The Effect of Social Stress and Trust on Cognition and Health in American Adults: A Replication and Extension Study

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Abstract

Declining cognition, physical health, and mental health are common yet major public health challenges. However, research connecting declining cognition and health to common social stressors is limited. This paper aims to replicate Lindert et al. (2021), who used the MIDUS data set, a national sample of non-institutionalized, English-speaking respondents aged 25-74 living throughout the United States, to investigate the decline in episodic memory and executive function with social stress variables. The subsequent extension of the original study seeks to predict various physical and mental health outcomes from different community trust variables. In both the replication and extension, multivariate linear regression models were used to analyze the effect of social stressors and trust on cognition and health. We replicated the results reported in the original study, which suggested greater levels of perceived inequality in the family, marital stress, lifetime discrimination, and daily discrimination were significantly associated with more cognitive decline. Additionally, we found that lower levels of trust in neighbors and friends, as well as having few trusting relationships, were significantly associated with worse physical and mental health in both men and women.

Key Terms: Social stress, cognitive decline, episodic memory, executive functioning, community trust, mental health, physical health

Introduction

Cognition

Cognition is broadly defined as the processes used in the brain such as the ability to learn and remember information (Centers for Disease Control and Prevention, 2019). When there is a decline in cognition, the health and lifestyle of an individual can be severely impacted. Increasing cognitive decline typically occurs as one ages and is often recognized by the individual. Executive functioning (EF), the cognitive processes that enable individuals to plan tasks and focus attention on certain tasks, is closely related to cognitive function (Hofmann et al., 2012). Efficient EF relies on mental flexibility, working memory, and self-control. Declining EF thus leads to a decreased ability to make plans, pay attention, solve problems and think abstractly; self-control, emotion regulation, and moral reasoning can also be affected by EF decline. Episodic memory (EM), another aspect of cognition, is the ability to remember experiences from the past (Tulving, 2002). EM is different from other types of memory systems, such as procedural memory and semantic memory in that it is the only one that involves retrieving information from the past. EM is crucial for the ability to learn, retain, and retrieve information from past experiences. The ability to describe the details of a past event or memory, for example, depends heavily on intact episodic memory function (Dickerson & Eichenbaum, 2010).

Social Stress

Social stress can be defined as a situation that threatens an individual's self-esteem, sense of belonging, or relationships in various groups. Social stress can be triggered by a variety of difficult social interactions, such as a conflict in a group or within one's relationship, or when one feels rejected or ostracized (Juth & Dickerson, 2013).

Social stress can also lead to the development of various psychological problems, including anxiety and depression. Researchers speculate that the inflammatory system in humans becomes dysregulated under social stress, contributing to the development of various psychological symptoms (Takahashi et al., 2018). While future studies are necessary to develop our understanding of the relation between social stress and change in cognition, this theory shares some similarities with long-established chronic stress theories.

Community Trust

Community trust is a psychological state encompassing "the intention to accept vulnerability based upon positive expectations of the intentions and behaviors of another" (Rousseau et al., 1998). Moreover, current literature has suggested that community trust and household health are positively related (Zarychta, 2015). In addition, a study that focuses on subjective well-being amongst children found that a greater proportion of children in urban areas perceived low community trust and safety, compared to children living in rural areas (Eriksson et al., 2011). Not only do we see a disproportionate effect of community trust on children living in different areas, but we see that perceptions of low community trust and safety seem to be related to low subjective well-being (Eriksson et al., 2011). It's also been documented that community trust reduces myopic decisions of low-income individuals (Jachimowicz et al., 2017) which was based on a study that suggested poverty impedes cognitive function (Mani et al., 2013). With this literature already published, we are curious about the effects of community trust on one's episodic memory and executive function especially since there seems to be a disproportionate effect on different groups of people.

Current Literature

There is a wealth of research on stress and its effect on various aspects of health. However, the relationship between cognitive decline and stress is less well understood. The existing literature regarding this topic of interest reveals a common trend of declining cognition with higher stress levels. For example, a study suggests that increased perceived stress results in EM decline (Chen et al., 2019). Moreover, Song and colleagues found that a history of other psychiatric disorders was more prevalent among individuals with stress-related disorders (Song et al., 2019).

Trust within communities and interpersonal relationships have also been demonstrated to have an impact on an individual's physical and mental well-being. We have evolved to trust other people because having trustworthy companions led to a higher chance of finding food and establishing protection against external threats. Forming trusting relationships with others allows both parties to feel safe and supported. Feelings of closeness and security are correlated with happiness, which is subsequently associated with health and longevity (Post, 2005). Conversely, a lack of trust can have adverse effects on human health, as described in the following studies. Developing a sense of belonging through social support increases self-efficacy and promotes mental health (Berkman, 1995). Higher levels of social trust have also been found to be beneficial for physical health and are associated with a lower risk of forming cardiovascular diseases (Hwang, 2020). Additionally, a study done in the UK found that trust is important for people with mental illnesses to maintain positive relationships with their therapists (Kai & Crosland, 2001).

The Present Study

The present study replicates the mean social stress variable levels from the original study, as well as the effects of each social stress variable on EM and EF. Since the subset of the MIDUS

participants deviated slightly from the original study, we base the success of our replication on whether or not we find positive or negative effects of social stress on our cognition variables, and if the directionality of the effect matches that of the original paper. Based on the original research and relevant literature, we expect to see greater cognitive decline as a result of higher social stress levels (Lindert et al., 2021).

The extension in the present study aims to further the discussion on the effects of social stressors on the human body. This extension will analyze different types of community trust and evaluate its relation to several physical and mental health variables. Given the current literature on the effect of social stress and trust on health and cognition, we predict that scores corresponding to less trust in other people are associated with worse physical health and mental health, less sleep, and a greater risk of a heart attack.

