Health Literacy Helps to Explain Heterogeneous Treatment Effect in Depression Treatment for Older Adults

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Accessibility
Health Literacy Helps to Explain Heterogeneous Treatment Effect in Depression Treatment for Older Adults

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A Thesis in the Field of Clinical Psychology for the Degree of Master of Liberal Arts in Extension Studies

Harvard University
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Abstract

This study aimed to identify factors related to mental health improvement as a function of health literacy. More specifically, it examined whether older adults with higher levels of health literacy exhibited greater reduction in depression symptoms after participating in the Positive Minds-Strong Bodies Program (PMSB). Presently, there is limited clinical data on how low health literacy contributes to health disparities in older adults’ mental health. This study hypothesized that the health literacy level of older adults would moderate the benefits obtained from participating in the PMSB program. It was expected that participants with higher health literacy levels at baseline would exhibit greater depression reduction after PMSB program completion than those with lower health literacy scores at baseline. Finally, this study also explored trends regarding what specific health literacy scores were associated with the greatest depression changes.

Participants’ data were obtained from a larger multi-center randomized trial that demonstrated PMSB effectiveness across participants who spoke English, Spanish, or Chinese languages. The intervention group \((n = 153)\) and the control group \((n = 154)\) were recruited from community clinics and health centers serving predominantly underserved communities in Boston, New York City, Miami, and Puerto Rico. The sample population was ages 60+ years. Data regarding self-report measures of health literacy, education level, and depression symptoms were obtained through clinical interviews by trained interviewers. Analyses focused on additional understanding of the PMSB program effectiveness at the six-month follow-up, as a function of health literacy. Chi-
square tests and t-tests were conducted among all study variables comparing differences between the intervention and control group.

In contrast to our hypothesis, there was no significant statistical relationship between health literacy level and depression change, after participating in the PMSB program. Exploratory analyses, however, found a linear trend relationship which neared significance ($t[269.388] = -1.539, P = .125$). Although on average health literacy did not influence the effect of the PMSB program on depression, the intervention appeared more effective in reducing depression symptoms for participants with health literacy scores of 12 and above.

These findings suggest that high health literacy may be a potential factor in psychosocial distress and mood symptoms reduction of those participating in the Positive Minds-Strong Bodies intervention.
Author’s Biographical Sketch

Jesús Hernández Ortiz is an Assistant Clinical Trial Project Manager at the Massachusetts General Hospital Psychiatry Department, a Harvard Medical School Teaching Hospital. There he works under the supervision of Maurizio Fava, Psychiatrist In-Chief and Director of the Division of Clinical Research. Jesús earned his Associates of Liberal Arts in General Studies from Suffolk College and his Bachelor of Arts in General Psychology from Binghamton University. He is a candidate for the Master of Liberal Arts in Extension Studies, concentrating in Clinical Psychology at Harvard University (2021).

Jesús was born and raised in Santo Domingo, Dominican Republic. As a junior in high school he relocated with his family to Long Island, NY. He did not speak English at the time, but his passion for learning and embracing challenges motivated him to stay in America and pursue an American education. The rest is history and Jesús is currently pursuing opportunities to complete a PhD program in psychology.
Dedication

To my family and close friends, for their unconditional support and encouragement during the long process of completing a master’s thesis on a part-time basis at an Ivy League institution, while being employed full-time, and all in the middle of a pandemic. Your kind yet forward feedback on my drafts made a significant impact in the progress I made.

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Massachusetts General Hospital’s Disparities Research Unit recently conducted an randomized clinical trial of Positive Minds–Strong Bodies (PMSB), finding that a culturally adapted intervention, combining Cognitive-Behavioral Therapy (CBT) with physical exercise, was successful in decreasing depression symptoms among older adults of racial/ethnic minorities (Alegria et al., 2019).

The present thesis is a further exploratory analysis of the data from Alegria et al. (2019) to gain further insight into how clinical benefits from this intervention were distributed across participants. By measuring depression severity outcome after treatment completion, it examines if participants’ health literacy moderated treatment response.

Health literacy (HL) is the ability to understand health terminology and concepts and to make informed health decisions (U.S. Department of Health and Human Services [HHS], 2010). Low HL has been associated with poorer health outcomes in older adults (Sudore et al., 2006). Furthermore, many of the participants in Alegria et al. (2019) are especially at risk for low HL due to racial/ethnic and immigrant status that is correlated with having lower HL levels (Coffman & Norton, 2010; Kutner et al., 2006; Sentell et al., 2011). An investigation of the moderation of HL on the depression outcomes for the intervention on this patient population is valuable to determine for whom the intervention works and for whom it might not.

The present study’s hypothesis is that HL moderates the depression outcomes of the intervention, even after controlling for the education level of participants.
Specifically, following completion of the PMSB program, at a six-month follow-up from the baseline interview, participants with higher HL will experience greater depression symptom reduction as compared to those with lower HL. This finding would be consistent with other studies of the association of HL on individual’s health outcomes (Lincoln et al., 2006; Rhee et al., 2017; Wolf et al., 2005).

No other studies to date have methodically assessed the influence of HL on treatment outcomes of culturally adapted evidence-based CBT/exercise interventions for older depressed individuals that are ethnic/racial minorities. The empirical literature mostly focuses either on exploring the direct effects of health literacy on health outcomes without exploring its impact on psychosocial interventions (Nutbeam et al., 2018), or the literature focuses on the effects of combined CBT/exercise interventions on clinical populations without exploring HL (Bernard et al., 2018; Thomas et al., 2020). A need exists to specifically understand how HL affects outcomes of participants from clinical psychosocial programs. If the present hypothesis is confirmed, it will show that adequate HL can enhance the ability of older adult with depression to benefit more from psychosocial interventions than those with lower HL. This research also has the potential to help tailor similar psychosocial interventions to reduce variability in treatment responses for depression. In addition to furthering the existing literature on impacts of HL in historically underserved communities, it could lead to interventions that “close a gap” for older minorities with low HL, allowing for improved mental health and reduced risk of disability.
Background

In the years ahead, the U.S. will see population growth among individuals 65-and-older from 49 million in 2016 to 95 million in 2060 and in the proportion of older adults who are of racial/ethnic minorities (Blazer et al., 2012; Vespa et al., 2018). The proportion of non-Hispanic white individuals in the US is expected to decrease from 199 million in 2020 to 179 million in 2060, showing the increasing racial diversity occurring in America (Vespa et al., 2018). It is especially important to find effective treatments for this population because older racial minority adults have both a higher incidence of depression and less access to mental health treatment than do non-Latino White older adults (Ali et al., 2018). Mental-health treatments that are tailored for age, racial/ethnic background, and other characteristics need to effectively serve this growing demographic (Blazer et al., 2012).

The Positive Minds - Strong Bodies (PMSB) program is just such a culturally sensitive intervention. It was found to be effective among depressed older adults of racial/ethnic minorities (Alegria et al., 2019). To extend the benefits of this finding, however, it is necessary to understand more about the distribution of treatment responses across participants. Participants’ Health Literacy (HL) level is an important factor to consider because existing research amply demonstrates its association with both, health status and treatment outcomes (Berkman et al., 2004; Berkman et al., 2011; DeWalt et al., 2004; Sheridan et al., 2011). HL effect on depression outcomes were not explored in the PMSB manuscript published in the original study (Alegria et al., 2019).

Berkman et al., (2011) conducted a systematic review to determine whether health literacy contributed to poorer health outcomes and health disparities. Berkman et al.,
(2001) selected 98 empirical articles after evaluating their quality directly measuring the relationship between health literacy and healthcare outcomes. The articles were analyzed for selection bias, measurement bias, and confounding variables. The review found that individuals with low HL tend to have poorer health outcomes, lower use of healthcare services, and lower comprehension of medical jargon than those with higher HL. Older minority adults with low HL experienced worse physical and mental health outcomes among Medicare users, increased rate of unemployment due to health status, and other health disparities. Berkman et al.’s (2011) review calls for increased focus on studying the benefits of adequate HL and potential detrimental effects of low HL on health outcomes. This thesis addresses this question by examining whether older depressed minorities with lower levels of HL less benefit from the PMSB program than those with higher HL levels.

Health Literacy (HL)

Health literacy (HL) is defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (HHS, 2000). HL is generally categorically measured as either high/adequate or low/inadequate (Chew et al., 2004). Several scales exist to measure health literacy, and so a consensus has not been established as to which scale is the standard (Mantwill et al., 2015). Generally, empirical findings demonstrate that variables such as health literacy, overall literacy, and education level can share variability in explaining health disparities and clinical outcomes (Mantwill et al., 2015). Von Wagner et al., (2007) noted that similarly, lower education has been linked to lower health literacy, OR = 5.94 95% CI: [1.87, 18.89]. This suggests that individuals who have
social disadvantage can in turn also have worse health status, due to lower health literacy skills (Mantwill et al., 2015). Though the direct causal relationship and the pathways between health literacy and health disparity outcomes is unclear, their correlation is well supported (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, 1999; Berkman et al., 2011; Mantwill et al., 2015; Sudore et al., 2006).

