



# Relationships Between English Language Proficiency, Health Literacy, and Health Outcomes in Somali Refugees

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## Abstract

Little is known about the impacts of health literacy and English proficiency on the health status of Somali refugees. Data came from interviews in 2009–2011 of 411 adult Somali refugees recently resettled in Massachusetts. English proficiency, health literacy, and physical and mental health were measured using the Basic English Skills Test Plus, the Short Test of Health Literacy in Adults, and the Physical and Mental Component Summaries of the Short Form-12. Associations were analyzed using multiple linear regression. In adjusted analyses, higher English proficiency was associated with worse mental health in males. English proficiency was not associated with physical health. Health literacy was associated with neither physical nor mental health. Language proficiency may adversely affect the mental health of male Somali refugees, contrary to findings in other immigrant groups. Research on underlying mechanisms and opportunities to understand this relationship are needed.

**Keywords** Refugees · Health literacy · English proficiency · Mental health · Physical health

## Background

Following the onset of civil war in Somalia in 1990, the US saw an increase in the number of refugees from Somalia, admitting over 60,000 refugees between 2000 and 2009 [1]. Somalis are the dominant ethnic group in Somalia,

composing 85% of the population [2]. The Somali Bantus are a historically marginalized and largely rural minority group [3]. The Somali Bantus share the same language and religion as ethnic Somalis, but are otherwise a distinct cultural group [4].

Before Somalia's independence in 1960, English and Italian were the primary languages in schools [5]. In 1972, Somali became the language of education in schools and youths had little exposure to English [5]. The outbreak of civil war in 1990 devastated most of Somalia's educational institutions resulting in limited access to education [5]. In 1990, the United Nations estimated a literacy rate of 24% in Somalia [5]. The exact rates of literacy, education, and English proficiency in the Somali Bantu population are unknown, but are likely lower, as this population had even less access to educational opportunities than the Somalis. It is estimated that only 5% of Bantu refugees have received formal education and only 5% of adult Bantu refugees are proficient in English [4].

There is a growing literature exploring the health status of Somali refugees. Several studies have found high prevalence of mental health disorders in Somali refugees, including depression, anxiety, and post-traumatic stress disorder (PTSD) [6–10]. Exposure to torture and traumatic events was widespread [11] and correlated with PTSD symptoms

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[12]. A study of over 4000 refugees, including nearly 500 Somalis in Massachusetts, demonstrated a high prevalence of obesity, hypertension, and diabetes [13]. Another study of 72 Somali psychiatric patients found that 32% had hypertension and 24% had diabetes [14]. While studies have examined factors associated with the presence of physical problems [12], few have examined associations between English proficiency, health literacy, and health in Somali refugees in the US.

Our first objective was to study the relationship between English proficiency and mental and physical health in Somali refugees living in Massachusetts. This relationship is important to understand since language proficiency is an actionable item that can be a focus of refugee resettlement programs [15]. Language proficiency can impact an individual's ability to integrate into society, to communicate with physicians, and can affect a refugee's ability to utilize effective healthcare [16] and mental health services [17]. We hypothesized that lower English proficiency would be associated with worse physical and mental health. We expected men to be more negatively impacted by lower English proficiency than women due to gender norms in Somalia, where men traditionally play more of a role in public life than women. We also expected to find a stronger association between lower English proficiency and worse mental health for the Somali Bantus than for the Somalis due to their higher risk for marginalization from lower education and lower levels of English proficiency.

Our second objective was to study the relationship between health literacy and mental and physical health in Somali refugees living in Massachusetts. Immigrants and refugees may be particularly at risk for low health literacy due to limited English proficiency and different cultural beliefs [18]. As such, they may be an important group in which to focus efforts and policies to improve health literacy. We hypothesized that lower health literacy would be associated with worse physical and mental health. Lower health literacy can impact utilization of health services, interactions with healthcare providers, and ability to provide self-care [19]. Higher health literacy has been associated with improved health outcomes in the general population [20] and better preventive dental care in Somali refugees [21].