Methods

Participants

The study uses MIDUS, a nationwide sample of English-speaking Americans between the ages of 25 and 74 (Mean = 55, SD = 12.4). Data was collected using random-digit-dialing starting from 1995. Non-Hispanic Whites were selected as the reference group since it is the largest race group of the participants. The replication and extension used an analytic subsample (n=4963) of participants who responded to social stress questions in MIDUS 2 and 3, respectively.

Replication Independent Variables - Social Stress

The social stress variables included in the present study are perceived levels of inequality within the family; marital, family strain, and spouse/partner strain; perceived inequality at work; chronic job discrimination; lifetime discrimination; and daily discrimination. The original

researchers measured social stress at the family and spouse/partner level (4 items), at the work level (6 items), through perceived inequality at work (6 items) and chronic job discrimination (6 items), through lifetime discrimination (11 items) and daily discrimination (9 items). These questions were answered on a 4-point scale from one (often) to four (never) (Brim et al., 2004).

Replication Dependent Variables - Episodic Memory and Executive Functioning

Researchers used the Brief Test of Adult Cognition by Telephone (BTACT) to measure cognition. EM was assessed by the Rey Auditory—Verbal Learning Test (examiners read out loud 15 words and the subjects recalled as many words as possible). EF was assessed by the Category—Verbal Fluency Test (participants were given one minute to produce as many words as possible within a category), Number Series, the 30-second and other counting tasks, and the Stop and Go Switch Task (Lindert et al., 2021).

Data Analysis - Replication

The replication of the present study focused on the stress variables by sex and age at MIDUS 2, as well as its effect on predicting change in EM and EF. First, we investigated the relationship between each stress variable described in MIDUS 2 and age for men and women. Second, we assessed the association between stress scores and change in EM and EF after controlling for several socioeconomic and health factors.

R Studio was used to complete all replication analyses. For Table 1, stress variable scores were separated by gender and five age groups (<40 years, 40-49, 50-59, 60-69, >70). Linear models were constructed to determine the effects of age and sex on the stress variables (significance at $p<0.05$).

Cognition change and social stress were modeled using linear regressions. Change in cognition was defined as an average change of over 10 years and z-scored, separately for EM

and EF (((MIDUS II–MIDUS III)/years of follow-up)x10). Due to the social stress scores' ordinal nature (1 often; 2 sometimes; 3 rarely; 4 never) and because participants rarely responded, 'never', stress variables were re-organized into an ordered distribution with three tertiles (0 often, 1 sometimes, 2 rarely), each containing a third of responses. Discrimination variables were analyzed on a continuous scale. Regression models were also adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

Extension Independent Variables - Trust

The independent trust variables included in the present study are trust in friends, trust in neighbors, and no experience in trusting relationships. Researchers asked participants for the degree they agreed with the statements, "I know that I can trust my friends, and they can trust me", "people in my neighborhood trust each other", and "I have not experienced many warm and trusting relationships", respectively, for each independent variable. Participants responded to the statement for trust in friends and no experience in trusting relationships using a 7-point scale, with 1 being "Agree Strongly" and 7 being "Disagree Strongly". Trust in neighbors used a 4-point scale, with 1 being "A lot" and 4 being "Not at all". For trust in friends and neighbors, higher scores correspond to individuals having less trust, and for "no experience in trusting relationships", higher scores correspond to individuals having more trust.

Extension Dependent Variables - Health

The health variables included in the present study are heart attack risk, physical health, hours of sleep, and mental health. Researchers instructed participants to rate their physical and mental health on a scale from 1 ("Excellent") to 5 ("Poor"). To measure hours of sleep, participants responded with the number of hours they typically sleep on non-workdays. To

measure heart attack risk, participants rated their degree of risk on a scale from 1 (“a lot”) to 3 (“little”).

Data Analysis - Extension

Similar to our replication, R Studio was also used to complete all extension analyses. Linear models were constructed to determine whether or not the effects of age and sex on the stress variable were significant ($p<0.05$).

Each trust variable was modeled against all health variables using linear regression. Tertiles were not used for our extension’s analysis. Regression models were also adjusted for education, income, and race.

Replication Results

Table 1. Stress/strain variables by sex and age at MIDUS 2.

