001$; hospitalization: OR 3.60; 95% CI 1.82, 7.14, $p<0.001$) compared with individuals with adequate support. Within the fully adjusted models unmet support needs were the sole significant predictor, and all other covariates were not predictive of urgent health care utilization.

4. Discussion

We found that nearly 1 in 6 community-dwelling older adults reported unmet tangible social support needs, and reported greater urgent health care use and worse health status than their counterparts. We found that individuals with unmet support needs, even after adjusting for many well recognized covariates, scored 6 points lower on the physical functioning score, and approximately 3.5 points greater with regards to anxiety symptoms, each suggesting a clinically meaningful difference from the overall sample.¹⁸⁹ These differences are sizeable enough to inform the clinical care of patients and further underscores the importance of perceived adequacy of support on health.

These findings are an important contribution to the extensive body of literature on social relationships. While many facets of social relationships have been specified, the field has not readily incorporated aspects related to adequacy of support.⁷¹ The literature on social support has operated under the assumption that if available, the support that is provided is sufficient to meet an individual's needs.⁹⁸ This aspect is important as the quality of social relationships experienced by individuals are a function of broader social and structural forces,^{20,69,101} which is consistent with

TABLE X. ADJUSTED ASSOCIATIONS BETWEEN ADEQUACY OF SOCIAL SUPPORT AND HEALTH STATUS AND URGENT HEALTH CARE USE

	Physical Function β (95% CI)	Anxiety β (95% CI)	Depression β (95% CI)	ED OR (95% CI)	Hospital OR (95% CI)
Adequacy of Support					
Adequate	-	-	-	-	-
Unmet Need	-6.33 (-8.31, -4.35)***	3.83 (1.51, 6.15)**	2.61 (0.45, 4.76)*	2.82 (1.50, 5.31)**	3.60 (1.82, 7.14)***
Male	1.94 (0.45, 3.43)*	-3.15 (-4.89, -1.41)***	-2.37 (-3.99, -0.75)**	0.60 (0.32, 1.15)	0.96 (0.50, 1.83)
Age					
55-59	-	-	-	-	-
60-64	0.64 (-0.89, 2.17)	-3.27 (-5.06, -1.48)***	-2.51 (-4.17, -0.84)**	0.77 (0.43, 1.4)	1.41 (0.70, 2.82)
65+	-0.10 (-2.16, 1.97)	-5.82 (-8.24, -3.41)***	-4.65 (-6.90, -2.40)***	0.64 (0.28, 1.43)	2.29 (0.95, 5.49)
# Chronic conditions					
0-1	-	-	-	-	-
2	-0.32 (-2.43, 1.80)	-0.66 (-3.13, 1.81)	0.75 (-1.55, 3.05)	1.5 (0.55, 4.1)	1.70 (0.58, 4.96)
3+	-3.75 (-5.73, -1.76)***	2.28 (-0.04, 4.60)	2.36 (0.20, 4.52)*	2.15 (0.86, 5.37)	1.88 (0.7, 5.06)
# Prescription medicines					
0-1	-	-	-	-	-
2-4	-2.53 (-4.34, -0.72)**	1.27 (-0.84, 3.39)	0.95 (-1.02, 2.92)	1.16 (0.53, 2.55)	0.78 (0.32, 1.89)
5+	-4.75 (-6.84, -2.66)***	2.45 (0.01, 4.90)	2.71 (0.43, 4.99)*	1.35 (0.58, 3.16)	2.12 (0.86, 5.22)
Limited health literacy	-1.83 (-3.68, 0.02)	-1.17 (-3.34, 0.99)	-1.98 (-3.99, 0.04)	1.64 (0.84, 3.21)	0.90 (0.43, 1.90)
Education Attainment					
Less than High School	-2.49 (-5.4, 0.42)	-1.81 (-5.22, 1.61)	-1.45 (-4.62, 1.72)	0.79 (0.27, 2.32)	0.56 (0.15, 2.03)
High School Graduate	1.28 (-1.15, 3.71)	-2.55 (-5.39, 0.29)	-1.7 (-4.34, 0.95)	0.87 (0.33, 2.3)	0.81 (0.28, 2.36)
Some College	-0.29 (-2.24, 1.66)	-1.77 (-4.05, 0.51)	-0.62 (-2.74, 1.5)	1.94 (0.95, 3.97)	1.15 (0.52, 2.55)
College Graduate	-	-	-	-	-
Income					
<\$25,000	-4.63 (-6.69, -2.57)***	2.38 (-0.03, 4.8)	4.21 (1.97, 6.46)***	1.72 (0.78, 3.77)	2.24 (0.98, 5.11)
\$25,000 – 49,999	-2.13 (-4.00, -0.26)*	2.29 (0.11, 4.48)*	2.84 (0.8, 4.87)**	1.43 (0.67, 3.09)	0.86 (0.37, 2.04)
>\$50,000	-	-	-	-	-
Race					
White	-	-	-	-	-
Black	0.40 (-1.32, 2.13)	-1.88 (-3.9, 0.14)	-2.31 (-4.19, -0.43)*	0.98 (0.50, 1.90)	0.73 (0.35, 1.53)
Other	2.38 (0.01, 4.76)	2.33 (-0.46, 5.11)	1.6 (-0.99, 4.19)	0.88 (0.33, 2.36)	0.68 (0.23, 2.02)

*= $p < 0.05$; **= $p < 0.01$; ***= $p < 0.001$

the socially patterned distribution of individuals identifying unmet tangible social support needs in our data. These findings likely reflect the principle of network homophily, which suggests that individuals disproportionately form network ties with others of similar background, thus the network members of disadvantaged individuals may also be in poor health.^{101,102} Therefore, while an individual may have an extensive social network, that network may be unable to provide the sufficient level of assistance an individual may require to engage in health promoting behaviors, resulting in unmet tangible social support needs.