## Methods

We performed a secondary analysis of a data set initially used to study the relationships between health literacy, acculturation, and oral health in Somali refugees [21, 22]. This data set is one of few available studying Somali refugees and including the variables of interest, including measures of health, English proficiency, and health literacy.

## Participants and Data Collection

Data came from structured interviews of 439 adult Somali refugees living in Massachusetts in 2009–2011 [21, 22]. Eligible refugees were at least 18 years of age, of Somali nationality, and had arrived in the US within the last 10 years. Exclusion criteria included visual, cognitive, or speech impairment; learning disabilities or traumatic brain injury; or contraindications to oral examination. We recruited individuals using word of mouth and snowball sampling, supplemented by purposive sampling to match the expected age and gender distribution of Somali refugees living in Massachusetts in 2009. A Somali research assistant obtained informed consent and conducted the research interviews in Somali. Interviews took place both during the workweek and outside of business hours to facilitate participation of working individuals. All written materials except the literacy measure were translated into Somali following “standard procedures for group, consensus translation” [22, 23]. Of the original interviews, 411 individuals had complete data on the primary outcomes and were the analytic sample.

## Measures

The primary outcomes were the Physical Component Summary (PCS) and Mental Component Summary (MCS) from the Medical Outcomes Study Short-Form 12-item survey (SF-12), a well-validated tool that globally assesses physical and mental health [24]. The 12-questions are transformed into two summary measures: the PCS and the MCS [24]. These summary measures are scored on a scale of 0–100 and are standardized to have a mean of 50 and a standard deviation of 10 [25]. Higher scores on the PCS and MCS are indicative of better physical and mental health, respectively. The SF-12 has been used in Somali populations [26–28]. Though it has not been validated for use specifically with Somali individuals, it has been validated in other ethnic groups [29–32] and has been recommended as an “optimal tool for the measurement of refugee self-rated health” due to its reliability and validity testing in refugee populations [33].

We assessed spoken English proficiency using the Basic English Skills Test Plus (BEST Plus) [34] and health literacy with the Short Test of Functional Health Literacy in Adults (STOFHLA) [35]. While no specific health literacy screening tools have been validated in Somali, the STOFHLA has been translated and validated in multiple other languages [36, 37]. No tool has been specifically validated to assess English proficiency in refugee communities; however, the BEST Plus test is appropriate to

use in adult populations of “non-native speakers of English who may or may not have received an education in their native language or in English, but who need to use English to function in day-to-day life in the United States” [38]. Additionally, the BEST Plus test is commonly employed in Massachusetts for learners in English for Speakers of Other Languages (ESOL) classes [39].

Our independent variables included age, gender, ethnicity (Somali, Somali Bantu), country before arrival in the US (Kenya, Somalia, other), age on arrival to the US, number of years in the US, highest level of education (high school or more, less than high school, none), income ( $\geq$  \$1000 per month,  $<$  \$1000 per month), employment status (employed, unemployed), proximity of residence to other Somalis (live within same building or street, other), insurance status (private, Medicaid or other government insurance, none), and having a usual place for healthcare. We included established screening tools for common mental health disorders: the Patient Health Questionnaire-2 (PHQ-2) for depression (negative: 0–2, positive: 3–6) and the Civilian Version of the Post-Traumatic Stress Disorder (PTSD) Checklist (PCL-C) (negative: 17–29, positive: 30–85).

## Analysis

We calculated prevalence and frequency of each categorical variable, and means and standard deviations of MCS and PCS for each level of these variables. We calculated means and standard deviations, or medians and interquartile ranges, for each continuous variable. We performed bivariable linear regression analyses using MCS and PCS as outcomes. The distribution of MCS and PCS had slight left skew; transformations of these variables did not convert them into normal distributions. We therefore treated PCS and MCS as continuous outcome variables in linear regression analyses. We also assessed for correlations between all variables.