		MEN			**WOMEN**		
Stress Variable	N	Mean (SD)	P for age trend	N	Mean (SD)	P for age trend	**P-value**
Marital Strain	<40: 145	3.34 (1.6)	**0.000**	<40: 213	3.52 (1.7)	**0.000**	0.311
	40-49: 359	3.36 (1.6)		40-49: 452	3.43 (1.7)		0.705
	50-59: 431	3.04 (1.5)		50-59: 437	3.22 (1.6)		0.087
	60-69: 332	2.64 (1.1)		60-69: 310	2.78 (1.3)		0.164
	>70: 246	2.50 (1.1)		>70: 194	2.56 (1.2)		0.571
Family Strain	<40: 173	2.10 (0.6)	**0.000**	<40: 266	2.29 (0.6)	**0.000**	0.001
	40-49: 437	2.09 (0.6)		40-49: 548	2.23 (0.6)		0.001
	50-59: 521	2.00 (0.6)		50-59: 603	2.16 (0.6)		0.000
	60-69: 384	1.87 (0.5)		60-69: 485	1.97 (0.6)		0.006
	>70: 308	1.79 (0.5)		>70: 369	1.85 (0.5)		0.104
Spouse/partner strain	<40: 145	2.14 (0.6)	**0.000**	<40: 212	2.20 (0.6)	**0.020**	0.338
	40-49: 360	2.10 (0.6)		40-49: 212	2.23 (0.6)		0.980
	50-59: 432	2.12 (0.6)		50-59: 437	2.21 (0.7)		0.040
	60-69: 332	2.00 (0.5)		60-69: 309	2.13 (0.6)		0.005
	>70: 246	2.02 (0.5)		>70: 193	2.10 (0.6)		0.105
Perceived Inequality at work	<40: 162	1.71 (0.6)	**0.000**	<40: 214	1.68 (0.6)	**0.000**	0.510
	40-49: 398	1.64 (0.5)		40-49: 447	1.63 (0.5)		0.770
	50-59: 454	1.57 (0.5)		50-59: 452	1.56 (0.5)		0.880
	60-69: 247	1.44 (0.5)		60-69: 237	1.48 (0.5)		0.400
	>70: 77	1.44 (0.5)		>70: 72	1.60 (0.6)		0.086
Chronic job discrimination	<40: 161	2.00 (0.8)	**0.000**	<40: 213	1.78 (0.8)	**0.000**	0.008
	40-49: 397	1.97 (0.7)		40-49: 447	1.81 (0.7)		0.001
	50-59: 455	1.83 (0.7)		50-59: 451	1.70 (0.7)		0.005
	60-69: 248	1.53 (0.6)		60-69: 242	1.50 (0.6)		0.590
	>70: 78	1.31 (0.5)		>70: 75	1.36 (0.6)		0.600
Perceived inequality of family	<40: 127	1.41 (0.5)	0.125	<40: 524	1.57 (0.5)	0.120	0.115
	40-49: 389	1.57 (0.5)		40-49: 462	1.55 (0.5)		0.312
	50-59: 451	1.53 (0.5)		50-59: 530	1.64 (0.5)		0.001
	60-69: 347	1.55 (0.5)		60-69: 453	1.58 (0.5)		0.343
	>70: 279	1.59 (0.5)		>70: 342	1.64 (0.5)		0.208
Lifetime discrimination	<40: 172	0.92 (1.7)	**0.000**	<40: 265	1.06 (1.7)	**0.00**	0.311
	40-49: 428	0.95 (1.6)		40-49: 538	1.03 (1.5)		0.705
	50-59: 512	0.82 (1.4)		50-59: 584	1.09 (1.6)		0.087
	60-69: 368	0.78 (1.4)		60-69: 468	0.78 (1.4)		0.164
	>70: 291	0.48 (1.1)		>70: 335	0.37 (0.8)		0.571
Daily discrimination	<40: 172	1.48 (0.5)	**0.000**	<40: 267	1.51 (0.5)	**0.00**	0.587
	40-49: 433	1.47 (0.5)		40-49: 547	1.54 (0.5)		0.050
	50-59: 518	1.40 (0.5)		50-59: 599	1.49 (0.5)		0.004
	60-69: 384	1.35 (0.5)		60-69: 479	1.34 (0.4)		0.653
	>70: 305	1.34 (0.4)		>70: 356	1.26 (0.4)		0.004

Note: Data is coded so that 1 = often, 4 = never. P for age trend refers to the trend in stress scores within one gender across all age groups. P-value refers to differences between men and women per age group. The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

We investigated the relationship between age, gender, and social stress through linear regressions, of which our results are shown above. Table 1 displays the summary statistics of social stress variables employed by the present study, organized by age group and sex. Overall, our analysis demonstrates a similar trend across most groups and social stress variables as the original study. Like the original study, our analysis found a significant age trend for all social stress variables except for the perceived inequality of family. Additionally, we found significant differences between men and women for variables, such as family stress and chronic job discrimination, that also had significant differences in the original study. Women in each age group under the age of 70 had significantly higher family strain scores than men in the same age group ($p<0.006$). Men in each age group under 60 also experience higher levels of chronic job discrimination than women in the same age group ($p<0.008$).

Table 2. Stress/strain variables and predicting change in episodic memory change

Scales	Tertiles	Men			Women		
		N	β (SE)	P-value	N	β (SE)	P-value
Perceived Inequality of family	0	921	Ref		1260	Ref	
	1		0.06 (0.06)	0.36		0.11 (0.07)	0.09
	2		0.07 (0.07)	0.30		0.20 (0.07)	**0.00**
Marital strain	0	934	Ref		1043	Ref	
	1		-0.11 (0.07)	0.14		-0.05 (0.55)	0.55
	2		0.15 (0.06)	**0.01**		0.10 (0.07)	0.14
Family Strain	0	1089	Ref		1432	Ref	
	1		-0.02 (0.05)	0.67		-0.04 (0.06)	0.51
	2		-0.02 (0.07)	0.75		0.05 (0.07)	0.47
Spouse/partner strain	0	935	Ref		1977	Ref	
	1		0.03 (0.06)	0.62		0.09 (0.07)	0.21
	2		0.08 (0.06)	0.23		0.11 (0.07)	0.12
Perceived Inequality at work	0	871	Ref		947	Ref	
	1		0.04 (0.06)	0.48		-0.03 (0.07)	0.67
	2		0.12 (0.07)	0.08		0.02 (0.79)	0.79
Chronic job discrimination	0	872	Ref		953	Ref	
	1		-0.02 (0.06)	0.68		-0.09 (0.08)	0.25
	2		-0.05 (0.07)	0.37		-0.04 (0.07)	0.60
Perceived inequality of family	0	921	Ref		1281	Ref	
	1		0.06 (0.06)	0.36		0.11 (0.07)	0.09
	2		0.07 (0.07)	0.30		0.20 (0.07)	**0.00**
Lifetime Discrimination	cont	1208	0.02 (0.01)	0.31	1529	0.01 (0.02)	0.81
Daily Discrimiation	cont	1208	0.01 (0.01)	**0.03**	1529	0.01 (0.01)	0.09