Policy leaders, healthcare clinicians, and scholars have called for more research exploring health literacy as a variable related to the improvement of individuals’ health (Koh et al., 2012; National Institutes of Health, 2009). For example, the American Medical Association formed an Ad Hoc Committee consisting of 12 healthcare experts and asked them to determine what is associated with adequate health literacy for purposes of navigating the jargon of healthcare and the health needs of communities, families, and individuals. After reviewing 216 empirical articles the Ad Hoc Committee determined that adequate health literacy is associated with positive outcomes, such as patients’ ability to read, comprehend, and take necessary steps toward informed and healthy decisions for themselves and their families. Low HL, on the other hand, has been linked to a variety of negative effects on health and healthcare, reducing a patient’s ability to seek out, understand, and engage with appropriate clinical care (Bennet et al., 2007; Coffman & Norton, 2010). Similarly, individuals with low HL may lack the tools to be treatment compliant, to monitor their own health and behavior, and to comprehend treatment-related information (Berkman et al., 2011). Much of the literature therefore focuses on HL differences helping explain steps taken to engage in treatment.

The evidence for the association between low HL and poor health is extensive. To begin with, low HL negatively impacts communication with health care providers (Buck,
1998; Ngoh, 2009). It leads patients to struggle with interpreting written information, instructions, and prescriptions (Baker, 2006; Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, 1999). It causes difficulty with adhering to treatment advice, completing instructed physical exercises, and understanding therapeutic counseling, which delays the time to recovery (Becker & Maiman, 1975; Flores, 2013; Ngoh, 2009, Pignone & Dewalt, 2006; Poss, 2001). For example, individuals with low HL have a lower chance of engaging in cancer screening services (Oldach & Kratz, 2014), and those who are diabetic can have worse blood glucose control (Schillinger et al., 2002). At-risk groups for low HL are racial/ethnic minorities, people with limited education, low overall literacy, older adults, and those who have a disability, low-income, are uninsured, or on public insurance (Cho et al., 2008; Howard et al., 2005; Kutner et al., 2006; Sudore et al., 2006). Given the serious impacts of HL on wellness, it is critical to investigate if older minority adults are experiencing moderating and mediating effects in their treatment responses due to low HL, thus inhibiting the reduction of depressive symptoms.

Heterogeneous Treatment Effects (HTE)

This thesis’s research and theoretical foundation relies on the concept of Heterogeneous Treatment Effects (HTE), which is defined as the existence of nonrandom differences among participants’ responses to an intervention (Kent et al., 2018). It is necessary to look beyond an average of participants’ responses to treatment, to understand who, specifically, was least or most likely to benefit from it (Athey & Imbens, 2017).
Several factors have already been documented to cause HTE in psychosocial interventions targeting older adults’ depression. These include chronic medical conditions, low education level, and age over 79 years (Chang-Quan et al., 2010; Engels & Vermey, 1997; Kales & Valenstein, 2002; Marquett et al., 2013; McGovern et al., 2014; Sudore et al., 2006; Yohannes & Baldwin, 2008). Alegria et al., (2019) PMSB’s manuscript primarily focused on the impact of the PMSB intervention on disability prevention. However, statistical analyses conducted by the Disparities Research Unit (DRU) show that there was unusual variability in depression outcomes. Therefore, by exploring the data collected in the PMSB program the findings of the larger investigative study can explore, as this thesis does, if HL influenced this variability.

HL and Older Adults

The population age group for this research are older adults. Age differences may influence the effects of Health Literacy (HL) in clinical outcomes. Generally, it has been argued that older adults are at risk for low HL (Kutner et al., 2006; Scott et al., 2002) and are more negatively affected by low HL than are other adult groups (Buck, 1998). Low HL in older adults has been associated with reports of worsened mental health, worsened physical health, increased pain, and reduced ability to complete daily tasks (Bennett et al., 2009; Cho et al., 2008; Lee et al., 2009; Wolf et al., 2010; Wolf et al., 2005). It has also been associated with increased risk for hospitalization and use of emergency care services (Baker et al., 2004; Berkman et al., 2004; Berkman et al., 2011; Cho et al., 2008; Howard et al., 2005); increased trouble opening and taking medications as instructed (Raehl et al., 2006); and higher mortality rates than those with higher HL, even after controlling for cognitive functioning, baseline measures of pathology, physical
functioning, and lifestyle (Baker et al., 2007; Baker et al., 2008; Sudore et al., 2006). For these reasons the older adult population was selected as the age group to be studied.

HL and Racial/Ethnic Minorities

Several studies have also demonstrated the prevalence of low health literacy (HL) among racial/ethnic minority communities, especially when English is not the first language (Brice et al., 2008; Kickbusch, 2001; Kutner et al., 2006; Sentell & Braun, 2012). African Americans and Native Americans were found, on average, to have lower HL scores than non-Latino Whites, while Latino adults were found to have the lowest average HL scores of all (Kutner et al., 2006). Another study found that 74% of Spanish speakers in the United States have low HL, while only 7% of English speakers do (Brice et al., 2008).

HL has been found to be a relevant mediating and moderating variable in health outcome disparities of older adults who are racial/ethnic minorities (Osborn et al., 2011; Sisco et al., 2015; Volandes et al., 2008). Among older adults, it was found that low HL negatively mediated the ability of African Americans to engage in proactive healthy behaviors in comparison to non-Latino Whites (Eneanya et al., 2016). Once HL was introduced in the models, the racial disparity in patient activation was significantly reduced, suggesting HL is an influential factor in increasing patient engagement of healthy behaviors (Eneanya et al., 2016). Among adults with low HL, Korean- and Chinese Americans were found to self-report poor health status more often than non-Latino Whites (Lee et al., 2015). Another study found that Filipino-Americans with low HL were twice as likely to have worse health status than non-Latino whites with low HL (Sentell et al., 2011). It is also important to note that when low English fluency is
combined with low HL, individuals are twice as likely to report having poor health status (Sentell & Braun, 2012). For these reasons, the sample population for this thesis is predominantly older adults of historically under-served racial and ethnic populations.

HL, Depression, and Racial/Ethnic Minorities

Each of the health determinants discussed above are considered in the Positive Minds - Strong Bodies (PMSB) trial, including age, race/ethnicity, Health Literacy (HL), and depression (Alegria et al., 2019, Ali et al., 2018). Given the literature of HL, it is important to look at research dealing with the interaction of HL and each of the other three constructs to further explore heterogenous treatment responses in the PMSB program.

A systematic review on depression in older adults (Fiske et al., 2009) indicated that depression alone is directly related to a wide range of negative outcomes. For example, physical and mental health outcomes such as elevated rates of suicide, elevated loss of interest, more somatic symptoms, more display of cognitive changes, greater insomnia severity, worse functional health, are all negative outcomes of depression (Fiske et al., 2009). Findings suggest that low HL is also associated with worse mental health (Bennett et al, 2007; Howard et al., 2006; Lincoln et al., 2006; Stewart et al., 2014; Wolf et al., 2005). Older adults with low HL are significantly more likely to have depression-related symptoms, such as worse depression levels, mental health, and physical health (Wolf et al., 2005). Additionally, older adults are more likely to have difficulties in their functional health, such as fewer accomplishments in activities of daily living (Wolf et al., 2005). For example, older adults with low HL can struggle more at recognizing depression-related symptoms than younger adults (Farrer et al., 2008). In one
of the few studies assessing longitudinal data in the relationship between health literacy and depression, it was found that over time, both depressed patients with high and low health literacy showed improved depression, but those with low health literacy had more depressive symptoms that persisted than those with high health literacy (Lincoln et al., 2006).

Low health literacy is also associated with medically-related negative outcomes like worse health status, poorer ability to understand healthcare information such as medication labels and clinician instructions, and lower likelihood to proactively take steps to engage in treatments (Ad Hoc Committee on Health Literacy, 1999; Berkman, 2011). Thus, having low health literacy with co-occurring depression could make it more difficult to reap the benefits of mental health treatment. Further research is needed addressing the interaction of effects on how adequate HL can enhance psychosocial improvements after treatment completion.