We included PHQ-2 and PCL-C scores in the descriptive analyses to depict the mental health of the population, but excluded them from adjusted analyses since they were felt to be closely related to the outcomes and inclusion may obscure relationships with other variables. Studies in non-refugee populations have demonstrated strong correlation between the MCS and PHQ-2 scores and weak correlation between PCS and PHQ-2 [40, 41]. A study of veterans also showed that a composite variable including both PHQ-2 and PCL-C scores was the primary predictor of functional health, including measures of both physical and mental health [42]. Functional health in that study was measured by the subscales of the Veterans Rand 36-Item Health Survey (a survey developed from the SF-36) [42].

We excluded the variable for age on arrival in adjusted analyses due to high correlation with age (Pearson's  $r=0.96$ ,  $p<0.001$ ). We included highest level of education in

descriptive analyses, but excluded it from adjusted models due to the uncertain meaning of this item. This population had variable access to education in Somalia, refugee camps, and the US, with different and changing educational norms, standards, and quality. We included all other independent variables in the adjusted models. For the purpose of our analyses, we categorized BEST Plus scores as low proficiency (0–329), moderate proficiency (330–598), and high proficiency (599–999) and STOFHLA scores as low health literacy (0–22) and functional health literacy (23–36) [43]. We conducted stratified analyses by gender and ethnicity to test our hypotheses of effect modification. Due to a high correlation between BEST Plus and STOFHLA scores (Spearman's  $\rho=0.86$ ,  $p<0.001$ ), we examined these variables in both separate models and a mutually adjusted model to test the robustness of the results. Since health literacy is likely contingent upon English proficiency, we conducted a sensitivity analysis among the subset of individuals with at least moderate English proficiency. We used R version 3.3.1 for all analyses.

This study was approved and monitored by the Institutional Review Board of the Massachusetts Department of Public Health.

## Results

### Sample Description

We included 411 participants in the analyses. The sample was 58% female with a median age of 30.9 years. Most of the sample was ethnically Somali (87%). Seventy-five percent had less than a high school education and 38% had no formal education. Most participants (75%) had low health literacy with a median STOFHLA score of 0 (IQR 0–1). Most participants (74%) scored low on the BEST Plus test of English proficiency, with a median BEST Plus score of 88 (IQR 88–677.5) (Table 1). In a subset of participants with at least moderate English proficiency ( $n=166$ ), the median STOFHLA score was 25.0 (IQR 16.3–31.8).

### Mental Health

Mean MCS score (mental health) for the study population was 60.6 (SD 6.3) compared to a mean MCS of 52.3 for the US population without chronic conditions [25]. In unadjusted analysis, coming to the US directly from Somalia and having high English proficiency were associated with lower MCS scores—worse mental health (Table 2). In a fully adjusted analysis, coming to the US directly from Somalia remained significantly associated with lower MCS scores, but English proficiency was no longer significant ( $p=0.08$ ). Among males, age and English proficiency were

**Table 1** Demographic and mental component summary (MCS) and physical component summary (PCS) characteristics of a Somali refugee sample in Massachusetts