Remarkably, two straight forward questions were able to identify individuals at risk for worse health status and greater urgent health care use. While these two items do not provide explicit guidance to the nature of the need, this brief screener could be easily implemented and clinically useful for health care providers to identify individuals who may be at risk for poor outcomes, especially as there is growing recognition about the importance of screening for social determinants of health.¹⁹¹ Similar to the two item Patient Health Questionnaire (PHQ-2), which has been incorporated into routine clinic intake procedures and is able to easily identify patients at risk for depression and notify clinic staff for additional follow-up, these two items could also be assessed as similar vital signs. Yet in order to be effective, health systems must have systems in place to respond after identifying individuals with unmet needs.¹⁹² As ambulatory care practices incorporate more allied health professionals including social workers and care coordinators, these professionals may be able to further work with patients to identify areas of need and provide a patient-tailored response or make appropriate referrals. Partnerships between clinics and community based or public health organizations may also facilitate addressing these unmet social support needs.

The possibility of incorporating the two screening items within the EHR also has policy implications. With the increase in value-based payment,¹⁹³ Medicare is seeking to account for social risk factors in Medicare payments.¹⁵⁴ A recent National Academies of Medicine report highlighted the value of screening for social relationships, especially among older adults; however the committee could not recommend a measure that was currently capturing these data or one that could be easily implemented within clinical practices.¹⁵⁴ These two questions could easily be implemented in EHRs and could inform Medicare value-based payment programs.¹⁵⁴

Older adults receive help from both formal and informal sources of support. Literature regarding informal caregiving of chronically ill adults has found that those who assume these roles often receive little to no training.^{194,195} Successful interventions related to developing caregivers skills seek to improve a sense of control, master and self-efficacy by reducing the caregiver's uncertainty.^{194,196} Complicating the development of these skills is the variability and sometimes unpredictable nature of these conditions, and therefore interventions are most successful when they are tailored to the key needs of specific patients and caregivers.¹⁹⁶ Additionally, home health aides, certified nursing assistants and personal care aides provide the majority of formal care to older adults; however, these positions experience significant attrition and staffing insufficiencies due to low wages, inadequate training and supervision, and the perception of the position as a 'dead-end' job,¹⁴⁷ and as a result these service providers may be inadequately prepared to provide the requisite level of support these older adults need. A greater investment of resources is needed to support direct care workers as they provide paid care for older adults.

This study should be recognized in the context of several limitations. The findings are limited to English speaking, predominantly female, older adults in one urban city. The cross-sectional nature of these analyses limits inferences regarding causality. The primary independent

variable was assessed with only two items and did not provide additional detail regarding the insufficiency of the desired support. However, for the purpose of clinical utility, its brevity is a strength. Furthermore, I assessed perceived support, as opposed to received support; however, perceived support has previously been found to be more predictive of health outcomes.^{68,124}

Future research should examine the adequacy of tangible support over time. As older adults are diagnosed with new illnesses or experience changes in health, their dependence on their support network may grow and the support person's ability to maintain a high level of assistance may not be able to keep up with the changes.¹⁹⁶ Based on longitudinal findings, clinical encounters may want to regularly check the availability and adequacy of support.

Current medical and public health efforts aim to promote aging in place for older adults. Often it is assumed that a support network will help older adults manage their health, but systems to develop these skills are largely missing. Clinical and community organizations should partner to address unmet tangible social support needs and work with older adults' support networks to identify their strengths and barriers to providing care for older adults. These findings highlight the importance of considering the adequacy of the support provided to older adults as they seek to manage their health independently.

V. CONCLUSION

A. Summary of Findings

Study one sought to examine associations between the presence of a daily routine and older adults' health status and urgent health care utilization, and determine whether a higher level of daily routine mediates associations between SEP and health outcomes. It was hypothesized that older adults with greater daily routine would have better health status and less urgent health care utilization, and that daily routine would mediate the associations between SEP and these outcomes.

The findings provided support for some aspects of these hypotheses, but not others. With regards to the first hypothesis, we observed an association between greater daily routine and better physical and mental health outcomes; however, we did not observe an association between daily routine and urgent health care utilization. We also did not observe strong support for the second hypothesis, and routine only attenuated the relationship between SEP and physical function and depressive symptoms. Daily routine only minimally attenuated the relationship between SEP and physical function, which suggests that while individuals of lower SEP had lower levels of daily routine, this only explained a small portion of the relationship with physical functioning. We also found that daily routine mediated the relationship between SEP and depressive symptoms to a greater extent and explained approximately a third of the relationship.

The second study sought to investigate associations between structural and functional aspects of social support and medication adherence. It was hypothesized that functional support, and not structural support, would be associated with medication adherence, and that less frequent

functional support related to medication management would be associated with poorer medication adherence.

We did not observe an association between adherence to asthma controller medications and structural support. Contrary to our hypothesis, the receipt of more frequent functional support with medication management tasks was associated with poorer adherence to asthma controller medications. Interestingly, we also observed a negative correlation between social isolation and frequency of functional support, indicating that those with fewer individuals in their social network reported greater frequency of assistance with medication management tasks.

The third study sought to evaluate the association between unmet tangible social support needs and older adults' health status and urgent health care utilization. It was hypothesized that older adults with unmet tangible support needs would have worse physical and mental health outcomes and greater urgent health care utilization. Our results provided support for our hypothesis, and we found that individuals who reported unmet tangible social support needs, reported greater urgent health care use and worse health status than their counterparts.