Note: Stress scores were organized into tertiles with 0 meaning often, 2 meaning rarely. The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

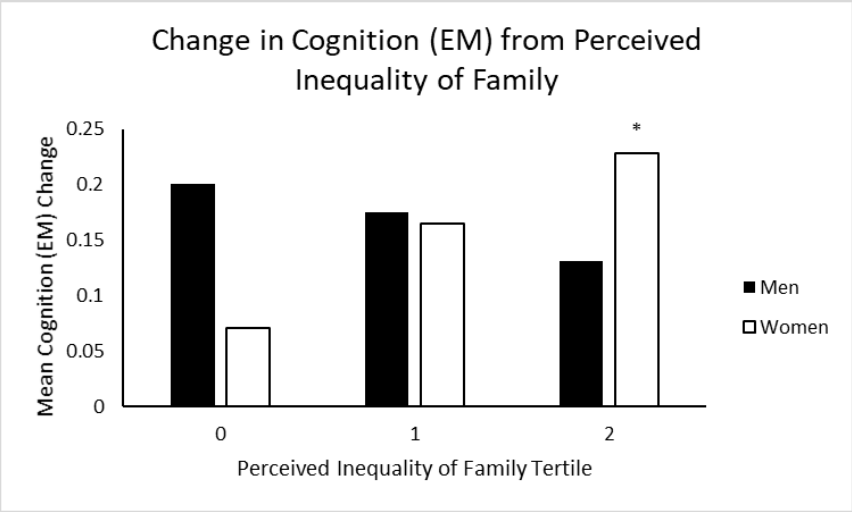

Fig. 1. Change in Cognition (EM) from Perceived Inequality of Family
Lower levels of perceived inequality in the family (tertile 2) were significantly associated with greater EM decline in women. Mean change in EM of the participants by gender and into tertiles representing ratings of perceived inequality of family (with 0 = often and 2 = never). Positive cognition change denotes a decline in cognition, negative cognition change denotes an improvement in cognition. Significant results are indicated by the * ($p<0.05$). The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

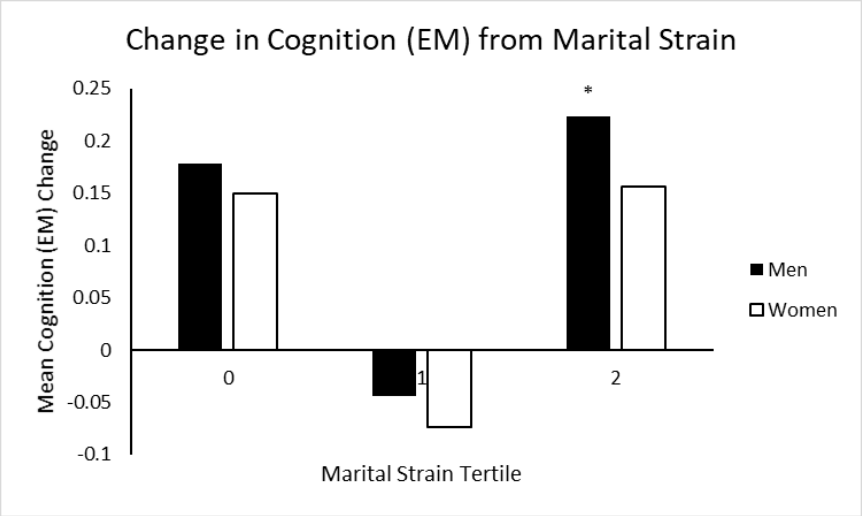

Fig. 2. Change in Cognition (EM) from Marital Strain
Lower levels of marital stress (tertile 2) are significantly associated with more EM decline in men. Mean change in EM of the participants by gender and into tertiles representing ratings of marital stress (with 0 = often and 2 = never). Positive cognition change denotes a decline in cognition, negative cognition change denotes an improvement in cognition. Significant results are indicated by the * ($p<0.05$). The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

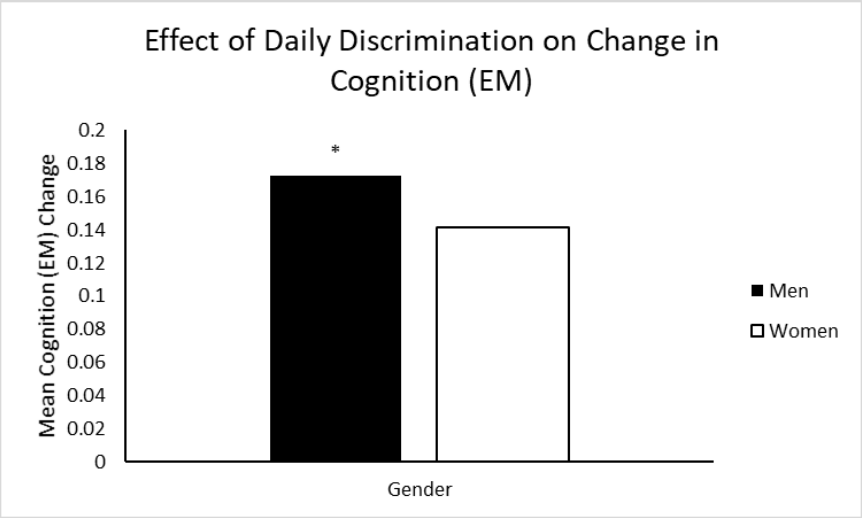

Fig. 3. Effect of Daily Discrimination on Change in Cognition (EF)
The effect of daily discrimination on EM decline is greater in men. Positive cognition change denotes a decline in cognition, negative cognition change denotes an improvement in cognition. Significant results are indicated by the * ($p<0.05$). The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

