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Discrimination, Social Support, and Telomere Length: The Multi-Ethnic Study of Atherosclerosis (MESA)

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Abstract

Purpose: We sought to assess the association of reports of discrimination with LTL and effect measure modification by social support.

Methods: This study used data from the Multi-Ethnic Study of Atherosclerosis Stress Ancillary Study (n=1,153). Discrimination was measured using the Everyday Discrimination and the Major Experiences of Discrimination Scales. LTL was defined as the ratio of telomeric DNA to single copy control gene (mean=0.916, SD=0.205). Linear Regression models were used to examine the relationship between discrimination and LTL.

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Conflict of Interest and Authorship Conformation Form

All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

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Results: We found no association between either measure of discrimination and LTL, but there was evidence of effect modification by social support (P (χ^2) = 0.001) for everyday discrimination only. Among those with low social support, reporting moderate and high everyday discrimination was associated with a 0.35 (95% CI: −0.54 to −0.15) and a 0.17 (95% CI: −0.34 to −0.01) shorter telomere length respectively, compared to reporting no discrimination, after adjusting for demographic factors, health behaviors, and health conditions. There were no associations between discrimination and LTL among those reporting moderate or high social support.

Conclusions: These findings underscore the importance of continued investigation of the potential health consequences of chronic unfair treatment in the absence of supportive resources.

Keywords

Discrimination; Telomere length; Psychosocial stress

Introduction:

Discrimination is a psychosocial stressor that has been shown to affect a myriad of chronic disease outcomes and procesess [1–6]. More recently, studies have begun to assess the health effects of discrimination by investgating biological disease risk markers, in order to better understand how discrimination becomes biologically embedded through physiological mechanisms [7]. One measure of biologic impact that has been used to study its health effects is telomere length [8]. Telomeres are DNA-protein complexes that cap and protect the ends of chromosomes and deteriorate as a result of cell division and oxidative stress [9,10]. Short Leukocyte Telomere Length (LTL) is indicative of accelerated cellular aging and has been associated with various adverse health outcomes [11–14].

Although a large amount of telomere length research focuses on individual health-related behaviors [15–18], a number of prior studies have shown that psychosocial stress has a negative effect on telomere length [10,19–25]. Chronic stressors are thought to more directly lead to shortened telomeres by impairing biological stress regulatory processes that impact a range of physiological organ systems tied to cell aging, such as inflammation [26]. However the literature in relation to discrimination has been limited. To our knowledge, there are only a few studies that have examined the association between reports of discrimination and telomere length and their findings have been inconclusive, with the majority of the studies finding no main effect of discrimination on LTL [8,27–32]. In addition to mixed findings, the majority of these studies were limited by small sample sizes and inclusion of only Black and white participants. Moreover, few studies have compared associations across distinct measures of discrimination (everyday vs major), which is imperative for understanding whether or not unfair treatment is differentially embodied based on the type and frequency of discrimination experienced.

Furthermore, the effects of discrimination on health may be modified by resources such as social support, which could influence psychological and physiological stress responses [33–35]. The availability of instrumental social support is thought to minimize the negative biopsychosocial consequences of discrimination by providing concrete emotional resources and by fostering an atmosphere in which to cope with the unfair treatment [34,36]. A

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study that assessed the association between discrimination and self-reported poor physical health among Latino immigrants in California found that discrimination was associated with significantly higher odds of self-reported poor health only among those with low social support [37]. Such findings highlight the importance of investigating the role that social support might play in moderating the impact of unfair treatment on different disease outcomes to help identify individuals who are more vulnerable. Nonetheless, there have not been any investigations to date that considered the buffering effect of social support in the relationship between discrimination and telomere length.

The current study assessed the relationship between discrimination, measured by both the Everyday Discrimination Scale and Major Experiences of Discrimination Scale, with LTL. The study also aimed to understand if this association was modified by the availability of social support. Given prior findings, we hypothesized that greater reports of discrimination would be associated with shorter telomeres, and that the negative association between discrimination and LTL would be stronger among those with lower levels of social support.