B. Overall Discussion of Findings

This dissertation examined psychosocial determinants of self-management behaviors and health outcomes among a socioeconomically and racially/ethnically diverse older population managing multiple chronic conditions. Health management is often narrowly viewed as interactions between patients and medical providers, but individuals spend only a small fraction of their time in medical settings and the vast majority is spent managing their health independently in home and community settings. As a result, health management occurs within the context of individuals' everyday lives, and health behaviors must be integrated within responsibilities as a

parent, child, spouse, employee or friend. Individuals facing significant hardship (such as housing instability, food insecurity, exposure to violence) must simultaneously take action to minimize these stressors. Therefore, an ecological approach with particular attention to the role of social determinants of health was applied in the investigation of two psychosocial factors.

At the individual level, greater levels of daily routine were associated with better health status. These findings are concordant with health promotion strategies individuals have previously reported.^{66,162,163,173} We did not observe an association between daily routine and urgent health care utilization. Urgent health care utilization may be too distal of an outcome, and the presence of a daily routine may have its greatest effect on more proximal outcomes such as health outcomes and health behaviors.⁵⁹ As we did not assess self-management behaviors, future research studies should explore these associations.

We did not observe strong evidence in support of the hypothesis that daily routine would mediate the association between SEP and health outcomes, except with regards to the association between SEP and depressive symptoms. This finding may be attributed to the fact that individuals of low SEP are consistently exposed to significant stressors; when stress is overwhelming, depression can be triggered.¹⁶⁸ Addressing all of these stressors in addition to engaging in daily behaviors requires significant cognitive resources. A daily routine may help individuals accomplish daily tasks with minimal cognitive effort, and as a result provides a sense of control and self-efficacy, which in turn may alleviate some depressive symptoms. Overall, a daily routine did not mediate associations between SEP and other health outcomes, which further underscores repeated calls for concurrent work on ‘upstream factors’^{85,87,93} and structural determinants of health.²⁰

At the interpersonal level, the analyses related to social relationships underscored the multidimensional and complex nature of social support. Contrary to our hypothesis, the second paper observed a negative association between the frequency of functional support and adherence to asthma medications. Functional support was measured as support that was received, regardless of whether an individual perceived they could manage the tasks independently. Conversely, the third paper observed findings consistent with its hypothesis that unmet tangible support needs would be associated with worse health status and greater urgent health care utilization, and assessed social support by first identifying whether participants self-reported a need for tangible assistance, and subsequently inquired about the perceived adequacy of the support. Together, these two studies suggest that it is important to first isolate a need for tangible assistance in managing one's health, and then examine perceptions related to the support's availability and adequacy.

This dissertation also hypothesized that functional social support would be more predictive of medication adherence, than structural support, which implied that functional support was superior to structural support in self-management behaviors among older adults. However, the findings from both papers suggest that one dimension may not be more relevant than the other among older adults managing multiple chronic conditions, rather both domains are necessary. Structural support, independent of functional support, was not predictive of medication adherence. However, functional support cannot be deployed without having people in one's social network to deliver it, and for functional support to be of value it must meet the needs of that person. A nuanced approach to the type and manner which social support exerts its influence is necessary in understanding the way in which it impacts self-management behaviors and health outcomes.

These findings also illustrated the interplay between socioeconomic position, health status, and tangible social support. The cross-sectional analyses cannot inform on causality or directionality, but we observed associations between measures of functional support and unmet tangible social support needs with measures of health status and socioeconomic factors. Social support is often mobilized in response to stressful circumstances, which could be due to poor health or in response to socioeconomic stressors. In consideration of the negative relationship between frequency of functional medication support and adherence, and the association between unmet tangible social support needs and health outcomes, the adequacy of the support that is provided appears to be of great importance. When seeking to understand the effect that support exerts, these findings suggest that attention should also be paid to the support provider. Applying the principle of network homophily, which suggests that individuals disproportionately form network ties with others of similar background, the network members of disadvantaged individuals may also be in poor health and/or contending with socioeconomic hardship.^{101,102} Therefore, network members may be unable to provide the sufficient level of assistance an individual may require to engage in health promoting behaviors. Furthermore, the negative correlation between social isolation and frequency of functional support suggests that individuals who receive more functional support with their medications are likely relying on only a few people.

C. Implications

1. Public Health and Clinical Partnership Implications

As described earlier, individuals with chronic illness must seek regular medical care and manage their health independently. Both aspects contribute to overall health and well-being, and clinical and community partnerships should be leveraged to identify and act upon the psychosocial

factors studied in this dissertation to promote well-being. With the introduction of Accountable Care Organizations, reimbursement mechanisms are more readily available to sustain these partnerships and team-based care models to better address these psychosocial determinants of health.¹⁹⁷

With the growing recognition of the importance of screening for social determinants of health in medical settings,¹⁹¹ clinical practices can screen for unmet tangible support needs and work with community-based organizations in order to respond to those needs and equip their social network to better meet the needs of the individual. Primary care practices could implement models similar to the CommunityRx strategy, in which providers write electronic prescriptions for health promoting services and resources based on an inventory of community services providers.¹⁹⁸

Older adults receive help from both formal and informal sources of support. Often it is assumed that a support network will help older adults manage their health, but systems to develop these skills are largely missing.^{194,195} Clinical and community organizations could partner to work with older adults' support networks to identify their strengths and barriers to providing care for older adults. Successful interventions related to developing caregivers skills seek to improve a sense of control, master and self-efficacy by reducing the caregiver's uncertainty.^{194,196}

With regards to the findings related to daily routine, it may be beneficial to target programs and develop tools to provide support on an individual basis to assess an individual's ability to plan for the future, stay organized, and maintain a routine.^{108,109} These results support a general framework of routine behaviors, rather than rigid adherence to daily routine, is needed to be beneficial. Additionally, with increasing age the number of recurring daily responsibilities or activities often decreases, programs designed to promote regular social engagement could also facilitate the development of a daily routine. Programs such as Experience Corps provide older

adults with structured opportunities for volunteering in school settings and have been shown to improve health outcomes and cognitive function.^{147,199,200} In addition to these benefits, these programs could provide opportunities for regular social engagement which could help develop a general structure to one's time.