In the Latino community, prevalence rates of depression are comparable to those of other racial/ethnic backgrounds (Alegria et al., 2008; Gonzalez et al., 2010; Mendelson et al., 2008). However, depressed Latinos generally have lower access to mental health services as compared to non-Latino Whites, with only 18.9% using mental health services to treat their depression (Alegria et al., 2008). Coffman & Norton (2010) found that recent Latino immigrants with higher immigration-related stress and low HL had higher depressive symptom scores as compared to those with higher HL.

There is also empirical literature on East Asian-American communities, correlating depression to HL. Low HL among Chinese Americans—especially those who are older, with low-income, or who have lower education levels—has been associated
with poorer health quality, such as depression, and severe underutilization of mental health services (Tieu et al., 2010; Wang et al., 2013; Yu et al., 2015). Lee et al., (2015) noted that low HL was found to be associated with depression symptoms among Korean and South Asian immigrants. Jang et al. (2014) found that among Korean Americans, low levels of acculturation combined with higher levels of depressive symptoms were associated with low HL. Bernstein et al., (2010) reported that the prevalence of depression in Korean-American communities has been increasing during last 10 years, and that those with low HL were more likely to have limited English proficiency, lower income, less education, and worse perceived health than those with high HL.

As for African Americans, Breslau et al. (2005) found that they report more consistent depressive symptoms than do non-Latino Whites. However, the literature that connects African Americans’ mental health with HL is more limited. A study by Gerber et al. (2010) found that older adult African Americans had lower HL, less social support, and unexpectedly lower depression scores than did non-Latino Whites, but race still predicted better health outcomes.

In summary, these studies illuminate the relationship between HL, depression, age, and disparities in health outcomes for racial/ethnic minorities. While most of them emphasize health status (e.g., having depression), one must also consider response to treatment. By examining heterogenous treatment effects and considering varying levels of HL on older adults’ response to a psychosocial intervention, especially those of racial/ethnic and immigrant backgrounds as in this study, can help achieve a better understanding of how to decrease health disparities.
Positive Minds – Strong Bodies Intervention

The outcomes of the intervention examined in this study come from the Positive Minds – Strong Bodies trial at Massachusetts General Hospital (MGH)’s Disparities Research Unit (DRU). The program was created in response to the Institute of Medicine report arguing for the creation of innovative, specialized combined interventions to benefit older adults at risk for serious health problems (Blazer et al., 2012). The multilingual PMSB trial specifically aimed to benefit older adults of racial/ethnic minorities with its multicomponent intervention, addressing a dearth of research literature on such treatments in this population (Ali et al., 2018).

PMSB is a controlled-randomized, community health worker (CHW)-based clinical intervention that focuses on supporting physical performance, preventing disability, and improving mental status including depression. It is comprised of a culturally adapted brief CBT treatment and InVEST physical exercise program (Ali et al., 2018; Alegria et al., 2019).

CBT is considered the standard depression psychological intervention with or without antidepressant usage (Butler et al., 2006; Cuijpers et al., 2014; Driessen & Hollon, 2010). In fact, several studies have confirmed CBT’s efficaciousness in samples of older adults (Chan et al., 2019; Kiosses et al., 2011; Scogin et al., 2006; Shah et al., 2012). Evidence-based physical exercise has also been found to be beneficial in reducing depressive symptoms among older adults (Bean et al., 2009; Houtjes et al., 2010). Because depression in older adults is related to an increased risk for disability (Thorpe et al., 2016), and disability in older adults is itself associated with depression (Fassberg et al., 2016), combined interventions like PMSB that include a physical as well as a
cognitive component are necessary. Interventions combining physical exercise with CBT, especially those culturally adapted, have shown promising results in reducing depression and decreasing disability risk at the same time (Alegria et al., 2019; Ali et al., 2018; Bernard et al., 2018; Ramos & Alegria, 2014).

A key component of the PMSB’s design is working with community-based organizations whose staff can speak participants’ native languages and provide culturally appropriate health education. Empirical literature suggests that when CHWs share a cultural background with older clients, it facilitates the maintenance of cultural sensitivity and patient rapport (Blazer et al., 2012). In the first published manuscript of the PMSB trial, it was indeed found that this intervention reduced participants’ mood symptoms, as well as providing other benefits such as deceleration of disability (Alegria et al., 2019). Overall, the intervention improved the functioning \( t[1775.7] = 2.1, p = 0.03 \) and saw a reduction in participants’ psychosocial distress \( t[817.3] = 3.1, p < 0.01 \) (Alegria et al., 2019). Despite the intervention been proven effective, prior studies report that health literacy can be a factor of who benefits from treatments. Therefore, a need existed to understand the influence that different levels of health literacy had in depression reduction related to the intervention. Thus, the question raised in the current investigation: was the depression variability in the PMSB study systematic, and if so, was it systematically related to variations in health literacy?

**Conclusion**

Due to the increased risk of health problems in depressed older adults who are racial/ethnic minorities, and because HL is associated with health and health outcomes, there exists a need to understand whether HL contributes to depressed patients’ outcomes.
in a culturally adapted effective psychosocial programs like the PMSB. This thesis will rely on an innovative, culturally adaptive intervention that employs Community Health Workers who speak the native language of patients and are trained to be culturally competent to administer the intervention to study participants (Alegria et al., 2019).

Using the PMSB data this study will test the hypothesis that following completion of the PMSB program, on average, participants with higher HL scores will show greater depression reduction than participants with lower HL, adjusting for their education level.

The Alegria et al., (2019) study is the only trial to date that has specifically evaluated the possibilities of using a controlled-randomized culturally adaptive intervention that combines a brief CBT intervention with a physical exercise training program to treat physical and mental health in older adults of racial/ethnic minorities (Alegria et al., 2019). The present study is needed to specifically analyze how HL influences treatment response, for depressed older adults who are racial/ethnic minorities, in clinical psychosocial trials of this type.
Chapter II
Research Method

The data for this thesis were drawn from a larger study on the effectiveness of an intervention that combined cognitive-behavioral therapy and physical exercise to prevent disability. This intervention was offered to predominantly older adults who are racial/ethnic minorities at risk for disability and related psychological symptoms, such as depression. This thesis will test the hypothesis that HL at baseline predicts which participants would demonstrate the most improvement in their mood symptoms (e.g., depression scores), after accounting for education level. For a full description of the study protocol see (Alegria et al., 2019).

Participants

1,057 subjects were screened for eligibility in the larger study. They were predominantly low-income older adults who are racial/ethnic minorities residing in Massachusetts, New York, Florida, or Puerto Rico. A visualization of the screening population’s racial and ethnic composition is presented in Figure 1 and 2 (Ali et al., 2018).

Inclusion criteria in the larger study included being at least 60 years old, living independently, and being fluent in English, Mandarin, Cantonese or Spanish. Additional inclusion criteria consisted of scoring above the clinical cutoffs on one or more of the outcomes measures in the larger investigation: a score of 5 or more on either the Patient Health Questionnaire (PHQ-9), the Generalized Anxiety Disorder 7-item Scale, or the
Figure 1

*Screened population racial demographics*

Note: 64.6% of the screening population were of racial minority background (46.2% Asian or Pacific Island; 14.3% African American; 2.5% American Indian; and 11.6% Multiracial/other. From *Lessons learned from the Positive Minds-Strong Bodies trial on disability prevention for racial/ethnic minority elders* (pp. 203–223), by Ali et al., 2018, In Contextualizing Health and Aging in the Americas: Effects of Space, Time and Place Springer, Cham.
Figure 2

Screened population Latino versus Non-Latino percentages.

Note: Almost one-third of the screening population identified as Latino. From Lessons learned from the Positive Minds-Strong Bodies trial on disability prevention for racial/ethnic minority elders (pp. 203–223), by Ali et al., 2018, In Contextualizing Health and Aging in the Americas: Effects of Space, Time and Place Springer, Cham.
Geriatric Depression Scale; and a score between 3 and 11 on the Short Physical Performance Battery.

The exclusion criteria included: reporting suffering of current substance abuse disorder or elevates substance misuse symptoms, using mental health treatment within the last three months prior to baseline, having a mental health appointment scheduled within next four weeks, being acutely suicidal as measured by the Suicide Paykel Questionnaire (SPQ), being unable to provide consent to participate in study, being confined to their homes, or being without clearance from a primary care provider to participate in the study.

From the 1,057 screened participants, 307 participants were eligible and agreed to participate in the study to acquire coping skills to combat symptoms related to depression, disability, and anxiety. These participants were assessed at baseline, 2, 6, and 12 months.