Characteristic	Total (n=411)	MCS score Mean (SD)	PCS score Mean (SD)
Overall	411 (100%)	60.6 (6.3)	52.0 (6.7)
Age, years, median (IQR)	30.9 (23.7–45.6)	NA	NA
Number of years in the US, mean (SD)	4.3 (2.9)	NA	NA
Age of arrival in the US, median (IQR)	26.7 (19.6–41.2)	NA	NA
Gender, no. (%)			
Male	173 (42.1%)	60.2 (6.8)	53.0 (5.8)
Female	238 (57.9%)	60.9 (5.9)	51.3 (7.2)
Ethnicity, no. (%)			
Somali	355 (86.6%)	60.6 (6.5)	51.8 (7.0)
Somali Bantu	55 (13.4%)	60.9 (5.9)	53.6 (4.2)
Country before arrival, no. (%)			
Kenya	321 (78.3%)	60.7 (6.2)	52.1 (6.7)
Somalia	9 (2.2%)	50.9 (11.0)	51.8 (10.1)
Other	80 (19.5%)	61.4 (4.8)	52.1 (6.3)
Education, no. (%)			
High school or more	100 (24.3%)	61.3 (5.4)	53.6 (4.9)
Less than high school	157 (38.2%)	60.3 (6.8)	52.9 (6.0)
None	154 (37.5%)	60.5 (6.2)	50.0 (8.0)
Income, no. (%)			
≥ \$1000/month	105 (28.5%)	61.1 (5.7)	52.9 (5.2)
< \$1000/month	265 (71.6%)	61.0 (5.8)	51.6 (7.2)
Living proximity to other Somali, no. (%)			
Same building or street	217 (52.9%)	60.6 (6.9)	51.6 (7.2)
Other	193 (47.1%)	60.7 (6.5)	52.5 (6.2)
Medical Insurance, no. (%)			
Private	29 (7.2%)	59.4 (9.5)	55.3 (3.9)
Medicaid or government	338 (84.1%)	60.5 (6.3)	51.6 (7.1)
None	35 (8.7%)	62.5 (1.2)	53.2 (3.4)
Usual place for healthcare, no. (%)			
Yes	349 (85.3%)	60.5 (6.4)	51.8 (7.0)
No	60 (14.7%)	61.7 (5.1)	53.3 (4.1)
Has current job, no. (%)			
Yes	134 (32.7%)	61.0 (5.9)	54.1 (3.6)
No	276 (67.3%)	60.5 (6.2)	51.0 (7.6)
Health Literacy (STOFHLA), no. (%)			
Functional (23–36)	104 (25.3%)	60.1 (7.1)	54.1 (4.9)
Low (0–22)	307 (74.7%)	60.8 (6.0)	51.3 (7.1)
English proficiency (BEST plus), no. (%)			
High proficiency (599–999)	103 (26.0%)	59.3 (8.5)	54.0 (6.2)
Moderate proficiency (330–598)	63 (15.9%)	61.9 (3.4)	53.4 (3.7)
Low proficiency (0–329)	230 (58.1%)	61.0 (5.3)	50.7 (7.3)
Depression screen (PHQ2 score), no. (%)			
Negative screen (0–2)	400 (99.3%)	60.8 (5.9)	52.1 (6.5)
Positive screen (3–6)	3 (0.7%)	42.6 (19.4)	44.4 (22.0)
PTSD screen (PCL-C score), no. (%)			
Negative screen (17–29)	366 (95.1%)	60.9 (5.9)	52.2 (6.1)
Positive screen (30–85)	19 (4.9%)	57.3 (10.3)	49.9 (12.9)

**Table 2** Bivariable and multivariable linear regression analyses examining the associations between health literacy, English proficiency, and PCS and MCS in a Somali refugee sample in Massachusetts (n = 411)