2. Policy Implications

These findings also have policy implications. First, with the increase in value-based payment,¹⁹³ Medicare is seeking to account for social risk factors in Medicare payments, but there is limited evidence about measures that can be easily implemented within clinical practices.¹⁵⁴ These two items used to identify unmet tangible social support needs could easily be implemented in EHRs and could inform Medicare value-based payment programs.¹⁵⁴

Second, with an aging population with significant health needs, these findings suggest a need for a greater investment in resources for the elder-care workforce. Home health aides, certified nursing assistants and personal care aides provide the majority of formal care to older adults; however, these positions experience significant attrition and staffing insufficiencies due to low wages, inadequate training and supervision, and the perception of the position as a 'dead-end' job,¹⁴⁷ and as a result these service providers may be inadequately prepared to provide the requisite level of support these older adults need. Additionally, as previously described, there are minimal opportunities to develop informal support networks skills to provide ongoing support.^{194,195} While there are repeated calls for investment in the health of our older generation, a shift in societal values is needed to act on this investment. Citizens must collectively inform policy makers that the health and wellbeing of our older generation is of value, and therefore, high-performing direct care workers or informal caregivers who fulfill this critical service should be adequately compensated and acknowledged.

D. Limitations

This study was a secondary data analysis, and while I was able to incorporate new measures related to the independent variables of interest with ongoing data collection, I did rely on the data from existing measures. As with all secondary data analyses, these analyses were not the primary aims of the study, and therefore many of the existing measures were collected for purposes outside of these analyses. Additionally, all analyses were cross-sectional and we are unable to determine the directionality of the observed associations. For example, we are unable to discern whether greater daily routine leads to improve physical and mental health status, or whether physical and mental health status leads to greater levels of daily routine. It is also plausible that the relationship between the independent variables and health status is bidirectional.

The composition of our sample also limits our generalizability to other populations. These samples were comprised of older adults who sought primary care in urban areas, and may not be generalizable to younger samples outside of urban areas. Both samples were predominantly comprised of female participants, and these findings may not be generalizable to older male adults.

The measures that were included have both strengths and weaknesses. While we used a validated measure of daily routine, our measure only included four items, and therefore may not fully capture variations in daily routine. This measure assessed the regularity of individual behaviors occurring at the same time of day within the home environment and did not encompass regular interpersonal interactions or activities outside of the home, which may be important dimensions.¹⁰³ Additionally, our measure of functional support was not previously validated; however, we were not aware of any medication-specific functional support measures. The SMMS demonstrated high internal reliability and acceptable construct validity. Our questions related to functional and structural support were broad by design and we did not inquire about who provided

about the support and the patient's perceived adequacy of the received support. Unmet tangible social support was assessed with only two items and did not provide additional detail regarding the insufficiency of the desired support. However, for the purpose of clinical utility, its brevity is a strength. Lastly, while this dissertation utilized quantitative methods to test the proposed hypotheses, qualitative approaches may be useful to further inform the manner which social support and routine are operationalized and measured.

E. Final Conclusion

There is increasing recognition of the importance of comprehensively understanding and responding to social determinants of health in order to improve health outcomes. As we seek to promote healthy aging, findings from this dissertation shed light on two psychosocial factors that could be leveraged, but also suggests that they must be acted on with simultaneous systemic changes. The statistics about an aging population and health inequities by social position have been well documented, and despite corrective efforts, these inequities persist. To address these looming issues, society will need to reckon with its values. If we truly value the health of our older and more disadvantaged members we must invest in and sustain systems that comprehensively support them aging in place.

APPENDICES

APPENDIX A

Study One: Selected Study Battery

Environmental Demands – Routine and Busyness

*Note: Questions related to the routine subscale are indicated with an *.*

1. How busy are you during an average day?
 - a. *Not busy at all*
 - b. *Rarely busy*
 - c. *Somewhat busy*
 - d. *Very busy*
 - e. *Extremely busy*
2. How often do you have too many things to do each day to actually get them all done?
 - a. *Never*
 - b. *Rarely*
 - c. *Sometimes*
 - d. *Often*
 - e. *Always*
3. How often do you find yourself rushing from place to place trying to get to appointments or to get things done?
4. How often are you so busy that you miss scheduled breaks or rest periods?
5. How often are you so busy that you miss your regular meal times?
6. How often do you rush out of the house in the mornings to get to where you need to be?
7. How often do you have so many things to do that you go to bed later than your regular bedtime?
8. How often do your days follow a basic routine?*
9. How often do you get out of bed in the morning and go to bed at night at about the same time?*
10. How often do you eat all of your meals at the same time each day and night?*
11. How often do you engage in activities at home at a specific time (i.e. read the paper after work, watch a particular television show, children, hobbies, etc.)?*

APPENDIX A (continued)**Physical Function - PROMIS**

Does your health now limit you...

1. In doing vigorous activities, such as running, lifting heavy objects, or participating in strenuous sports?
 - a. *Not at all*
 - b. *Very little*
 - c. *Somewhat*
 - d. *Quite a lot*
 - e. *Cannot do*
2. In walking more than a mile?
3. In climbing one flight of stairs?
4. In lifting or carrying groceries?
5. In bending, kneeling, or stooping?