Materials and Measures

This thesis relied on electronic access to retrieve the larger investigative dataset, and access to a secured server for retrieval of relevant study materials, such as intervention protocols explaining procedures, a copy of relevant measures administered, and spreadsheets including participants’ collected data and obtained scores. Stata statistical software was used for all analyses (Hamilton, 2013). For this thesis’s statistical analysis, all participants were evaluated on depression, HL levels, and education levels.
Depression Measurement

To facilitate and provide flexibility in the exploratory analysis of depression data, two depression measures were used to capture depression symptoms. The PHQ-9 and the HSCL-25 measures were used, both of which were collected at baseline, 2-, 6-, and 12-month follow-up. The Patient Health Questionnaire-9 (PHQ-9), is a 9-item, rated on a 0-3 scale, screening measure, which focuses on diagnosing current depression, identifying symptom severity, and monitoring treatment response across follow-up visits (Kroenke et al., 2001; Kroenke & Spitzer, 2002; Huang et al., 2006; O’Riley et al., 2014). Because the data collection during follow-up assessments from the larger Alegria et al., (2019) study took about two hours per interview, the PHQ-9 provided an ideal measure to minimize patient burden, as it takes about half as much time to complete than other depression measures (Kronke et al., 2001).

The psychometrics of the PHQ-9 indicate that the measure is valid, clinically satisfactory, and comparable with the most used depression measures (Kronke et al., 2001). For example, internal reliability (a Cronbach’s $\alpha = 0.89$), test-retest reliability ($r = 0.84$), and positive likelihood ratios (likelihood ratio = 38.0, for PHQ-9 scores 20 to 27) are excellent for the PHQ-9; that is, the higher the score, the more likely individuals have a diagnosis of major depression disorder (MDD) (Kronke et al., 2001). The area under the curve is 0.95 for the PHQ-9 detecting depression. The PHQ-9 has adequate ability to discern individuals who have MDD from those who do not, and thus the PHQ-9 is an excellent test to identify those with depression (Kronke et al., 2001). Furthermore, the construct validity was found appropriate as the PHQ-9 correlated more with mental health ($r = 0.73$) than with other, more distant areas such as general functioning, social
functioning, etc. (Kronke et al., 2001). In terms of reflecting depression symptom change over time, sensitivity was adequate and comparable with other depression tools (Kronke et al., 2001).

Phelan et al., (2010) looked at older adults specifically to see how the PHQ-9 performed and found an AUC of 0.89 in predicting Major Depression Disorder, which is comparable to other reliable depression measures. In addition, Huang et al. (2006) noted the PHQ-9 measures depression accurately across different racial/ethnic groups. They collected a sample of Chinese Americans, Latinos, African Americans, and non-Latino Whites, and found the internal consistency to have a Cronbach’s α= 0.79, 0.80, 0.80, 0.86, respectively. See Alegria et al., (2019) for further rationale of the PHQ-9 selection and see Figure 3 for a sample of the PHQ-9.

The Hopkins Symptom Checklist-25 (HSCL-25) is a self-report scale used to measure mood symptoms and psychosocial distress levels (Derogatis et al., 1974). This scale includes 25 questions, 10 of which measure anxiety symptoms, and 15 of which measure depression symptoms. The score ranges for the HSCL-25 are 0-4, with higher scores indicating more severe symptoms (Derogatis et al., 1974; Frojdh et al., 2004). Because this thesis will use the depression items only the total scores are calculated averaging the 15 items from the depression subscale (range: 0 – 4).

The Cronbach’s α for the HSCL-25 shows good internal consistency overall (α = 0.92) and for the samples with diverse languages English α = 0.90; Spanish α = 0.91; Mandarin α = 0.92; Cantonese α = 0.95. This scale has also been validated in samples of
**Patient Health Questionnaire (PHQ-9)**

*Over the last 2 weeks,* how often have you been bothered by any of the following problems?

<table>
<thead>
<tr>
<th>PHQ</th>
<th>Question</th>
<th>Not at all</th>
<th>Several days</th>
<th>More than half the days</th>
<th>Nearly every day</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQ1</td>
<td>Little interest or pleasure in doing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ2</td>
<td>Feeling down, depressed, or hopeless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ3</td>
<td>Trouble falling or staying asleep, or sleeping too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ4</td>
<td>Feeling tired or having little energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ5</td>
<td>Poor appetite or overeating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ6</td>
<td>Feeling bad about yourself—or that you are a failure or have let yourself or your family down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ7</td>
<td>Trouble concentrating on things, such as reading the newspaper or watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ8</td>
<td>Moving or speaking so slowly that other people could have noticed, or the opposite—being so fidgety or restless that you have been moving around a lot more than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>PHQ9</td>
<td>Thoughts that you would be better off dead, or of hurting yourself in some way</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>999</td>
<td>777</td>
</tr>
</tbody>
</table>

[Interviewer: If the participant had any of the above symptoms, ASK:]

**PHQ10.** How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

|          | Not
difficult
at all | Somewhat
difficult | Very
difficult | Extremely
difficult |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQ10</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Note: A Research Assistant (RA) reads aloud the depression-related questions and a 4-point Likert scale for each. The subject self-reports which answer most accurately describes how they have been feeling in the last two weeks. Because each question can be scored from 0 to 3, total scores range from 0 to 27 (highest scores = most severe)
depressed older adults; with 94% sensitivity for identifying any depression and 94% for the specificity for patients identified with a positive diagnosis for MDD disorders. (Frojdh et al., 2004). See Alegria et al., (2019) for further rationale of the HSCL-25 selection and see Figure 4 for a sample of the HSCL-25.

Health Literacy Measurement

The larger study used an adapted health literacy scale (Alegria et al., 2019), given the limited research determining optimal HL measures (Chew et al., 2004; Griffin et al., 2010). Literature focusing on determining low HL, specifically, is even more scarce (Chew et al., 2004). Because the larger study baseline assessment was expected to take about two hours, a shorter, adapted HL measure was used (Alegria et al., 2019).

HL was evaluated using the Health Literacy Scale, adapted from (Chew et al., 2004). This scale has demonstrated an area under the curve for detecting low HL, as compared to the Short Test of Functional Health Literacy in Adults (STOFHLA), to be (AUROC > 0.70), which is comparable to other HL measures (Chew et al., 2004). The AUROC plots the sensitivity versus (1-specificity), allowing the simultaneous evaluation of true positive and negative diagnosis rates of the scale, and the overall performance of each of the scale questions (Chew et al., 2004). For a sample of this scale and further details see Figure 5.
Figure 4

*Hopkins Symptom Checklist (HSCL-25)*

<table>
<thead>
<tr>
<th>HSCL</th>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>999</th>
<th>777</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Suddenly scared for no reason</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>2</td>
<td>Feeling fearful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>3</td>
<td>Faintness, dizziness, or weakness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>4</td>
<td>Nervousness or shakiness inside</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>5</td>
<td>Heart pounding or racing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>6</td>
<td>Body trembling</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>7</td>
<td>Feeling tense or keyed up</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>8</td>
<td>Headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>9</td>
<td>Spells of terror or panic</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>10</td>
<td>Feeling restless, can't sit still</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>11</td>
<td>Feeling low in energy, slowed down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>12</td>
<td>Blaming yourself for things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>13</td>
<td>Crying easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>14</td>
<td>Loss of sexual interest or pleasure</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>15</td>
<td>Poor appetite</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>16</td>
<td>Difficulty falling asleep and difficulty sleeping</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>17</td>
<td>Feeling hopeless about the future</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>18</td>
<td>Feeling blue</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>19</td>
<td>Feeling lonely</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
</tr>
<tr>
<td>HSCL 20. Thoughts of ending your life</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>HSCL 21. Feeling of being trapped or caught</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
<td></td>
</tr>
<tr>
<td>HSCL 22. Worrying too much about things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
<td></td>
</tr>
<tr>
<td>HSCL 23. Feeling no interest in things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
<td></td>
</tr>
<tr>
<td>HSCL 24. Feeling everything is an effort</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
<td></td>
</tr>
<tr>
<td>HSCL 25. Feelings of worthlessness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>999</td>
<td>777</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5

*Adapted Health Literacy Scale*

**HEALTH LITERACY (HL)**

**INTERVIEWER:** “Please refer to SCALE E. These questions focus on how well you understand what your doctor tells you as well as the materials he/she provides you with during your visit.”

**HL1.** How often are appointment slips written in a way that is easy to read and understand?
- Always
- Often
- Sometimes
- Occasionally
- Never
- DK
- Refused

**HL2.** How often are medical forms written in a way that is easy to read and understand?
- Always
- Often
- Sometimes
- Occasionally
- Never
- DK
- Refused

**HL3.** How often are medication labels written in a way that is easy to read and understand?
- Always
- Often
- Sometimes
- Occasionally
- Never
- DK
- Refused

**HL4.** How often do you understand written information your health care provider gives you?
- Always
- Often
- Sometimes
- Occasionally
- Never
- DK
- Refused

**HL5.** How often are you unsure about how to take your medication(s) correctly because of problems understanding written instructions on the bottle label?
- Always
- Often
- Sometimes
- Occasionally
- Never
- DK
- Refused

Note: Participants are read 5 questions with a 5-point Likert scale for each, while having a paper copy of the scale as well. Participants self-report which answer best describes their experience understanding healthcare jargon and total scores range from 5 to 25.