Material and Methods:

Study Sample:

This study used data from the Multi-Ethnic Study of Atherosclerosis (MESA). Details about the study design of MESA are described elsewhere [38]. Briefly, 6814 participants (age range=45–84 years) free of clinical cardiovascular disease at baseline were recruited from six field centers across the US: Baltimore, MD; Chicago, IL; St. Paul, MN; Los Angeles, CA; New York, NY; and Forsyth County, NC, between the years 2000–2002. The following analyses are based on a baseline ancillary study that was carried out on a subset of 1295 MESA participants from two of the six study sites (New York, NY; Los Angeles, CA) throughout the years 2000–2002 to investigate the effect of stress on cardiovascular outcomes (MESA Stress Ancillary Study I). After removing 142 individuals due to missing data (telomere length; n=72, discrimination and social support; n=27, other covariates; n=43), the final analytic sample included 1153 participants. This study was approved by the Institutional Review Boards of MESA field centers at all study sites and the MESA Coordinating Center and participants gave written consent.

Study Variables

Leukocyte Telomere Length (LTL) was assessed using blood samples collected at baseline (Exam I; 2000–2002). Telomere length was obtained through quantitative polymerase chainreaction (qPCR) at the University of California, San Francisco [39]. Telomere length is defined as the ratio of telomeric DNA to single copy control gene (T/S), with higher T/S ratio referring to longer LTL. To guarantee quality and reproducibility, each of the samples were assayed three times on three separate days on duplicate wells and 8 control DNA samples from different cancer cell lines were used to normalize for run-to-run variations. The average inter-assay Coefficient of Variation for this study was 2.9% [40].

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Discrimination was measured using modified versions of the Everyday Discrimination Scale (EDS) and the Major Experiences of Discrimination Scale (MDS), originally developed for the Detroit Area Study [41].

The EDS assesses the frequency of occurrences of unfair treatment in everyday instances of participants' lives. Respondents are asked how often (1=almost every day to 6=never) they have experienced nine unfair incidents in their day-to day lives such as being treated with less respect than others or being threatened/harassed. Each of the items were reverse coded, summed, and averaged to obtain a mean score, with higher mean values indicating greater discrimination. In our analyses we considered this continuous measure as well as a categorical version of this measure, in which we grouped the mean score into approximate quartiles i.e. none (mean=1), low (mean >1 and <1.44), moderate (mean=1.44–2.0), and high (mean >2), in order to account for potential threshold effects.

The MDS asks participants about the occurrence of lifetime unfair treatment (yes/no) in six domains, including the workplace, encounters with police, educational environments, housing, and neighborhoods. A score, which ranged from 0–6, was created for each respondent based on the sum of their affirmative responses to the questions. This was then categorized into 3 groups based on the distribution of responses in the study population (did not experience discrimination, experienced discrimination in one domain, and experienced discrimination in two or more domains).

Both the EDS and MDS are validated scales that have been widely used in racially diverse groups to indicate experiences of discrimination [42]. They have each shown high reliability, and their items have demonstrated good internal consistency in this study population (EDS Cronbach's alpha=0.88).

Social support was measured using the ENRICHD Social Support Inventory (ESSI), which asks participants about the current availability (1=none of the time to 5=all of the time) of an individual who listens, gives advice, shows love/affection, helps with daily chores, provides emotional support, and can be trusted [43]. Responses were summed across the six items, and based on prior categorization of the ESSI utilized in this cohort [44] and due to the discrete demarkations in the distribution of reponses, were categorized as low (<12), moderate (12–24), and high (>24). The ESSI is a commonly used inventory that has been cross validated with other social support scales, and in the present study has shown good internal consistency (Cronbach'salpha=0.88) [43].

Covariates—Sociodemographic covariates that may confound the relationship between discrimination and telomere length included: age, race/ethnicity, gender, educational status, employment status, categorized household income in US dollars, marital status, and self-reported birth place (see Table 1 for categories).

Based on prior literature on the implications of discrimination on telomere length [8,27–29], we also included the following health conditions and health related behaviors as covariates in our fully adjusted models: Body Mass Index(BMI: kg/m^2), Diabetes Mellitus (yes/no), Hypertension (yes/no), cancer diagnosis (yes/no), physical activity (metabolic equivalents of

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physical activity in minutes per week), Center for Epidemiologic Studies Depression Scale (CESD) (range=0–60), the Chronic Burden Scale (range=0–5), and pack years of smoking.

Statistical Analysis:

Descriptive statistics were calculated in order to examine the univariate distribution of study covariates and bivariate associations between LTL and all study covariates. To examine the association between discrimination and telomere length, we used Ordinary Least Squares Regression and modeled EDS and MDS separately. Using sequential modeling to adjust for covariates, we compared unadjusted models (Model 1) with models adjusting for sociodemographic covariates (Model 2). These models were then compared to the subsequent fully adjusted models, which included health related behaviors and health conditions (Model 3). To investigate effect measure modification by social support, we incorporated additional models with two-way interactions between each measure of discrimination and social support, adjusting for all other study covariates. Sensitivity analyses were also conducted to examine if the association between discrimination and telomere length differed by race/ethnicity and gender. All analyses were conducted using Stata: Data Analysis and Statistical Software version 15 at UC Berkeley.