Tell me if you are able to...

6. Do chores such as vacuuming or yard work?
 - a. *Without any difficulty*
 - b. *With a little difficulty*
 - c. *With some difficulty*
 - d. *With much difficulty*
 - e. *Unable to do*
7. Dress yourself, including tying shoelaces and doing buttons?
8. Shampoo your hair?
9. Wash and dry your body?
10. Get on and off the toilet?

APPENDIX A (continued)Anxiety (PROMIS)

In the past 7 days...

1. I felt fearful
 - a. *Never*
 - b. *Rarely*
 - c. *Sometimes*
 - d. *Often*
 - e. *Always*
2. I felt anxious
3. I felt worried
4. I found it hard to focus on anything other than my anxiety
5. I felt nervous
6. I felt uneasy
7. I felt tense

Depression (PROMIS)

In the past 7 days...

1. I felt worthless
 - a. *Never*
 - b. *Rarely*
 - c. *Sometimes*
 - d. *Often*
 - e. *Always*
2. I felt I had nothing to look forward to
3. I felt helpless
4. I felt sad
5. I felt like a failure
6. I felt depressed
7. I felt unhappy
8. I felt hopeless

APPENDIX B

Study Two: Selected Study Battery

Medication Adherence Response Scale

1. I use my [controller name] medication only when I need it.
 - a. *Always*
 - b. *Often*
 - c. *Sometimes*
 - d. *Rarely*
 - e. *Never*
2. I use my [controller name] only when I feel breathless.
3. I decide to miss out a dose of my [controller name].
4. I try to avoid using my [controller name].
5. I forget to take my [controller name].
6. I change the dose of my [controller name].
7. I stop taking my [controller name] for a while.
8. I use my [controller name] if my other treatment doesn't work.
9. I use my [controller name] before doing something which might make me breathless.
10. I take my [controller name] less than instructed.

Lubben Social Network Scale – 6 (LSNS-6)

1. How many relatives do you see or hear from at least once a month?
 - a. *None*
 - b. *1*
 - c. *2*
 - d. *3 or 4*
 - e. *5-8*
 - f. *9 or more*
2. How many relatives do you feel at ease with that you can talk to about private matters?
3. How many relatives do you feel close to such that you could call on them for help?
4. How many friends do you see or hear from at least once a month?
5. How many friends do you feel at ease with that you can talk to about private matters?
6. How many friends do you feel close to such that you could call on them for help?

APPENDIX B (continued)**Support with Medication Management Questions**

1. How often does someone come with you to your doctor's appointments?
 - a. *Always*
 - b. *Often*
 - c. *Sometimes*
 - d. *Rarely*
 - e. *Never*
 - f. *Not Applicable*
2. How often does someone call the doctor's office when your medicines are running out?
3. How often does someone call the pharmacy for refills of your medicines?
4. How often does someone bring your prescriptions to the pharmacy to be filled?
5. How often does someone pick up your prescriptions at the pharmacy?
6. How often does someone pay for your medicines with their own money?
7. How often does someone put your pills in a pill organizer or box?
8. How often does someone put your medicines in a place where you will remember to take them?
9. How often does someone remind you to take your (controller medicine)?
10. How often does someone remind you to take your other medicines?
11. How often does someone bring your medicines to you when it's time to take them?
12. How often does someone put the pills in your hand when it's time to take them?
13. How often does someone set up your nebulizer when you need to use it?
14. When you get a new medicine, how often does someone ask your doctor what the medication is for?
15. When you get a new medicine, how often does someone ask your doctor what side effects the medicine may cause?
16. Is there someone who checks to see whether your medications need refills?

APPENDIX C

Study Three: Selected Study Battery

Adequacy of Tangible Social Support

1. In the last 6 months, have you needed any kind of extra help at home because your health kept you from taking care of yourself or doing what you usually do?
 - a. Yes
 - b. No

2. Of the help you got at home, would you say you got:
 - a. All you needed
 - b. Most you needed
 - c. Some you needed
 - d. Only a little
 - e. None that you needed

APPENDIX D

Institutional Review Board Office
Northwestern University

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 Chicago, Illinois 60611
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Social and Behavioral Sciences IRB
 600 Foster Street
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APPROVAL OF MODIFICATION AND CONTINUING REVIEW

DATE: October 23, 2017

TO: Dr. Michael Wolf

FROM: Office of the IRB

DETERMINATION DATE: 10/23/2017

APPROVAL DATE: 10/23/2017

EFFECTIVE DATE: 10/23/2017

EXPIRATION DATE: 10/22/2018

The Northwestern University IRB has reviewed and approved the submission described below:

Type of Submission:	Modification and Continuing Review
Review Level:	Expedited
Expedited Category:	- (4) Noninvasive procedures - (7) Behavioral research/social science methods - (mm) Minor modification
Title of Study:	Health Literacy and Cognitive Function Among Older Adults
Principal Investigator:	Michael Wolf
IRB ID:	STU00026255-MODCR0005
Funding Source:	Name: National Institute on Aging, Grant Office ID: SP0034508, Funding Source ID: 2 R01 AG030611-09A1
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	<ul style="list-style-type: none"> • Derin Cobia CITI Training 2017, Category: Training Documents; • LitCog I Protocol 01.23.pdf, Category: IRB Protocol; • LitCog IV MRCI Survey V1.pdf, Category: Questionnaire/Survey; • LitCog IV Day 2 Survey V1.pdf, Category: Questionnaire/Survey; • Pharmacy Authorization Form NU_LitCog.docx, Category: Recruitment Materials; • Walgreens authorization_third_party_LitCog.pdf, Category: Recruitment Materials; • CVS Caremark Release Form_LitCog.pdf, Category: Recruitment Materials; • LitCog III Grant, Category: Sponsor Attachment;

Northwestern University has an approved Federalwide Assurance with the Department of Health and Human Services:
 FWA00001549.