Characteristic	PCS				MCS			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p
Age	-0.18	<0.001	-0.15	<0.001	-0.020	0.34	-0.042	0.057
Gender, male (ref)								
Female	-1.70	0.011	-1.03	0.15	0.76	0.23	0.42	0.50
Number of years in the US	0.028	0.81	0.0023	0.99	-0.10	0.34	0.080	0.48
Ethnicity, Somali (ref)								
Bantu	1.80	0.065	3.13	0.0017	0.46	0.61	0.019	0.98
Country before arrival, Kenya (ref)								
Somalia	-0.25	0.91	-2.49	0.36	-9.75	<0.001	-5.40	0.026
Other	0.078	0.93	0.77	0.35	0.70	0.36	0.84	0.25
Income, $\geq$ \$1000/month (ref)								
< \$1000/month	-1.33	0.083	-0.55	0.47	-0.13	0.85	-0.36	0.61
Proximity to other Somali								
Live in same building/street (ref)								
Other	0.97	0.14	1.27	0.051	0.14	0.82	0.14	0.81
Medical insurance, private (ref)								
Medicaid or government	-3.66	0.0048	-0.36	0.80	1.06	0.39	0.75	0.54
None	-2.06	0.20	-0.44	0.80	3.06	0.055	1.97	0.22
Usual place for healthcare, yes (ref)								
No	1.45	0.12	1.17	0.28	0.14	0.19	-0.25	0.80
Has current job, yes (ref)								
No	-3.10	<0.001	-2.55	0.0011	-0.53	0.41	-0.75	0.28
Health literacy (STOFHLA)								
Functional (ref)								
Low	-2.73	<0.001	-0.50	0.63	0.70	0.33	0.12	0.89
English proficiency (BEST plus)								
High (ref)								
Moderate	-0.64	0.54	0.30	0.78	2.59	0.008	1.71	0.078
Low	-3.33	<0.001	-0.081	0.94	1.75	0.016	1.48	0.13

significantly associated with MCS (Table 3); specifically, low English proficiency and lower age were associated with higher MCS scores—better mental health. No variables were significant in the adjusted analysis among females (Table 3).

In unadjusted analysis for ethnic Somalis (n = 355), coming to the US directly from Somalia was associated with lower MCS scores ( $\beta = -8.22$ ,  $p < 0.001$ ); having moderate ( $\beta = 2.68$ ,  $p = 0.01$ ) and low English proficiency ( $\beta = 1.85$ ,  $p = 0.02$ ) were associated with higher MCS scores. In adjusted analysis, older age and coming to the US directly from Somalia were associated with lower MCS scores, but English proficiency was no longer significant. In unadjusted analysis for the Somali Bantus (n = 55), only coming to the US directly from Somalia was associated with lower MCS scores ( $\beta = -8.22$ ,  $p < 0.001$ ) and no variables were significant in an adjusted analysis.

Health literacy was not significantly associated with MCS in unadjusted or fully adjusted analyses of the

overall population or any subgroups. In an adjusted analysis restricted to individuals with at least moderate English proficiency, health literacy remained unassociated with MCS ( $\beta = 0.20$ ,  $p = 0.86$ ). When health literacy and English proficiency were evaluated in separate models, health literacy remained unassociated with MCS and the relationship between English proficiency and MCS was unaffected.

### Physical Health

Mean PCS score (physical health) for the study population was 52.0 (SD 6.6) compared to a mean PCS of 54.3 for the US population without chronic conditions [25]. In unadjusted analysis, older age, female gender, Medicaid or government insurance, unemployment, low health literacy, and low English proficiency were significantly associated with lower PCS scores, indicative of worse physical health (Table 2). In adjusted analysis of the overall population,

**Table 3** Multivariable Linear Regression Analyses Examining the Associations Between Health literacy, English proficiency, and Mental Health (MCS) By Gender