We then analyzed the relationship between social stress and change in episodic memory (EM) and executive function (EF) for men and women through linear regressions. Table 2 highlights the relationship between social stress scores and changes in EM for men and women. While social stress is generally negatively associated with EM for both men and women, the strength of their associations largely depends on the stress variable ratings. Higher levels of perceived inequality in the family were significantly associated with greater increases in EM decline in women ($p = 0.003$) (Fig. 1). Higher levels of marital stress ($p = 0.01$), lifetime discrimination ($p = 0.03$), and daily discrimination ($p = 0.03$) were all significantly associated with greater decline in EM in men. Other stress variables (family stress, partner/spouse stress, perceived inequality at work, and chronic job discrimination) were not significantly associated with changes in EM.

Table 3. Stress/strain variables and predicting change in executive function change

Scales	Tertiles	Men			Women		
		N	β (SE)	P-value	N	β (SE)	P-value
Perceived Inequality of family	0	921	Ref		1260	Ref	
	1		-0.03 (0.04)	0.35		0.06 (0.04)	0.13
	2		0.03 (0.04)	0.53		0.02 (0.04)	0.57
Marital strain	0	934	Ref		1043	Ref	
	1		-0.06 (0.04)	0.20		0.04 (0.04)	0.41
	2		0.00 (0.04)	0.94		0.03 (0.03)	0.31
Family Strain	0	1089	Ref		1432	Ref	
	1		-0.02 (0.03)	0.51		-0.07 (0.04)	0.06
	2		0.07 (0.04)	0.08		0.02 (0.04)	0.63
Spouse/partner strain	0	935	Ref		1042	Ref	
	1		0.02 (0.04)	0.62		0.01 (0.04)	0.79
	2		0.00 (0.04)	0.94		0.01 (0.03)	0.67
Perceived Inequality at work	0	871	Ref		947	Ref	
	1		0.05 (0.04)	0.21		0.00 (0.05)	0.98
	2		0.05 (0.04)	0.27		0.11 (0.05)	0.22
Chronic job discrimination	0	872	Ref		1825	Ref	
	1		0.01 (0.04)	0.70		-0.04 (0.03)	0.26
	2		0.02 (0.04)	0.66		0.03 (0.03)	0.34
Perceived inequality of family	0	921	Ref		1281	Ref	
	1		-0.03 (0.04)	0.35		0.02 (0.03)	0.48
	2		0.03 (0.04)	0.53		0.02 (0.03)	0.44
Lifetime Discrimination	cont	1208	0.01 (0.01)	0.27	1529	0.00 (0.01)	0.77
Daily Discrimiation	cont	1208	0.01 (0.00)	**0.01**	1529	0.00 (0.00)	0.35

Note: Stress scores were organized into tertiles with 0 = often, 2 = rarely. The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

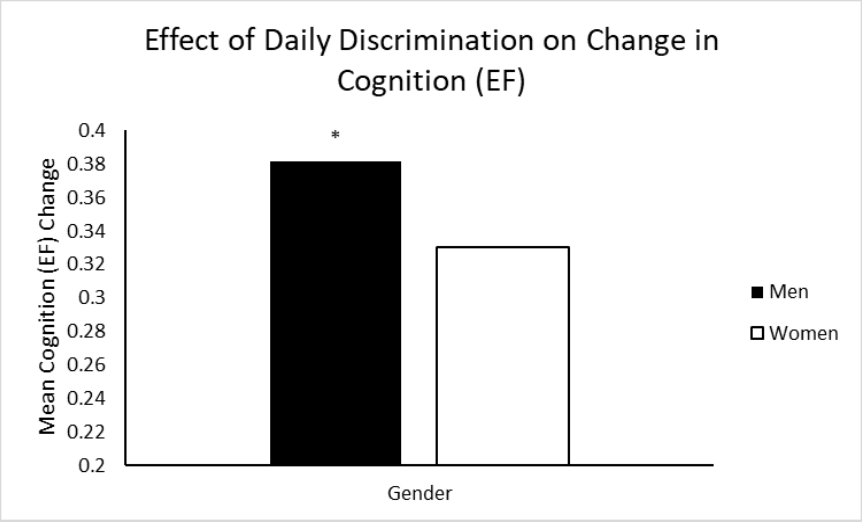

Fig. 4. Effect of Daily Discrimination on Change in Cognition (EF)
The effect of daily discrimination on EF decline is greater in men. Positive cognition change denotes a decline in cognition, negative cognition change denotes an improvement in cognition. Significant results are indicated by the * ($p<0.05$). The model was adjusted for age at MIDUS 2, baseline cognition score, race (White, Hispanic, Other), education, income, and physical health.

Table 3 displays the results of our regression relating various social stress variables to EF. While our values differed slightly from the original paper, the present study's analysis yielded similar results to the original paper. Most of the variables did not have a significant effect on EF. The only significant predictor of EF from the original study was daily discrimination, which also had a significant positive association with EF ($p = 0.006$). This positive association indicates that higher levels of daily discrimination are associated with more EF decline.

Extension Results

Table 4. Trust and Health Variables by Sex and Age.