HRP-704 / v070115

APPENDIX D (continued)

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APPROVAL OF CONTINUING REVIEW

DATE: June 13, 2017

TO: Dr. Michael Wolf

FROM: Office of the IRB

DETERMINATION DATE: 6/13/2017

APPROVAL DATE: 6/13/2017

EFFECTIVE DATE: 6/13/2017

EXPIRATION DATE: 6/12/2018

The Northwestern University IRB reviewed and approved the submission described below:

Type of Submission:	Continuing Review
Review Level:	Expedited
Expedited Category:	- (4) Noninvasive procedures - (5) Data, documents, records, or specimens - (7) Behavioral research/social science methods
Title of Study:	Seniors' health literacy, beliefs and asthma self-management
Principal Investigator:	Michael Wolf
IRB ID:	STU00016454-CR0003
Funding Source:	Name: Internal Funding – Dept. Not specified (Conversion)
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	<ul style="list-style-type: none"> • 12-Month Scheduling Letter Version 2.docx, Category: Recruitment Materials; • 12-Month Scheduling Letter_Spanish.doc, Category: Recruitment Materials; • 12-Month_SPA_V4_2.15.12.pdf, Category: Interview; • 12-month_v3 2.1.12 clean.pdf, Category: Interview; • 18 Month Consent Spanish Version 1 11.14.11.docx, Category: Consent Form; • 18 Month Consent Spanish Version 1 11.14.11.docx, Category: Consent Form; • 18 Month Survey V2 1.3.11 Clean.pdf, Category: Interview; • 18 month verbal consent Version 1 9.14.11.doc, Category: Consent Form;

Northwestern University has an approved Federalwide Assurance with the Department of Health and Human Services:
FWA00001549.

HRP-703 / v070115

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VITA

1. NAME

Rachel M. O’Conor

2. EDUCATION

- 2014 – 2018 University of Illinois Chicago, Doctor of Philosophy Candidate, Public Health Sciences
 Dissertation Title: *Psychosocial determinants of self-management behaviors and health outcomes among older adults*
 Dissertation Chair and Advisor: Jennifer Hebert-Beirne, PhD MPH
- 2010 – 2012 University of Illinois Chicago, Master of Public Health, Community Health
- 2005 – 2009 DePaul University, Bachelor of Science in Psychology and Spanish

3. PROFESSIONAL EXPERIENCE

- 2016 – present Clinical Research Associate, Northwestern University, Division of General Internal Medicine and Geriatrics
- 2013 – 2016 Research Project Manager, Northwestern University, Division of General Internal Medicine and Geriatrics
- 2011 – 2013 Research Project Coordinator, Northwestern University, Division of General Internal Medicine and Geriatrics
- 2011 – 2012 Graduate Student Intern, Women Health Foundation
- 2009 – 2011 Research Study Coordinator, Northwestern University, Division of General Internal Medicine and Geriatrics
- 2008 – 2009 Public Health Intern, Chicago Department of Public Health

4. AWARDS, HONORS, DISTINCTIONS

- 2009 Summa Cum Laude, Graduation with Honors, DePaul University
- 2018 Abstract-of-the-day, Society of General Internal Medicine Annual Meeting

5. PROFESSIONAL and SCIENTIFIC SERVICE

Journal Manuscript Reviews

Health Expectations

Journal of Aging and Health
 Journal of Applied Gerontology
 Journal of Asthma
 Journal of Gerontology: Series A Medical Sciences
 Journal of Health Communication
 Journal of the American Geriatrics Society
 PLOS ONE

Conference Abstract Reviews

American Public Health Association
 Academy Health: Disparities and Health Equity

Community Service

2012 – 2015 Big Brothers Big Sisters Chicago, mentoring

6. TEACHING

2018 School of Public Health at University of Illinois at Chicago, Community Health Sciences,
Pragmatic Randomized Controlled Trials, guest lecturer

2018 University of Illinois at Chicago, Department of Communication, *Health Literacy*,
 guest lecturer

7. RESEARCH GRANTS/CONTRACTS

Current

National Institute of Health (UG3NS105562; Gershon, 09/25/17 – 08/31/22)
MyCog - Rapid detection of cognitive impairment in everyday clinical settings
 Role: Co-Investigator

National Institute of Health (R01NR015444; Wolf, 09/26/16 – 07/31/21)
EHR-based Universal Medication Schedule to Improve Adherence to Complex Regimens
 Role: Project Director

National Institute of Health (R01HL126508; Wisnivesky, 07/01/15 – 06/30/20)
Self-management Behaviors among COPD Patients with Multi-morbidity
 Role: Research Associate

National Institute of Health (R01AG030611; Wolf, 03/01/11 – 02/29/20)
LitCog III: Health Literacy and Cognitive Function among Older Adults
 Role: Statistical Analyst
 Patient Centered Outcomes Research Institute (AS-130705584; Federman, 03/01/14 – 12/31/17)
Clinic-based vs. Home-based Support to Improve Care and Outcomes for Older Asthmatics
 Role: Research Associate

American Board of Obstetrics and Gynecology (No Number; You, 02/01/15 – 01/31/18)
Health Literacy/Numeracy and Patient Education in Pregnancy-Related Diabetes Mellitus
 Role: Research Associate and Statistical Analyst