Characteristic	Males (n = 173)		Females (n = 238)	
	$\beta$ (SE)	p value	$\beta$ (SE)	p value
Age	-0.18 (0.04)	<0.001	0.043 (0.026)	0.10
Number of years in the US	0.27 (0.18)	0.13	-0.089 (0.14)	0.52
Ethnicity, Somali (ref)				
Bantu	0.93 (1.53)	0.55	0.56 (1.02)	0.58
Country before arrival, Kenya (ref)				
Somalia	-5.98 (3.33)	0.075	-5.82 (3.57)	0.11
Other	1.08 (1.25)	0.39	0.56 (0.86)	0.51
Income, $\geq$ \$1000/month (ref)				
< \$1000/month	-1.29 (1.09)	0.24	0.45 (0.88)	0.61
Proximity to other Somali				
Live in same building/street (ref)				
Other	-0.71 (0.97)	0.47	0.86 (0.68)	0.21
Medical insurance, private (ref)				
Medicaid or government	1.83 (1.63)	0.26	-1.95 (1.89)	0.30
None	1.90 (2.26)	0.40	-0.083 (2.36)	0.97
Usual place for healthcare, yes (ref)				
No	1.07 (1.37)	0.44	-1.83 (1.41)	0.20
Has current job, yes (ref)				
No	-1.32 (1.11)	0.24	-0.47 (0.85)	0.58
Health literacy (STOFHLA)				
Functional (ref)				
Low	0.36 (1.38)	0.79	-0.41 (1.25)	0.74
English proficiency (BEST plus)				
High (ref)				
Moderate	1.49 (1.42)	0.30	1.91 (1.33)	0.15
Low	3.23 (1.58)	0.043	0.74 (1.19)	0.53

older age, Somali ethnicity, and unemployment were significantly associated with lower PCS scores (Table 2). When stratifying by gender, living within the same building or street as other Somalis was also significantly associated with lower PCS scores in males but not females (Table 4).

Results for unadjusted and adjusted analyses restricted to ethnic Somalis were similar to the results for the overall population, depicted in Table 2. In the Somali Bantu, older age was associated with lower PCS scores in unadjusted analysis, but no variables were significant in an adjusted analysis.

Health literacy and English proficiency were associated with PCS scores in unadjusted analysis, but the associations were no longer significant in adjusted analysis (Table 2). When restricted to individuals with at least moderate English proficiency, health literacy remained unassociated with PCS ( $\beta = -0.63$ ,  $p = 0.51$ ). Further, there was no significant association between health literacy and PCS in either gender or ethnic group (Table 4). When health literacy and English proficiency were examined in separate models, neither had a significant association with PCS.

## Discussion

Higher English proficiency was associated with worse mental health in men only, and had no association with physical health. In all of our adjusted analyses, health literacy was not associated with mental or physical health. Factors that lend credibility to these findings are the large sample size, high quality interview techniques with culturally concordant data collection staff, and well-validated measures. Yet, our findings are contrary to our hypotheses and to results from other studies, which have suggested an association between low English proficiency and worse health. Such associations have been seen in African refugees in the Southwestern US [44], Vietnamese and Chinese refugees in California [45], various immigrant groups in Canada [46, 47], and Cambodian immigrants in Massachusetts [48]. Further, a review of acculturation in African Immigrants in the US, of which Somalis were the largest group, suggested that high English proficiency generally had a positive impact on mental health [49].

There are several potential explanations for the inverse association between English proficiency and mental health.



**Table 4** Multivariable linear regression analyses examining the associations between health literacy, English proficiency, and physical health (PCS) by gender

Characteristic	Males (n= 173)		Females (n= 238)	
	$\beta$ (SE)	p value	$\beta$ (SE)	p value
Age	−0.12 (0.032)	< 0.001	−0.17 (0.037)	< 0.001
Number of years in the US	0.13 (0.15)	0.41	−0.16 (0.19)	0.41
Ethnicity, Somali (ref)				
Bantu	3.08 (1.32)	0.022	3.24 (1.44)	0.025
Country before arrival, Kenya (ref)				
Somalia	1.99 (2.88)	0.49	−9.84 (5.03)	0.052
Other	0.60 (1.08)	0.58	0.78 (1.21)	0.52
Income, $\geq$ \$1000/month (ref)				
< \$1000/month	−0.65 (0.93)	0.48	−0.89 (1.21)	0.46
Proximity to other Somali				
Live in same building/street (ref)				
Other	2.25 (0.83)	0.0074	0.41 (0.95)	0.67
Medical insurance, private (ref)				
Medicaid or government	0.11 (1.41)	0.94	−0.36 (2.66)	0.89
None	0.26 (1.92)	0.89	−0.26 (3.25)	0.94
Usual place for healthcare, yes (ref)				
No	1.23 (1.18)	0.30	0.50 (1.92)	0.79
Has current job, yes (ref)				
No	−2.25 (0.96)	0.020	−2.46 (1.20)	0.041
Health literacy (STOFHLA)				
Functional (ref)				
Low	0.31 (1.19)	0.80	−1.37 (1.75)	0.44
English proficiency (BEST plus)				
High (ref)				
Moderate	0.18 (1.23)	0.88	−0.16 (1.87)	0.93
Low	−1.08 (1.37)	0.43	−0.18 (1.68)	0.92