			MEN				WOMEN			
Stress Variable	**Age**	**N**	**Mean**	**SD**	**P for age trend**	**N**	**Mean**	**SD**	**P for age trend**	**P-value**
Trust in Friends	<40	174	1.89	1.15	**0.00**	267	1.91	1.21	**0.00**	0.89
1= Agree Strongly, 7= Disagree Strongly	40-49	440	1.98	1.21		548	1.93	1.30		0.26
	50-59	523	1.95	1.27		603	1.70	1.14		0.00
	60-69	386	1.72	1.06		485	1.51	1.03		0.00
	>70	311	1.73	1.08		369	1.55	1.08		0.00
Trust in Neighbors	<40	172	2.03	0.78	**0.00**	265	1.92	0.84	**0.00**	0.19
1 = A Lot, 4 = Not at All	40-49	438	1.90	0.77		545	1.93	0.82		0.81
	50-59	520	1.81	0.79		595	1.83	0.82		0.87
	60-69	379	1.70	0.72		483	1.64	0.70		0.12
	>70	308	1.64	0.73		360	1.63	0.75		0.74
No Experience in Trusting Relationships	<40	174	5.36	1.79	0.10	266	5.52	1.87	**0.02**	0.37
1= Agree Strongly, 7= Disagree Strongly	40-49	439	5.27	1.82		548	5.49	1.89		0.02
	50-59	523	5.32	1.94		603	5.52	1.97		0.13
	60-69	385	5.55	1.84		485	5.96	1.69		0.00
	>70	308	5.46	1.84		367	5.58	1.96		0.00
Heart Attack Risk	<40	44	2.25	0.58	0.66	69	2.23	0.69	0.13	0.89
1 = A Lot, 3 = A Little	40-49	132	2.28	0.65		170	2.09	0.7		0.02
	50-59	122	2.20	0.68		173	2.21	0.69		0.98
	60-69	61	2.23	0.64		96	2.31	0.59		0.43
	>70	18	2.33	0.59		47	2.17	0.67		0.21
Physical Health	<40	275	2.18	0.79	**0.00**	343	2.23	9.00E-	**0.00**	0.51
1 = Excellent, 5 = Poor	40-49	611	2.25	0.90		686	2.34	0.96		0.09
	50-59	649	2.41	1.01		696	2.44	1.01		0.53
	60-69	475	2.54	1.11		550	2.57	1.04		0.55
	>70	356	2.81	1.08		429	2.86	1.07		0.11
Hours of Sleep	<40	173	4.66	1.25	**0.01**	266	4.86	1.27	**0.00**	0.08
	40-49	439	5.46	1.23		545	5.74	1.34		0.01
	50-59	517	6.45	1.20		590	6.50	1.37		0.54
	60-69	385	5.43	1.16		484	5.27	1.26		0.04
	>70	306	5.27	1.26		357	5.13	1.44		0.04
Mental Health	<40	275	2.02	0.88	**0.00**	343	2.19	0.91	0.15	0.02
1 = Excellent, 5 = Poor	40-49	610	2.07	0.87		687	2.24	0.95		0.00
	50-59	649	2.12	0.92		695	2.24	0.92		0.00
	60-69	475	2.10	0.93		550	2.18	0.93		0.20
	>70	355	2.34	0.94		429	2.36	0.93		0.00

Note: P for age trend refers to the trend in stress scores within one gender across all age groups. P-value refers to differences between men and women per age group. The model was adjusted for education, income, and race.

Table 3 shows the summary statistics for our dependent health variables and independent trust variables by age group and gender. Our analysis also identified significant trends between men and women and by age group. For example, we found that trust in neighbors (linear regression; men: $p < 0.001$, women: $p < 0.001$) and friends (linear regression; men: $p < 0.001$, women: $p < 0.001$) tends to increase as people age. We also found that differences in trust

between men and women become significant only in older age groups. As expected, physical health and mental health also declined as people aged. Everyone except the individuals in the age 60-70 group had significantly worse mental health scores than men in the same age group.

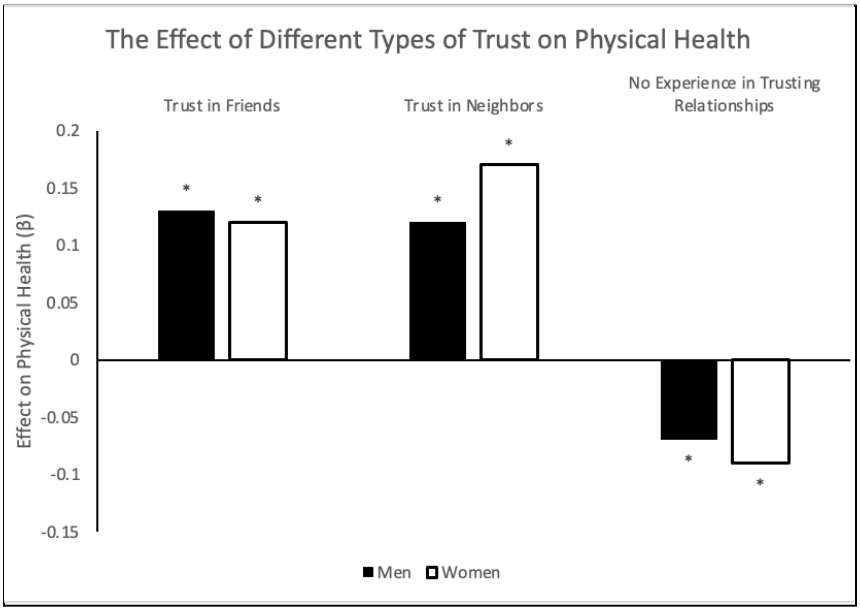

Fig. 5. Effect of different trust variables on physical health

Due to the way the trust variables were coded, a positive effect in "Trust in friends" and "Trust in Neighbors" denotes a worse physical health score due to less trust in others. A negative effect in "No experience in Trusting Relationships" denotes a better physical health score due to the experience of trusting relationships. Significant results are indicated by the * ($p<0.05$). The model was adjusted for education, income, and race.