Pending

National Institute of Health (R34HL143747; Federman, 07/01/18 – 06/30/21)

Comprehensive Home-based Self-Management Support for COPD Patients

Role: Co-Investigator

Completed (Principal Investigator)

Illinois Area Health Education Center Network (07/15/11 – 12/31/11)

The Role of Maternal Figures in Shaping Adolescent Pelvic Health: An Exploratory Study

Role: Principal Investigator

Completed

National Institute of Health (R01HL105385; Wisnivesky, 08/18/11 – 06/30/16)

Longitudinal Study of Cognition, Health Literacy, and Self-care in COPD Patients

Role: Project Manager

National Institute of Health (R01AG030611; Wolf, 03/01/11 – 02/29/16)

LitCog II: Health Literacy and Cognitive Function among Older Adults

Role: Statistical Analyst

National Institute of Health (R01HL096612; Federman, 08/01/09 – 05/31/13)

Seniors' Health Literacy, Beliefs and Asthma Self-Management

Role: Project Manager

National Institute of Health (R01AG030611; Wolf, 09/15/07 – 12/31/10)

Health Literacy and Cognitive Function among Older Adults

Role: Project Coordinator

8. SCHOLARLY BIBLIOGRAPHY

Original, Peer-reviewed Articles

1. Wolf MS, Smith SG, Pandit AU, Condon D, Curtis LM, **O'Connor R**, Rush SR, Bailey SC, Kaplan G, Haufler V, Martin D. Development and Validation of the Consumer Health Activation Index. *Medical Decision Making*. 2018;38(3):334-343.
2. Mullan RJ, Curtis LM, **O'Connor R**, Serper M, McCarthy DM, Bailey SC, Parker R, Wolf MS. Visual acuity, literacy and unintentional misuse of over the counter medications. *American Journal of Health-System Pharmacy*. 2018;75(9):e213-e220.
3. **O'Connor R**, Smith SG, Curtis LC, Yoshino Benavente J, Vicencio DP, Wolf MS. Mild visual impairment and its impact on self-care among older adults. *Journal of Health and Aging*. 2018;30(3):327-341.
4. Yee LM, Kamel L, Quander Z, Rajan PV, Taylor SM, **O'Connor R**, Wolf MS, Simon MA. Characterizing literacy and cognitive function during pregnancy and postpartum. *American Journal of Perinatology*. 2017;24(9):927-934.

5. Hebert-Beirne J, **O'Connor R**, Ihm J, Parlier MK, Lavender M, Brubaker L. Effectiveness of a Pelvic Health Educational Curriculum for Adolescent Females in School Settings. *Journal of Pediatric & Adolescent Gynecology*. 2017;30(2):188-192.
6. Soones T, Lin JL, Wolf MS, **O'Connor R**, Martynenko M, Wisnivesky JP, Federman AD. Pathways Linking Health Literacy, Health Beliefs, and Cognition to Medication Adherence in Older Adults with Asthma. *Journal of Allergy and Clinical Immunology*. 2017;139(3):804-809.
7. **O'Connor R**, Martynenko M, Gagnon M, Hauser D, Young E, Lurio J, Wisnivesky JP, Wolf MS, Federman AD, SAMBA Investigators. A Qualitative Investigation of the Impact of Asthma and Self-management Strategies among Older Adults. *Journal of Asthma*. 2017;54(1):39-45.
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9. Salmon C, **O'Connor R**, Singh S, Ramaswamy R, Kannry J, Wolf MS, Federman AD. Characteristics of outpatient clinical summaries in the United States. *International Journal of Medical Informatics*. 2016;94:75-80.
10. Goodman ER, Federman AD, Martynenko M, **O'Connor R**, Wolf MS, Wisnivesky JP. One Size Does Not Fit All: Adherence to Medications for Multiple Conditions Among Older Asthmatics with Multimorbidity. *Journal of American Geriatrics Society*. 2016;64(5):1133-1135.
11. Woods EC, **O'Connor R**, Martynenko M, Wolf MS, Wisnivesky JP, Federman AD. Associations of Asthma Control and Airway Obstruction with Performance of Activities of Daily Living Among Older Asthmatics. *Journal of American Geriatrics Society*. 2016;64(5):1046-1053.
12. Goel MS, **O'Connor R**. Increasing Screening Mammography at a Federally Qualified Health Center Using a Pre-visit Video. *Patient Education and Counseling*. 2016;99(3):408-413.
13. Federman AD, Wolf MS, Sheng, T, **O'Connor R**, Martynenko M, Wisnivesky JP. Diminished Cognitive Function among Chronic Obstructive Pulmonary Disease Patients during periods of Acute Illness Exacerbation. *Journal of Gerontology: Series A: Medical Sciences*. 2016;71(2):279-280.
14. **O'Connor R**, Wolf MS, Smith SG, Martynenko M, Vicencio D, Sano M, Wisnivesky JP, Federman AD. Associations between Health Literacy, Cognitive Function and Medication Use among Older Adults with Asthma. *CHEST Journal*. 2015;147(5):1307-1315.
15. Bailey SC, **O'Connor R**, Bojarski EA, Mullen R, Patzer RE, Vicencio D, Jacobson KL, Parker RM, Wolf MS. Literacy Disparities in Patient Access and Health-Related Use of Internet and Mobile Technologies. *Health Expectations*. 2015;18(6):3079-3087.
16. Smith SG, **O'Connor R**, Curtis LM, Waite KM, Paasche-Orlow MK, Wolf MS. Limited health literacy predicts decline in physical function. *Journal of Epidemiology & Community Health*. 2015;69(5):474-480.