Overall, the adapted HL measure is recommended because previous attempts to identify briefer low HL assessments have been unsuccessful in adults (Chew et al., 2004). On the PMSB trial, this scale adaption consisted of shortening the measure from 16 questions to 5 and translating it into Spanish and Chinese and then back into English. Any ambiguities revealed by the back translation were then resolved by a diverse expert panel (Alegria et al., 2019). The response options consisted of a 5-point Likert scale for each question and total HL score was calculated summing all items. Currently, DRU is producing a peer-reviewed paper on the psychometrics of the PMSB trial.

Education Measurement

Education level is often correlated with health literacy levels. For this reason, the education effect will be adjusted in some of the analyses. The education questions were asked during the screening process for all potential study participants. They were modeled after the U.S. Census educational attainment questions. For more information please see Alegria et al., (2019).

Design

This is a between-subject design drawing from the larger investigative randomized trial of 307 participants, equally randomized into intervention or enhanced usual care. One independent variable is the PMSB intervention. This will have two levels, the PMSB intervention (combined CBT/exercise group) and the enhanced usual care group. Another independent variable will be health literacy level at baseline. The third independent variable will be an interaction between the PMSB variable and HL. The dependent variable is depression symptoms at six-month follow up.
Procedure

Patient identification numbers were randomly assigned to participants to ensure confidentiality during data collection and data retrieval. The follow-up assessments were administered and scored by trained RAs. Data collection occurred using Partners Healthcare-approved tablets. After each interview was completed, data was digitally synchronized to the Partners Healthcare-approved database server, where it is saved securely and password-protected. Only approved project staff could access the data.

Because this thesis analyzed data already collected, this procedure section draws from the larger investigative study. Participants were recruited from community-based organizations and community clinics that partner with MGH, located in sectors that predominantly serve historically underserved, low-income people who are mostly racial/ethnic minorities in Massachusetts, New York, Florida, or Puerto Rico. All participants were told that they would be participating in a study to acquire tools to help manage feelings of lack of interest, tiredness, sadness, and worry, and to better manage physical and mental health problems. It was explained that there was no guarantee of any direct benefits from participating, that they would be randomly assigned to a condition group, that they could withdraw participation at any time, and that any information they provided would be kept confidential, unless it was deemed necessary to report to authorities in case of suicidality or participant’s report of harming others. A 10-item capacity-to-consent questionnaire (Zayas et al., 2005) was administered to each potential participant.

As described in Alegria et al. (2019), over one thousand participants \( (N = 1,057) \) were screened for mood symptoms and mobility limitations, rewarded with a $10 gift
card for their time. 36% of them (N = 381) were found eligible to complete baseline assessments. 80.6% of those potential participants (N = 307) accepted to complete the baseline, at which the adapted HL measure, the PHQ-9, and the HSCL-25 were administered, after which participants received a $25 gift card for their time. Then patients were randomized, using random sampling, into either the PMSB intervention group (N = 153) or the enhanced care control condition (N = 154).

The “positive minds” component, adapted from a previous successful psychosocial intervention (Alegria et al., 2014), consisted of 10 one-hour sessions of individual CBT psychosocial intervention over a 6-month period, administered by trained CHWs and emphasizing psychoeducation, mindfulness, cognitive restructuring, awareness of toxic behaviors, overcoming maladaptive thoughts, and the development of self-care strategies. The “Strong Bodies” component, adapted from the InVEST program (Bean et al., 2009), consisted of 36 group exercise sessions over 3 months, led by trainers, with an emphasis on strength, agility, and greater physical functioning. Each session included 10 functional exercises, completed in 3 sets of 10 repetitions each. For the CBT treatment, all CHWs had their first two sessions, and 15% of randomly selected other sessions, reviewed by clinical psychologists. For the exercise treatment, 8.85% of sessions were checked for protocol adherence. All sessions of both types were audio recorded.

The control group consisted of three components of enhanced usual care. First, a call by an RA every other week to administer the PHQ-9 and the Paykel suicide questionnaire. Second, an RA would provide empathetic support whenever appropriate. Third, a National Institute of Health booklet, including content on mental health
treatment and self-care, was mailed to control participants. For more details see (Alegria et al., 2019).

Follow-up interviews occurred at 2, 6, and 12 months from baseline to assess symptom changes or lack thereof. At each of these visits, the PHQ-9 and the HSCL-25 were administered again. RAs conducting the follow-up assessments were blind to the patient’s study condition. $25 gift cards were given at both the 2- and 6-month follow-ups, and a $50 gift card was awarded at the final one. All interviews were audio recorded for quality control.

Data Analysis

Because the larger study already had approval by the Institutional Review Board (IRB) at MGH, a Harvard Medical School affiliate, this thesis meets IRB criteria. The larger investigative dataset was retrieved to conduct statistical analyses using Stata (Hamilton, 2013), to identify relationships between HL, depression, and the PMSB intervention. Using G-power (Faul et al., 2007), it was determined that to obtain at least an effect size of .20 and a power of .95, the minimum sample size needed would be (N = 88). Given the large sample size of the original study (N = 307), this was obtainable. The research question of whether at a 6-month follow-up from baseline, HL will be strongly associated with depression reduction after older adults from under-served communities participated in the PMSB trial, was answered using a multilevel linear regression model. Since depression levels were measured at three post-baseline follow-ups at 2, 6 and 12 months, a multilevel model was used to account for the repeated measures structure of the data. This type of model fits better because it accounts for the fact that repeated
measures within the same subject are not independent, and it is common in intent-to-treat analyses.

Independent variables consisted of the intervention, health literacy and their two-way interaction. Depression served as the dependent variable. Education served as an additional independent variable for adjustment purposes. The two-way interaction between intervention and health literacy examined the question of whether the intervention was more effective in reducing depression levels among participants with higher levels of health literacy than lower levels. Thus, the main coefficient of interest was the one associated with this two-way interaction. Baseline descriptive statistics were obtained. The multilevel regression test assumptions requirements (Field, 2013) were explored to assess data fitness for the model design. Figures and tables were used to illustrate statistical analysis relationships and outlier statistical points. The Cohen’s distance test was used to identify whether any outlier points were influential points skewing the data (Aguinis et al., 2013). Overall model statistical significance, model F statistic tests, specific variable statistical significances, and linear trends were explored.

Given that the adapted health literacy scale has not been validated as a categorical variable, it was analyzed quantitatively with total scores ranging from 5 to 25. For more information of the validated original health literacy scale see (Chew et al., 2004). Because exploring anxiety symptoms as measured by the HSCL-25 anxiety subset of questions is beyond the scope of this thesis, only the depression subset of questions was analyzed. For more information on the depression subset of questions see (Frojdh et al., 2004). Depression analysis for both the PHQ-9 and the HSCL-25 were explored as the depression scores changed from baseline to the six month-follow up. The education data
was split into two groups, a less than high school attainment group and a high school or more attainment group.
Chapter III

Results

The final sample included 307 participants who were randomly assigned to either the intervention group (N = 153) or the control group (N = 154). T tests and chi-square tests were used to assess effective randomization. Both the intervention and the control group were evenly distributed. At baseline, the two conditions showed comparable PHQ-9 depression ratios (t[304] = -0.18, p = 0.85), HSCL-25 depression subset ratios (t[305] = 0.29, p = 0.77), health literacy ratios (t[301] = 0.27, p = 0.79), and education level ratios (χ²[1] = 2.25, p = 0.13). Additionally, the Cronbach alpha levels for the PHQ-9, HSCL-25 depression, and HL were all acceptable, 0.73, 0.88, 0.68, respectively. The sociodemographic and clinical characteristics of the sample are presented in Table 1.