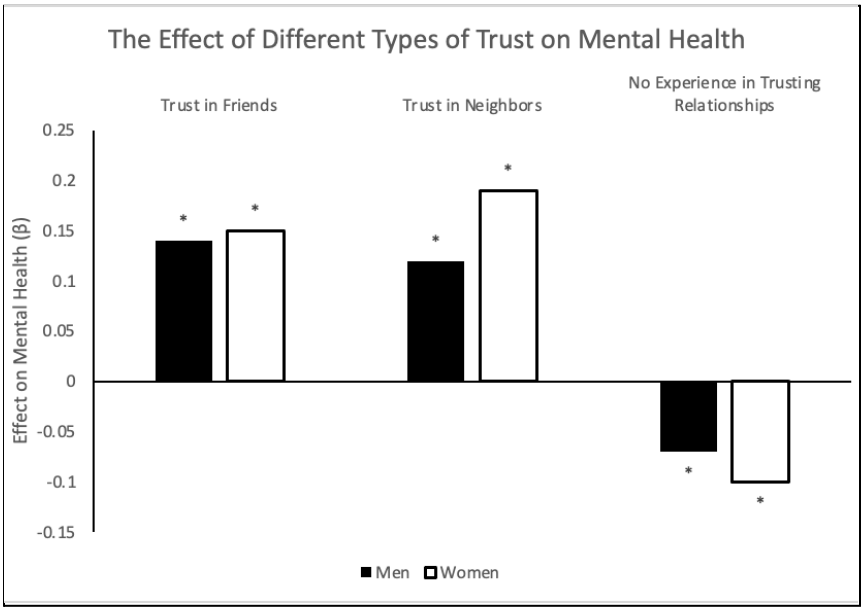

Fig. 6. Effect of different trust variables on mental health

Due to the way the trust variables were coded, a positive effect in "Trust in friends" and "Trust in Neighbors" denotes a worse mental health score due to less trust in others. A negative effect in "No experience in Trusting Relationships" denotes a better mental health score due to the experience of trusting relationships. Significant results are indicated by the * ($p<0.05$). The model was adjusted for education, income, and race.

Table 5. The effect of "Trust in Friends" on predicting changes in health variables

Trust in Friends	**Men**				**Women**			
Health Scales	**β**	**SE**	**P-value**	**N**	**β**	**SE**	**P-value**	**N**
Heart Attack Risk	-0.01	0.03	0.99	2316	0.00	0.03	0.95	2647
Physical Health	0.13	0.02	**0.00**	2316	0.12	0.02	**0.00**	2647
Hours of Sleep	-0.02	0.03	0.83	2316	0.00	0.03	0.95	2647
Mental Health	0.14	0.02	**0.00**	2316	0.15	0.02	**0.00**	2647

Note: A positive effect denotes a worse physical health score due to less trust in others. The model was adjusted for education, income, and race.

The linear regression with Trust in Friends yielded significant results for only some of the health variables. Higher scores (less trust in friends) had a significant positive association with worse physical and mental health scores in both men and women. Trust in friends did not have a significant effect on heart attack risk and hours of sleep.

Table 6. The effect of "Trust in Neighbors" on predicting changes in health variables

Trust in Neighbors	**Men**				**Women**			
Health Scales	**β**	**SE**	**P-value**	**N**	**β**	**SE**	**P-value**	**N**
Heart Attack Risk	0.05	0.05	0.30	2316	-0.04	0.04	0.31	2647
Physical Health	0.12	0.03	**0.00**	2316	0.17	0.03	**0.00**	2647
Hours of Sleep	-0.03	0.04	0.41	2316	-0.02	0.04	0.59	2647
Mental Health	0.11	0.03	**0.00**	2316	0.19	0.03	**0.00**	2647

Note: A positive effect denotes a worse physical health score due to less trust in others. The model was adjusted for education, income, and race.

Similar to the results with the variable Trust in Friends, the linear regression with Trust in Neighbors yielded significant results for only physical and mental health. Higher trust scores (less trust in neighbors) had a significant positive association with worse physical and mental health scores in both men and women. Trust in neighbors did not have a significant effect on heart attack risk and hours of sleep.

Table 7. The effect of having no experience in trusting relationships on predicting change in health variables

No Experience in Trusting Relationships	Men				Women			
Health Scales	**β**	**SE**	**P-value**	**N**	**β**	**SE**	**P-value**	**N**
Heart Attack Risk	0.02	0.02	0.31	2316	0.03	0.02	0.06	2647
Physical Health	-0.07	0.01	**0.00**	2316	-0.09	0.01	**0.00**	2647
Hours of Sleep	0.00	0.02	0.80	2316	0.03	0.02	0.07	2647
Mental Health	-0.10	0.01	**0.00**	2316	-0.14	0.01	**0.00**	2647

Note: A negative effect denotes a better mental health score due to the experience of trusting relationships. The model was adjusted for education, income, and race.

The linear regression with "No Experience in Trusting Relationships" yielded significant results for only physical and mental health. Higher scores (strongly disagree with "No Experience in Trusting Relationships") were associated with better health scores. In other words, people who experienced trusting relationships tend to have better physical and mental health. There was also a significant association between sleep and experience in trusting relationships among women. The regression shows that experience in trusting relationships is significantly associated with more sleep.

Discussion

Our study aimed to replicate the mean social stress variable levels from the original study, as well as the effects of each social stress variable on EM and EF. The extension in the present study aims to further the discussion on the effects of social stressors on the human body. Although there were some minor differences in significance levels and which variables were significant, our results were very similar to those of the original papers.