17. Smith SG, **O'Connor R**, Aitken W, Curtis LM, Goel MS, Wolf MS. Disparities in activation and use of an online patient portal among older adults. *Journal of the American Medical Informatics Association*. 2015;22(4):888-895.
18. Federman AD, Martynenko M, **O'Connor R**, Kannry J, Karp A, Lurio J, Hoy-Rosas J, Wolf MS, Wisnivesky JP. Rationale and design of a comparative effectiveness trial of home- and clinic-based self-management support coaching for older adults with asthma. *Contemporary Clinical Trials*. 2015;44:103-111.
19. Smith SG, Curtis LM, **O'Connor R**, Federman AD, Wolf MS. ABCs or 123s? The Independent contributions of Literacy and Numeracy skills on Health Task Performance. *Patient Education and Counseling*. 2015;98(8):991-997.
20. Bailey SC, Fang G, Annis I, **O'Connor R**, Paasche-Orlow MK, Wolf MS. Health Literacy and 30-day Hospital Readmission after Acute Myocardial Infarction. *British Medical Journal Open*. 2015;5(6) e006975.
21. Kobayashi LC, Smith SG, **O'Connor R**, Curtis LM, Park D, Baker DW, Deary IJ, Wolf MS. The Role of Cognitive Function in the Relationship between age and health literacy: a cross-sectional analysis of older adults in Chicago, USA. *British Medical Journal Open*. 2015;5(4):e007222.
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24. Brooks, TL, Leventhal H, Wolf MS, **O'Connor R**, Morillo J, Martynenko M, Wisnivesky JP, Federman AD. Strategies among Elderly Asthmatics for Adherence to Inhaled Corticosteroids. *Journal of General Internal Medicine*. 2014;29(11):1506-1512.
25. Serper M, Patzer R, Curtis LM, Smith SG, **O'Connor R**, Baker DW, Wolf MS. Health Literacy, Cognitive Ability, and Functional Health Status among Older Adults. *Health Services Research*. 2014;49(4):1249-1267.
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Annual Meetings

1. **O'Connor R**, Mindlis I, Hauser D, Hoy-Rosas J, Lopez R, Lurio J, Chen L, Wolf MS, Wisnivesky JP, Federman AD. Supporting Asthma self-Management Behaviors in Aging Adults (SAMBA): A Randomized Clinical Trial. *Oral presentation at Society for General Internal Medicine, Denver, CO; April 14, 2018.*
2. **O'Connor R**, Yoshino Benavente J, Arvanitis M, Curtis LM, Federman AD, Wolf MS. Unmet Needs for Social Support and its Impact on Health Status and Urgent Healthcare Use among Older Adults. *Oral presentation at Society for General Internal Medicine, Denver, CO; April 12, 2018.*
3. **O'Connor R**, Yoshino Benavente J, Small E, Davies M, Curtis LM, Wolf MS. Unmet needs for social support and its impact on health status and urgent healthcare use among community-dwelling older adults. *Roundtable presentation at American Public Health Association Annual Meeting, Denver, CO; October 31, 2016.*
4. **O'Connor R**, Curtis LM, Yoshino Benavente J, Wolf MS. Health Literacy Measures – what are they really capturing? *Oral presentation at International Conference on Communication in Healthcare, Heidelberg, Germany; September 2016.*
5. **O'Connor R**, Yoshino Benavente J, Curtis LM, Wolf MS. Longitudinal Changes in Older Patients' Perceived Comfort when Engaging Healthcare Providers. *Oral presentation at International Conference on Communication in Healthcare, Heidelberg, Germany; September 2016.*
6. **O'Connor R**, Yoshino Benavente J, Curtis LM, Small E, Davies M, Wolf MS. Just out of sight: Mild visual impairment and its impact on self-care. *Oral presentation at American Public Health Association Annual Meeting, Chicago, IL; October 2015.*
7. **O'Connor R**, Martynenko M, Wisnivesky JP, Wolf MS, Federman AD. Older Patients' and Providers' Perspectives on Asthma management: A Qualitative Investigation. *Poster presentation at International Conference on Communication in Healthcare, New Orleans, LA; October 2015.*
8. **O'Connor R**, Smith SG, Curtis LM, Waite KR, Deary I, Paasche-Orlow MK, Wolf MS. Low health literacy predicts decline in physical function among older adults: findings from the LitCog study. *Oral presentation at Health Literacy Annual Research Conference, Bethesda, MD; November 3, 2014.*
9. **O'Connor R**, Wolf MS, Martynenko M, Sofianou A, Wisnivesky JP, Federman AD. Health Literacy, Cognition and Asthma Self-Management Beliefs. *Oral presentation at Health Literacy Annual Research Conference, Washington D.C.; October 29, 2013.*

10. **O'Connor R**, Curtis LM, Mullen R, Wolf MS. Health Communication and Health Literacy: Overview of Research Projects. *Oral presentation at Alliance of Chicago: Annual User Conference, Chicago, IL; May 23, 2013.*
11. **O'Connor R**, Hebert-Beirne J. Maternal Knowledge of and Communication about Pelvic Health With Their Adolescent Daughters: An Exploratory Study. *Round table presentation at American Public Health Association Annual Meeting, San Francisco, CA; October 30, 2012.*
12. **O'Connor R**, Goel M, Garcia G. Multimedia tool to increase new mammogram referrals among disadvantaged women. *Oral presentation at International Conference on Communication in Healthcare. Chicago, IL; October 17, 2011.*
13. **O'Connor R**, Shah N, Davis T, Federman AD, Persell S, Wolf MS. Prescription Drug Samples without Physician Counseling: An Opportunity for Misuse. *Poster presentation at International Conference on Communication in Healthcare. Chicago, IL; October 18, 2011.*