Health Literacy, Adjusting for Education

Table 2 presents the results at a 6-month follow-up, showing that health literacy at baseline did not statistically moderate the effectiveness of the intervention on depression change, after controlling for the education level effect, (t[266.370]=-.546, P=.585, ns) for the PHQ-9 or for the HSCL-25 (t[269.388]=--1.539, P=.125, ns), respectively. Thus, the results obtained did not support the hypothesis that health literacy would statistically affect the relationship between the intervention and mean depression reduction change in the population.
Table 1
Baseline characteristics of the intent-to-treat population

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total (N=307)</th>
<th>Intervention (N=153)</th>
<th>Control (N=154)</th>
<th>Statistic (df), p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-64</td>
<td>21 (6.8%)</td>
<td>9 (5.9%)</td>
<td>12 (7.8%)</td>
<td>(\chi^2 (2) = 0.96, p = 0.62)</td>
</tr>
<tr>
<td>65-74</td>
<td>133 (43.3%)</td>
<td>70 (45.8%)</td>
<td>63 (40.9%)</td>
<td></td>
</tr>
<tr>
<td>75+</td>
<td>153 (49.8%)</td>
<td>74 (48.4%)</td>
<td>79 (51.3%)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>59 (19.2%)</td>
<td>30 (19.6%)</td>
<td>29 (18.8%)</td>
<td>(\chi^2 (1) = 0.03, p = 0.86)</td>
</tr>
<tr>
<td>Female</td>
<td>248 (80.8%)</td>
<td>123 (80.4%)</td>
<td>125 (81.2%)</td>
<td></td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High School</td>
<td>111 (36.2%)</td>
<td>49 (32.0%)</td>
<td>62 (40.3%)</td>
<td>(\chi^2 (1) = 2.25, p = 0.13)</td>
</tr>
<tr>
<td>High school or more</td>
<td>196 (63.8%)</td>
<td>104 (68.0%)</td>
<td>92 (59.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Self-rated mental health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>11 (3.6%)</td>
<td>5 (3.3%)</td>
<td>6 (3.9%)</td>
<td>(\chi^2 (4) = 0.12, p = 1)</td>
</tr>
<tr>
<td>Very good</td>
<td>35 (11.4%)</td>
<td>18 (11.8%)</td>
<td>17 (11.0%)</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>115 (37.5%)</td>
<td>57 (37.3%)</td>
<td>58 (37.7%)</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>126 (41.0%)</td>
<td>63 (41.2%)</td>
<td>63 (40.9%)</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>20 (6.5%)</td>
<td>10 (6.5%)</td>
<td>10 (6.5%)</td>
<td></td>
</tr>
<tr>
<td><strong>Health Literacy at Baseline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.22</td>
<td>13.27</td>
<td>13.17</td>
<td></td>
</tr>
<tr>
<td><strong>Baseline outcome measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression (PHQ-9)</td>
<td>7.98</td>
<td>7.93</td>
<td>8.03</td>
<td>(t (304) = -0.18, p = 0.85)</td>
</tr>
<tr>
<td>Hopkins Symptom Checklist (HSCL-25 depression subset)</td>
<td>1.68</td>
<td>1.67</td>
<td>1.69</td>
<td>(t (305) = -0.29, p = 0.77)</td>
</tr>
</tbody>
</table>

Note: \(N = 307\), the analyses were done at a significance level of alpha = 0.05, 2-sided
Table 2
Effectiveness of the PMSB Intervention at 6-month follow-up as a function of health literacy scores at baseline$^a$

<table>
<thead>
<tr>
<th></th>
<th>PHQ-9</th>
<th>HSCL-25 (15 depression items only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b (SE) t (df) p-value</td>
<td>b (SE) t (df) p-value</td>
</tr>
<tr>
<td>Intervention (control reference)</td>
<td>-.024 (2.003) -.012 (277.107) .991</td>
<td>.121 (.198) .611 (279.664) .542</td>
</tr>
<tr>
<td>Health literacy at baseline</td>
<td>.229 (.106) 2.162 (265.299) .032</td>
<td>.022 (.010) 2.131 (269.001) .034</td>
</tr>
<tr>
<td>Health literacy at baseline x</td>
<td>-.080 (.147) -.546 (266.370) .585</td>
<td>-.022 (.015) -1.539 (269.388) .125</td>
</tr>
<tr>
<td>Intervention</td>
<td>Education at baseline (&lt; high school reference)</td>
<td></td>
</tr>
<tr>
<td>High school and above</td>
<td>.358 (.508) .705 (266.486) .482</td>
<td>.068 (.050) 1.345 (268.359) .180</td>
</tr>
</tbody>
</table>

$^a$ Analyses on mental health (PHQ-9, HSCL-25 Depression Subset) outcomes use longitudinal data of 307 participants, with three follow-up assessments per participant. Each outcome variable was measured three times at 2-month, 6-month, and 12-month follow-up. The unit observation is a specific follow-up assessment.

Note: The analyses were done at a significance level of alpha = 0.05, 2-sided.
Because the two-way interaction between intervention and health literacy was not significant for either outcome, exploratory analyses were conducted to examine whether the average marginal effect of the intervention on depression symptom level varied as a function of each possible health literacy score (from 5 to 25). Figure 6 presents the results from this analysis for the PHQ-9 measure. Consistent with the results from Table 2, the effect of the intervention did not vary as a function of each health literacy score. The 95% confidence intervals either crosses or touches zero for all levels of health literacy scores.

Figure 7 presents the same analysis (i.e., the effect of the intervention as a function of each health literacy score) for the HSCL-25 depression subset, which showed a trend of approaching significance according to the results from Table 2 (P = .125). In this case, higher health literacy scores at baseline were associated with greater levels of depression reduction at the six-month follow-up. In particular, the intervention was more effective in reducing depression symptoms for participants with health literacy scores of 12 and above. The 95% confidence intervals do not cross or touch zero for health literacy scores 12 or above. This finding supports the hypothesis that high health literacy levels might be an influential factor in depression reduction as a function of the intervention.

Health Literacy, Without Adjustments for Education

Table 3 presents the results at a 6-month follow-up, showing that health literacy at baseline did not statistically moderate the effectiveness of the intervention on depression change, when not controlling for education level effect, (t[267.470]= -.512, P = .609, ns) for the PHQ-9 and (t[-270.588]= -.1.465, P =144, ns) for the HSCL-25 depression subset, respectively.
Figure 6

*PHQ-9 linear trend for depression change measured as a function of health literacy, accounting for education level*

Note: This depression scale is the PHQ-9. The y-axis is depression symptom change. The x-axis is the range of health literacy scores at baseline.
Figure 7

*HSCL-25 depression subset linear trend for depression change measured as a function of health literacy, accounting for education level*

Note: This depression scale is the HSCL-25 Depression subset. The y-axis is depression symptom change. The x-axis is the range of health literacy scores at baseline.
Table 3
Effectiveness of the PMSB Intervention at 6-month follow-up as a function of health literacy scores at baseline, not accounting for education level

<table>
<thead>
<tr>
<th></th>
<th>PHQ</th>
<th>HSCL-25 (15 depression items only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b (SE) t (df) p-value</td>
<td>b (SE) t (df) p-value</td>
</tr>
<tr>
<td>Intervention (control reference)</td>
<td>-.069 (.1999) -.034 (278.245) .973</td>
<td>.112 (.198) .564 (280.816) .573</td>
</tr>
<tr>
<td>Health literacy at baseline</td>
<td>.226 (.106) 2.133 (266.467) .034</td>
<td>.021 (.010) 2.055 (270.365) .041</td>
</tr>
<tr>
<td>Health literacy at baseline x Intervention</td>
<td>-.075 (.146) -.512 (267.470) .609</td>
<td>-.021 (.015) -1.465 (270.588) .144</td>
</tr>
</tbody>
</table>

*a Analyses on mental health (PHQ-9, HSCL-25 Depression Subset) outcomes use longitudinal data of 307 participants, with three follow-up assessments per participant. Each outcome variable was measured three times at 2-month, 6-month, and 12-month follow-up. The unit observation is a specific follow-up assessment.

Note: The analyses were done at a significance level of alpha = 0.05, 2-sided.
As before, exploratory analyses were conducted to examine whether the average marginal effect of the intervention on depression symptoms varied as a function of each health literacy score. Figures 8 and 9 present the results from this analysis for this model that does not account for the education effect. The results remained unchanged for the PHQ-9 in that since the 95% confidence interval crosses zero for all scores, there is no significant effect. For the HSCL-25 depression subset the intervention was more effective in reducing depression symptoms for participants with health literacy scores of 12 and above, shown as the 95% confidence intervals not crossing or touching zero from 12 on.