Results for the trend between social stress factors and change in EM were similar to those of the original study. Both results showed a negative association between social stress factors, where decreased social stress was associated with increased EM, but our results provided more significant associations. The original study concluded similarly that lower perceived inequality in

the family was significantly associated with increased EM in women, though they also found a significant association in men. They also similarly found that less marital stress was associated with increased EM for men, but then found no other significant results while our method also found this association for lifetime and daily discrimination in men. These results are comparable to existing studies on family inequality and marital stress that prove detrimental to overall well-being. In studies done on gender inequality in household chores, researchers cite unequal distribution of household chores and perception of partner's lack of contribution in the household as being significantly associated with increased work conflict in men and women, and increased family conflict in women (Cerrato and Cifre 2018), with the stress of unequal household duties associated with negative health outcomes in women (Eek and Axmon 2015). These findings are consistent with Table 1's findings that women report more family and spouse stress than men, and Table 2's findings that more perceived inequality in the family and marital stress lead to decreased EM in men and women.

The trends between social stress factors and change in EF were similar to the original study. Similar to the original study, we found that more marital stress is associated with decreased EF in men and amongst working women. Moreover, the original study found that more daily and lifetime discrimination is associated with worse EF in men, especially amongst low-income men, though our methods yielded no significant association between the two. The original study did not find an association between work stress and decline in EF, however, our methods found one association between the two amongst women. The results of these studies can draw similar conclusions to previous studies done on discrimination against race and/or gender and health outcomes. For instance, in a study documenting discrimination and changes in mental health amongst African-American women, the researchers found a positive relationship between

the two (Schulz et al. 2006). Additionally, another study on low SES among African-American women found that gender discrimination was a factor that increased the risk for worse health outcomes by increasing how vulnerable an individual is to each stressor (Perry et al. 2013). These results are consistent with Table 1's findings regarding women reporting more lifetime and daily discrimination than men, and Table 2's findings that in working women, marital stress is associated with declines in EF.

Mental and physical health tend to consistently differ between men and women ($p<0.05$). This finding is consistent with a study on German cohorts that used the Study of Health in Pomerania (SHIP) data to confirm that women were more often affected by depression, anxiety, obsessive-compulsive disorder, PTSD, and somatoform, and eating disorders (Beutel et al., 2021). The findings in Table 3 are also consistent with a study that identified the neural basis of age differences in trust. Using Siemens 3-tesla Trio MRI neuroimaging, younger adults showed greater anterior insula activation to untrustworthy faces compared to older adults who showed muted activation of the anterior insula to the same faces. This neuroanatomical region has been shown to underlie the basis of "gut feelings," (Castle et al., 2012). A diminished "gut" response may partially explain the trend of increased trustworthiness in aging adults.

The results from our extension show that participants who reported higher levels of trust in others self-reported higher levels of mental and physical health. However, the results also show that as age increases the correlation between trusting factors and a participant's self-evaluated health show increases as well, meaning that the same results would not be reproduced with a group with a lower average age amongst its participants.

In analyzing the effect of various social stressors and trust on cognition and health, it is important to note that the factors for exclusion we employed are likely different from the original

study due to discrepancies in how such factors were defined and coded in the data. The calculated means for each variable and gender are the same in both our results and the original paper's results or differ by a very small amount. However, the calculated p-value and number of participants do differ quite a bit in our data and the original papers'. For the replication, these differences can partially be attributed to the fact that it was unclear how the original analytic sample was obtained. The methods for determining the analytic sample in the present study most likely differed from the original study, and our linear model also differed slightly from the original study's. As a result, the present study had a larger sample size, and some participants under analysis are likely different from the original sample. Despite these methodological differences, our results were overall consistent with the original study. Additionally, it is crucial to note that the physical and mental health data employed in the present study are self-reported. The data for physical and mental health, for example, were not objectively measured. Future studies could potentially employ other methods to quantify people's physical and mental health.

Conclusion

Social stress and by extension, trust, is an important issue in psychology and general health. Numerous studies have shown its negative correlation with the probability of various diseases, like cardiovascular disease and mental illnesses. The present study looked at various stress factors and their effect on cognitive decline, then examined how trust affects physical and mental health. Our analysis found a significant emphasis on the social environment on physical health, mental health, and cognition. While health and cognition are typically represented as biological aspects of one's wellbeing, our findings demonstrate the importance of looking beyond biological causes and considering the effects of social factors on health.

Future research can focus on comparing different healthcare systems and the level of trust their patients have in them. Asking participants to rank their level of trust and measuring their mental and physical health under different healthcare systems can strengthen our findings that trust correlates with better health, and can advise future healthcare policies on the best model for optimizing patient health. Moreover, a stratified analysis based on race and ethnicity, and age would be helpful in understanding trends amongst different groups; perhaps, a study could be conducted that measures levels of community trust and compares the health outcomes of two different communities.

Our research has many important implications for public health. Future healthcare could prioritize building more trusting relationships between physicians and the community, especially targeting populations that historically have weaker relationships with the healthcare system. Medical education can also have a greater emphasis on social factors. New teaching models can improve the integration of social factors from various patient populations into the assessment and treatment of patients. For example, in a country where forced sterilization and unethical clinical trials have put certain marginalized communities under direct harm, levels of trust can be so low that healthcare workers and industrialists should prioritize building more trusting relationships between themselves and the community they are working with. This emphasis on creating intentional and trusting relationships are important in more than just the healthcare sector; community input is crucial in any aspect that involves community, whether that regards a community fundraiser for a life that was lost, school board, or local policy, or coalition building. Not only does trust correlate with cognitive functions such as EF and EM, but it's involved in many aspects of life, creating an urgency to focus on building trusting relationships.

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