Despite the widespread use of the SF-12, it may not be an accurate measure in all ethnic populations, including Somali individuals. Other studies of the PCS and MCS have found internal consistency and construct validity with other mental health screening tools in Russian refugees [29], Alaskan Natives and American Indians [30], and the Chinese in Hong Kong [31]. However, a study in New Zealand found that ethnic minorities, such as Pacific people and older Maori, interpreted the SF-36 (the tool from which the SF-12 is derived) differently than the general population [50]. The Maori “do not recognize the separation of mental and physical health,” and therefore a tool that separates health into separate mental and physical components may not adequately represent the health of a population that rejects this “mind–body dualism” [50]. In a qualitative study of Somali and Somali Bantu individuals regarding their beliefs about mental health, participants described mental illness as creating “observable behaviors” and causing physical symptoms [51]. Similar to the case with the Maori, the Somali model of health that seems to intertwine mental and physical health may create difficulties using a tool like the SF-12 that assumes two distinct dimensions of health.

The translation of the SF-12 into Somali may have affected the validity of the tool. In a British study, not speaking English as a first language was associated with a significant difference in MCS score for various ethnic groups [32]. The authors concluded that the meaning of some SF-12 questions might change when translated. A validated translation of the SF-12 was not available in Somali at the time of the study. We therefore administered the SF-12 in Somali via standard translation techniques [23], as done by others when validated translations of study instruments are not available [10, 52, 53]. Without validation to ensure appropriate translation of meaning, we cannot rule out the possibility of changes in how subjects understood specific survey items.

Our population had a lower prevalence of screening positive for depression on the PHQ-2 and PTSD on the PCL-C than was expected based on prior literature, and had higher scores on the MCS than we see in the healthy US population. Our population may truly have better mental health than other Somali refugee populations, or these numbers may underestimate the true burden of mental illness in the population. One explanation is that the SF-12, PHQ-2 and PCL-C may not be valid in the Somali population, as discussed

previously. Alternatively, stigma of mental health disorders and the potential of introducing social desirability bias by using culturally-concordant research staff could have led to underestimates of mental health burden [16, 51]. A prior study also used the PHQ-2 to assess depression prevalence in a Somali population and found lower than expected rates of depression [54]. Somali individuals in that study also reported high levels of stigma associated with mental illness and the authors considered that this may have led to an underestimate of depression. Subjects with greater English proficiency may be more accepting of the concepts of mental health due to acculturation and may answer mental health questions more similarly to the general US population; this could explain the inverse association between mental health and English proficiency in our study. Notably, stigma and social desirability bias do not fully explain why our study found less burden of mental disease than did other studies with similar data collection methods [6, 7]. These findings suggest a need for improved and validated tools to assess the mental health of this population.