Results:

Distribution of population characteristics are presented in Table 1. Mean LTL in the total study population was 0.916 (SD=0.205) and ranged from 0.487 to 1.669. Bivariate analyses results suggest that LTL was shortest among participants who were older, Black/African American, men, unmarried, born in Puerto Rico, had hypertension, and diagnosed with cancer (Table 1).

Among the 1153 participants, 29.3% reported no everyday discrimination, while 20.7%, 28.3%, and 21.7% reported low, moderate, and high everyday discrimination, respectively (Table 1). A higher number of study participants reported not having experienced any major experiences of discrimination (53.6%), while 23.7% reported major discrimination in one domain and 22.7% reported major discrimination in two or more domains. Bivariate analyses also show that participants who reported high everyday discrimination and those who reported major discrimination in two or more domains tended to be younger, Black/African American, employed, married, born in the United States, and earned between $20,000 and $49,999 (Table A1).

Everyday Discrimination:

Results of multivariable linear regression for main effects are shown in Table 2. Mean everyday discrimination was not significantly associated with telomere length in the unadjusted, partially adjusted, or fully adjusted models (β for fully adjusted= −0.006, 95% CI: −0.025 to 0.012). Similar results were observed when treating everyday discrimination as a categorical variable (Table 2). However, we observed significant interactions between social support and the categorical measure of everyday discrimination (P (χ^2) = 0.001 (Figure 1, Table 3). Among participants with low social support, reporting moderate everyday discrimination was associated with a 0.35 shorter LTL (95% CI: −0.54 to −0.16)

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and high everyday discrimination was associated with a 0.17 shorter LTL (95% CI: −0.34 to −0.01), each compared to reporting no everyday discrimination, after adjusting for sociodemographic factors, health behaviors, and health conditions. Additional tests of interaction between the continuous measure of everyday discrimination and social support did not reveal any significant results (Table A2).

Major Discrimination:

We found no associations between major experiences of discrimination and LTL in all models (Table 2). There was also no evidence that associations were modified by social support (Table 3).

In sensitivity analyses results, we found no statistically significant interactions between both discrimination measures and race/ethnicity or gender (data not shown).

Discussion:

This study investigated the association between reports of everyday and major experiences of discrimination and telomere length in older adults, and whether this relationship was modified by availability of social support. It is the first to document that the association between everyday discrimination and cellular aging may be conditional on the level of social support available to individuals, independent of sociodemographic characteristics, health behaviors, and health conditions. In those with low social support, we observed that reports of moderate and high everyday discrimination were associated with shorter telomeres, each compared to reporting no everyday discrimination. Our findings are consistent with the hypothesis that persistent, unfair encounters, tend to result in adverse biological outcomes due to repeated activation of physiological stress responses, especially in individuals without access to supportive resources [45,46].

Low social support has been previously linked with increased risk of mortality in a seminal longitudinal study [47,48]. It has also been found to be related to short telomeres in this particular cohort [49]. Our findings with regards to the association between everyday discrimination and LTL only in the absence of social support, is consistent with prior studies that have shown that reports of discrimination are associated with increased risk of other adverse health outcomes in those reporting low social support [34,37,50]. We extend this body of literature by focusing on telomere length, a measure of biological aging. Taken together, these results provide evidence for the importance of instrumental social support in moderating the embodiment of discrimination.

Our findings also have a strong theoretical basis. Conceptual models such as the Transactional Model for Stress and Coping help contextualize similar patterns of elevated risk of psychological distress and physiological dysfunction observed in individuals with low social support when confronted with chronic stressors, such as discrimination [36]. Social networks can facilitate a positive reappraisal of an unfair treatment that is primarily perceived as a threat, by validating individuals' experiences and by providing an inclusive environment that promotes resilience against discrimination [36]. Lack of social support,

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however, may lead to deleterious coping strategies such as denial and acceptance of a discriminatory event as a deserved treatment [36,51].