Education, Not Accounting for Health Literacy

Table 4 presents the results at a 6-month follow-up, showing that education at baseline did not statistically moderate the effectiveness of the intervention on depression change (t[269.689] = 1.131, P = .259, ns) for the PHQ-9 and for the HSCL-25 depression subset (t[271.721] = 1.019, P = .309, ns). A linear trend analysis was not conducted for this model because this graph would not provide any more information than the results from Table 4 given the fact that education only has two categories (<HS and HS and above).
Figure 8

*PHQ-9 linear trend for depression change as a function of health literacy, not accounting for education level*

*Note:* This depression scale is the PHQ-9. The y-axis is depression symptom change. The X-axis is the range of health literacy scores at baseline.
Figure 9

HSCL-25 Depression subset linear trend for depression change as a function of health literacy, not accounting for education level

Note: This depression scale is the HSCL-25 Depression Subset. The y-axis is depression symptom change. The x-axis is the range of health literacy scores at baseline
Table 4
Effectiveness of the PMSB Intervention at 6-month follow-up as a function of education level at baseline, not accounting for health literacy

<table>
<thead>
<tr>
<th></th>
<th>PHQ</th>
<th></th>
<th></th>
<th>HSCL-25 (15 depression items only)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b (SE)</td>
<td>t (df)</td>
<td>p-value</td>
<td>b (SE)</td>
<td>t (df)</td>
<td>p-value</td>
</tr>
<tr>
<td>Intervention (control reference)</td>
<td>-1.892 (.864)</td>
<td>-2.190 (331.565)</td>
<td>.029</td>
<td>-2.236 (.085)</td>
<td>-2.757 (333.892)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Education at baseline (&lt; high school reference)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school and above</td>
<td>-.220 (.702)</td>
<td>-.314 (269.341)</td>
<td>.754</td>
<td>.017 (.069)</td>
<td>.239 (271.717)</td>
<td>.811</td>
</tr>
<tr>
<td>Education at baseline x Intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>1.151 (1.018)</td>
<td>1.131 (269.689)</td>
<td>.259</td>
<td>.103 (.101)</td>
<td>1.019 (271.721)</td>
<td>.309</td>
</tr>
</tbody>
</table>

*a* Analyses on mental health (PHQ-9, HSCL-25 Depression Subset) outcomes use longitudinal data of 307 participants, with three follow-up assessments per participant. Each outcome variable was measured three times at 2-month, 6-month, and 12-month follow-up. The unit observation is a specific follow-up assessment.

Note: The analyses were done at a significance level of alpha = 0.05, 2-sided.
Chapter IV
Discussion

The purpose of this study was to gain further insight into how clinical benefits from the Positive Minds – Strong Bodies program were distributed across underserved older adults. By measuring depression severity outcomes after patient completion of a psychosocial treatment, how participants’ health literacy impacted treatment response could be evaluated.

Health literacy (HL) is the ability to understand health terminology and concepts and to make informed health decisions (U.S. Department of Health and Human Services [HHS], 2010). High HL scores have been found to be a protective factor in older adults’ depression and associated with greater depression reduction symptoms after treatment (Lincoln et al., 2006; Rhee et al., 2017). Low HL scores have been found to be a risk factor in older adult’s depression by being associated with more severe depression symptoms, and worse functional and physical health (Rhee et al., 2017; Wolf et al., 2005). Given the documented effects of different levels of health literacy on health outcomes, we investigated the relationship between health literacy and depression, after completing evidence-based psychosocial interventions to determine whether these effects persisted even after completing a treatment that was already documented to be effective for most participants.

Towards this end, the MGH Disparities Research Unit assisted in obtaining clinical data to explore the research question in a representative sample. Because current
research exploring health literacy’s effect on the depression of under-served older adults is limited, this study is one of the early attempts to incorporate health literacy into clinical science health disparities depression trials in the growingly diverse geriatric population of the US. The larger PMSB investigative trial showed that a culturally sensitive, evidence-based, combined CBT-physical exercise intervention was effective in reducing depression in vulnerable older adult communities (Alegria et al., 2019). Based on this finding, as well as previous research on the effects of different levels of health literacy on health status and depression (Coffman & Norton, 2010; Kutner et al., 2006; Lincoln et al., 2006; Sentell et al., 2011; Sudore et al., 2006) it was broadly hypothesized that HL affected depression outcome in the PMSB trial, even after controlling for education level. Specifically, it was hypothesized that following completion of the PMSB program, at a six-month follow-up from baseline, participants with higher HL would experience greater improvements in their depression. With higher HL, it was predicted that they would be able to understand and apply skills taught in the program more adequately thereby benefitting more from treatment. This finding would be consistent with other studies on the relationship between HL and health outcomes.

However, the results obtained in this study failed to confirm the broader hypothesis that, on average, health literacy moderated depression outcomes, after controlling for education. Even when not accounting for education in the model, HL was also not significant in predicting the PMSB depression outcomes. This lack of significance was somewhat surprising. A potential explanation may be that the PMSB program adapted the program to a sixth-grade reading level (Falgas et al., 2021). Keeping all materials at a modest level of difficulty may have made the program more accessible
to older adults with lower health literacy. The importance of lowering the reading levels and language requirements for treating those with lower health literacy is critical to ensure that all participants benefit equally from the intervention.

Nonetheless, using the HSCL-25 depression subset to measure depression severity outcome at the six months follow up trended towards significance, with those with lower HL showing more depression symptoms than those with higher HL even if the results were not strong enough to be significant. One potential explanation for the discrepancy in significance approximation between the PHQ-9 and the HSCL-25 depression subset may be that the PHQ-9 is built on the Primary Care Evaluation of Mental Disorders (PRIME-MD) whereas the HSCL-25 is built on the Diagnostic Statistical Manual of Mental Disorders (DSM). The PRIME-MD is a 2-stage system in which a patient would complete as a self-report questionnaire to screen for the 5 most common mental disorders observed in medical care whereas the DSM is the diagnostic algorithm used globally as the authoritative protocol to diagnose mental disorders such as depression (American Psychiatric Association, 2013; Spitzer et al., 1999). Many depression trials are using a modified version of the HSCL-25 depression subset scale, called the HSCL-20, which incorporates additional depression items to have a clearer picture of measuring MDD diagnostic symptoms and to improve the instruments sensitivity to clinical change (Alegria et al., 2014; Fraser et al., 2004; Hedrick et al., 2003; Lee et al, 2007; Schmaling, 2019). Given that both the PHQ-9 and the HSCL are widely used in research trials to measure depression symptom progression and that they both have strong psychometric properties as a measure to identify depression, it is surprising that the discrepancy was observed. Because of the increased sensitivity recognizing depression shown by the
HSCL-20, a follow up study may need to use it to study whether results would significantly change with more questions that assess changes in depression because of the PMSB intervention.

As part of this study specific hypothesis, it was expected that higher score levels of health literacy would be associated with greater depression reduction than lower score levels of health literacy. A linear trend analysis showed that after controlling for the education level effect, an association existed between health literacy and the effects of the intervention on depression symptom change for HSCL-25. In other words, there was a negative relationship between HL and changes in depression symptoms, as a function of the intervention. On average, the greater the HL score of more than 12 score on the HL measure, the greater the likelihood of depression reduction from baseline at the six months follow up in the HSCL-25. Specifically, as measured by the HSCL-25 depression items, the intervention had an even more pronounced effect in reducing depression symptoms for participants with health literacy scores of 12 and above than those with lower scores. As HL scores rose above 12 patient depression was subsequently reduced. For example, the highest possible HL score of 25, reflecting high HL, was associated with the greatest depression reduction (see Figure 7). HL scores of 25 had, on average, four standard deviations more depression reduction that the lowest HL scores of 5, which, on average, did not see depression reduction. This finding is consistent with the model using the HSCL measure that trended towards significance. This finding is also like a previous study who noted that higher levels of HL were associated with greater depression reduction at follow up interviews after a detox program completion (Lincoln et al., 2006).
While the average marginal intervention effect seen in the depression reduction across higher HL scores in the HSCL model, there was unexpected variability in participants with HL scores lower than 12 (see Figure 7). This finding likely contributed to HL not being statistically significant in our statistical models. One possible explanation is that when community health workers met with participants with very low HL, some of these community health workers might have been able to do more explanation than others given their ability to modify and explain the program and this extra support may have resulted in improved comprehension and therefore greater treatment effects, from participants with low HL.

Another explanation of the unusual variability among participants with scores in the lower range may be that the adaptation of the PMSB program to a sixth grade reading literacy level and other adaptations made by the community health worker implementing the program may have benefited more patients with HL scores less than 12 who had at least a sixth grade reading level. In other words, among those with HL under 12, some could, and some could not read at the 6th grade level and those who had more trouble reading may have benefitted less.

While the education effect was controlled for in the research design, the education level variable was formatted as less than high school attainment versus greater than high school attainment, thus, not accounting for the potential effect that lower sixth grade level literacy reading skills modification would have on study results. Another possibility is that education, rather than HL, was the determining factor. While education level was considered, data were limited to “less than” or “more than” high school completion. It may be that among those who did not finish high school some had substantially less
education completed than others. Leaving HS prior to graduation because of one or two missing classes may be very different than leaving school after 6th or 7th grade. We also did not have data on whether specific participants completed any of their education in the US vs. all of it outside the US, often in a second language.