Lower English proficiency may be a marker for strong social connections within the Somali community, which could have a protective effect on mental health. Conversely, higher English proficiency may be a marker for marginalization from Somali culture and early but incomplete integration into American culture, which could have a negative impact on mental health [55]. Unfortunately, we were unable to account for acculturation due to high correlation between a measure of acculturation and both English proficiency (Spearman's  $\rho = 0.82$ ,  $p < 0.001$ ) and health literacy (Spearman's  $\rho = 0.77$ ,  $p < 0.001$ ) and a high frequency of missing items in the acculturation data. Alternatively, English-speaking ability may represent individuals' social standing prior to arrival in the US. Thus individuals with higher English-speaking ability may come from more privileged groups in Somalia. These individuals would therefore have experienced the largest loss in social status upon coming to the US, which could be a reason for higher mental distress. A study of Somali women in the US found that women with greater English proficiency were more likely to experience psychological abuse and physical aggression from their partners [56]. This study suggests that the perhaps the relationship between increasing English proficiency and worse mental health for men may actually reflect changes in their relationships that accompanied increases in their own and their partner's English proficiency.

Older age and unemployment were associated with worse physical health as expected. It is somewhat unexpected that living closer to other Somalis was associated with worse physical health in men, as living closer to other Somalis could be a measure of social capital. This finding may reflect a selection bias whereby men with underlying poor physical health elected to live closer to other Somalis for support.

Differences in proximity to other Somalis may also be a marker for differences in the neighborhoods where Somalis live. For example, living closer to other Somalis could be a marker for a living in a lower-income, ethnically segregated neighborhood. Research has demonstrated that community socioeconomic factors can influence individual health [57]. Thus the worse physical health of individuals who live closer to other Somalis could reflect a trend towards worse health for those living within particular neighborhoods.

The Somali Bantus had better physical health than ethnic Somalis. Because the Somali Bantu are a group with even lower education, literacy, and English proficiency than the ethnic Somalis, we expected them to have worse health. However, the social challenges in Somalia and in refugee camps, which would be amplified for the less-educated Somali Bantu, may have led to a healthy immigrant effect whereby only the healthiest and most resilient Somali Bantu were able to successfully resettle. Another possibility is that the Somali Bantu in our study may represent a subset of the Somali Bantu population that are socially well adjusted and with adequate healthcare access, as a result making them healthier than the overall Bantu population.

It is unexpected to see that health literacy is neither associated with physical nor mental health after adjusting for multiple demographic and social factors. Several studies have identified low health literacy as problem in Somali refugees [58–60]. Further, multiple qualitative studies of Somali refugees in the US have identified health literacy and English proficiency as significant barriers to accessing healthcare [61–63]. Based on our findings, English proficiency appears to play a larger role in the health status of refugees than does health literacy. This trend is consistent with a prior study of multiple immigrant groups in California that found that immigrants with both low health literacy and low English proficiency had the highest prevalence of poor health (45.1%), followed closely by those with low English proficiency only (41.1%), and trailed by those having low health literacy only (22.2%) [64]. We are unaware of similar studies examining the effects of both health literacy and English proficiency specifically in Somali refugees.

In addition to the limitations discussed above, our results demonstrate certain associations but we cannot make conclusions about causation. Additionally, our data set was missing variables on exposure to torture and trauma, which have been linked in prior studies to negative mental health outcomes in refugees [12]. We also did not have information on the presence of chronic medical conditions, which could impact both physical and mental health. Therefore we could not control for these variables in our adjusted analyses. Finally, the data set used in this study is several years old, which may call into question the generalizability of the results to more recently resettled refugees. However, newly resettled refugees from Somalia likely share similar



experiences to those in this study, come from the same refugee camps, and have undergone similar resettlement procedures. Therefore, it is unlikely that the relationships studied here will have significantly changed since the data were gathered.

## New Contribution to the Literature

Our study adds to the literature on the relationships between health literacy, English proficiency, and health in Somali refugees. Our findings suggest that English proficiency may play a larger role on the mental health of Somali refugees than does health literacy, though in a direction that was unexpected and contrary to prior reports. Further research is needed to clarify and understand the relationship between English proficiency and mental health in Somali refugees.

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## Compliance with Ethical Standards

**Conflict of interest** The authors declared that they have no conflict of interest.

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