Future studies will need to explore further how to more specifically study the different ways that education can interact with health literacy and the benefits of a psychosocial intervention.

General Discussion

Given the lack of available research on how HL influences the ability of older adult patients to benefit from culturally appropriate evidence-based psychosocial programs targeting depression, this study provides initial data on the potential beneficial effects of higher levels of HL in predicting the effectiveness of depression reduction interventions. More broadly, this study suggests that low health literacy levels could hinder psychosocial program effectiveness in reducing depression symptoms.

Further research is needed to better understand why there is a relationship between lower HL scores and less effective depression reduction. It is important to understand the mechanism leading to increased variability in treatment effectiveness among older adults with lower HL scores, as this can help develop a more targeted plan for providing support and helping for older adults who may be at risk of not adequately using the skills taught in these psychosocial programs.
Limitations & Future Directions

The findings from this study should be interpreted in the context of several limitations. Inclusion criteria for the larger study included that all participants needed to be at least at risk for minor to moderate disability (Alegria et al., 2019), the interpretation of this thesis’ results cannot directly be generalized to older individuals who are not at risk for disability. Nonetheless, depression is the number one cause of disability in the world resulting in relevant findings (Friedrich, 2017). Similarly, the sample was predominantly older adults who were racial/ethnic minorities (Alegria et al., 2019). Caution should be taken when generalizing the findings to other racial/ethnic or age groups, be they other minorities or non-minority group members. Lastly, because this thesis only looked at 6-month follow-up interview scores, it is unclear how health literacy may affect treatment effectiveness at shorter or longer periods of time; it is possible that HL does not affect treatment effectiveness right after the intervention but affects maintenance and generalization moving forward. Participants were evaluated at 2 months post-intervention, but those data were not considered here. Additionally, it is unclear whether the findings would remain true for a longer period, for example at the 12-month final interview. However, the use of the multivariate regression model accounted for data not being independent, and the larger study found the intervention effect to last at least until the 12 months follow up (Alegria et al., 2019) suggesting that for most of the sample effects were maintained for at least one year. Future studies assessing health literacy effect on depression reduction after completing psychosocial interventions should consider exploring more closely the mentioned limitations.
There is a need for future studies to empirically validate the back translations of the adapted health literacy measure to confirm equivalent validity, specificity, sensitivity, and reliability in Spanish and Chinese languages. Additionally, there is a need to validate categorical interpretations of this adapted HL scale, such as adequate, marginal, and inadequate HL. This would facilitate better interpreting the results. While no validation currently exists of the HL scale translations and adaptation the DRU team hired experts to back translate these measures from Spanish and Chinese to the standard English version (Alegria et al., 2019), and an empirical paper on the psychometrics of the PMSB measures was produced noting future steps to assure greater level of measurement invariance across ethnically and linguistically diverse older adult populations (Cruz-Gonzalez et al., 2021).

Because approximately 75% of the sample size of the screened population in the larger study were females (Ali et al., 2018), the results might be more representative of older woman of racial/ethnic minorities than their male counterparts. However, there are more women than men in the older adult population (Vespa et al., 2018).

It should be noted that Hurricane Maria impacted Puerto Rico and Florida during the study period, and 23% of subjects who initially enrolled to participate in the intervention did not actually complete the intervention, due to damaged facilities and because of failed/delayed medical clearance related to the hurricane (Alegria et al., 2019). Latino potential participants were more likely to be affected, and Asian participants were least likely to be affected by the hurricane (Alegria et al., 2019). However, because subjects were randomly assigned to the study groups and an intent-to-treat analysis was
used (Alegria et al., 2019), it is unlikely that any effects found in the study will result from undetected confounding variables.

Future studies should explore if health literacy scores change across time when participating in the psychosocial PMSB intervention and how this affects depression reduction across time, accounting for the education level effect. Forthcoming studies should also explore the relationship between health literacy, psychosocial distress, and mood symptoms. Specifically, a post-hoc analysis exploring the comorbidity of depression and anxiety via the entire HSCL-25 measure showed a linear trend that further approximated statistical significance (P = .067). Higher health literacy scores at baseline appeared, on average, associated with greater levels of psychosocial distress reduction at the six-month follow-up. The intervention was more effective in reducing depression and anxiety symptoms for participants with health literacy scores of 12 and above. Please see Appendix A and B for further details regarding the post-hoc analysis.
Appendix A

PMSB Effectiveness on Psychosocial Distress as a Function of HL

Effectiveness of the Positive Mind – Strong Bodies (PMSB) Intervention at 6-month follow-up as a function of health literacy scores at baseline, as measured by the entire Hopkins Symptom Check List scale (HSCL-25).

<table>
<thead>
<tr>
<th></th>
<th>HSCL-25</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b (SE)</td>
</tr>
<tr>
<td>Intervention (control reference)</td>
<td>.162 (.184)</td>
</tr>
<tr>
<td>Health literacy at baseline</td>
<td>.022 (.010)</td>
</tr>
<tr>
<td>Health literacy at baseline x Intervention</td>
<td>-.025 (.014)</td>
</tr>
<tr>
<td>Education at baseline (&lt; high school reference)</td>
<td></td>
</tr>
<tr>
<td>High school and above</td>
<td>.051 (.047)</td>
</tr>
<tr>
<td>Time</td>
<td>-.013 (.006)</td>
</tr>
<tr>
<td>Intervention x Time</td>
<td>-.025 (.011)</td>
</tr>
<tr>
<td>(Time-t*)</td>
<td></td>
</tr>
<tr>
<td>Intervention x (Time-t*)</td>
<td>.017 (.008)</td>
</tr>
<tr>
<td></td>
<td>.030 (.016)</td>
</tr>
</tbody>
</table>

* Analyses on mental health (PHQ-9, HSCL-25) outcomes use longitudinal data of 307 participants, with three follow-up assessments per participant. Each outcome variable was measured three times at 2-month, 6-month, and 12-month follow-up. The unit observation is a specific follow-up assessment.

* Time is a continuous variable which equals to -4, 0, and 6 for the 2-month, 6-month, and 12-month follow-up, respectively.

* Time-t* is a continuous variable equal to 6 for the 12-month follow-up and 0 otherwise. t* denotes the time when treatment ends which equals to 6.
Appendix B

PMSB Effectiveness on Mood Symptoms as a Function of HL

Trend for HSCL-25 indicating that the intervention appeared more effective in reducing mood symptoms and psychosocial distress for participants with higher levels of health literacy scores.
Appendix C

Definition of Terms

**Health Literacy (HL)**: ease with which one can read and understand health-related information (Baker, 2006; Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, 1999).

**Heterogeneous Treatment Effect (HTE)**: effect of subject nonrandom differences in responding to treatment interventions (Kent et al., 2018).

**Cognitive-Behavioral Therapy (CBT)**: CBT aims to challenge and change maladaptive behaviors and cognitive distortions, improve emotional stability, and develop coping skills to effectively target stressful situations (Beck, 2011).

**Increased Velocity Exercise Specific to Task (InVEST)**: Exercise training program that emphasizes task-specific exercises and muscle-power strengthening (Bean et al., 2009).

**Depression in Older Adults**: Existence of clinical depressive symptoms after the age of 65 (Glover & Srinivasan, 2017).
References


https://doi.org/10.1097/MLR.0000000000000232

https://doi.org/10.1007/978-3-030-00584-9_10


Science and Medicine, 66(8), 1809–1816.
https://doi.org/10.1016/j.socscimed.2008.01.003


https://books.google.com/books?hl=en&lr=&id=c0Wk9IuBmAoC&oi=fnd&pg=PP2dq=Discovering+statistics+using+IBM+SPSS+statistics:+And+sex+and+drugs+and+research+in+social+and+behavioral+sciences


https://doi.org/10.1016/j.amjopharm.2010.03.002


https://www.mendeley.com/catalogue/978b92f9-9ba6-37fd-b753-c308d9409906/?utm_source=desktop&utm_medium=1.19.4&utm_campaign=open_catalog&userDocumentId=%7Bf133ae21-57e1-3d92-a2eb-98cfe3969a7b%7D

General Psychiatry, 67(1), 37–46.
https://doi.org/10.1001/archgenpsychiatry.2009.168
https://doi.org/10.1007/s11606-010-1304-2


https://doi.org/10.1089/jpm.2007.0224


https://doi.org/10.1136/jech.2006.053967


https://doi.org/10.1186/1477-7525-11-153


https://doi.org/10.1016/j.socscimed.2009.12.013