In our sample, among those reporting low social support, experiencing moderate everyday discrimination had a stronger association with short telomere length than experiencing high everyday discrimination, which contradicts our hypothesis. However, this lack of dose-response relationship in which moderate reports of discrimination have stronger associations with poor health outcomes than higher reports of discrimination, has previously been documented [2,6,35,51]. As clearly outlined by Lewis et al., perception bias, defined as the inconsistency between the level of discrimination experienced and self-reported due to psychosocial differences in processing such events, might influence associations observed between discrimination and health outcomes [6]. This suggests that those who may potentially over-report the unfair treatments they experience could have lower risk for accelerated cell aging than those who report unfair encounters to a lesser degree.

The fact that we did not observe any significant associations between major experiences of discrimination and LTL suggests that everyday encounters of unfair treatment and exposure to chronic day-to-day discrimination, rather than major lifetime discrimination, may have more harmful implications to telomere length. These observations are consistent with a prior study by Liu et al, that did not find any differences in telomere length across reports of lifetime major discrimination [29]. However, other studies have found that greater reports of lifetime discrimination were associated with shorter telomere length, but only in certain subgroups [28,30,31]. Differences in the demographic characteristics of the study participants across studies makes it difficult to know what is driving these differences, thus warranting additional research.

Limitations

Our findings should be interpreted within the context of the limitations of the study. Use of cross-sectional data, precludes us from establishing temporal relationship between discrimination and LTL, as well as rate of LTL attrition over time. Future studies should implement longitudinal measures of telomere length to understand the relationship between discrimination and physiological wear and tear. Furthermore, the results observed in this study are specific to leukocytes and might not resemble telomere length in other tissues. New methods that have been developed to assess absolute telomere length were not available to be implemented in this cohort, which warrants future work to understand if associations observed are comparative in both relative and absolute telomere length measurements [52]. We may have been underpowered in our assessment of effect measure modification due to the small sample sizes within subgroups of social support, particularly the low social support group, which made up only 4% of our study population. Moreover, we were more powered to detect associations using the mean everyday discrimination score, but we did not see a statistically significant interaction between this continuous measure of discrimination and social support. The significant associations we observed in our study may also be susceptible to the risk of alpha inflation due to multiple testing. These limitations highlight the need for corroboration of our results.

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Additional methodological issues should also be considered in interpreting our results. The ESSI did not ask about the extent to which participants utilized social support and was not designed to understand stress-buffering pathways. Although not within the scope of our study, another possible limitation of our investigation is not addressing the social identities to which participants attribute the discrimination they encountered. Unfair treatment is often tied to race/ethnicity, gender, sexual orientation, etc. However, in this study, we only considered discrimination as a broad stressor and did not investigate the different ways in which it manifests. Future work should include measures that explicitly address types of discrimination, as it is important for understanding disparities in health [53]. Additionally, data on appraisal of the stressfulness of the unfair encounters were not available, which is essential for understanding the pathways to biological embodiment of discrimination. Finally, our study results might not be generalizable to the greater U.S. older-adult population, as members of the MESA cohort in our analyses are selected from three distinct sites, are wealthier, more educated and healthier than similar age groups in the nation [54].

Despite the above limitations, our study also has several strengths. MESA is a well-characterized cohort with racially and socioeconomically diverse study participants, making our findings based on this population noteworthy. Next, our study assessed both major and everyday experiences of discrimination, which helps delineate which form of stress (major vs. minor more daily stressors) has a stronger and lasting effect on physiologic dysfunction. One of the most important strengths of our study is that it is the first to investigate how the association between discrimination and LTL varied across the availability of social support. By utilizing telomere length as an outcome of interest, our findings extend the current understanding of the ways in which chronic stress, in this case discrimination, gets biologically embedded to potentially influence various disease outcomes. More specifically, this study highlights the need to pay particular attention to vulnerable populations, i.e. those with low social support, in studying the effect of chronic stressors, such as discrimination, on premature aging.

Conclusion:

Our study is the first to show that the association between everyday discrimination and telomere length was moderated by the level of social support available to individuals. Results from this study underscore the need for more nuanced understanding of which population subgroups may be more vulnerable to accelerated physiological wear and tear when experiencing chronic unfair treatment. Future studies should investigate the relationships between discrimination, social support, and telomere length using longitudinal study designs with repeated measures of telomere length.

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Appendix

Table A1:

Distribution of Population Characteristics by Everyday Discrimination and Major Discrimination Categories; The Multi Ethnic Study of Atherosclerosis 2000–2002 (N=1,153).

		Everyday Discrimination Scale (% or mean(sd))				Major Discrimination Scale (% or mean(sd))		
	N	None N=338	Low N=239	Moderate N=326	High N=250	None N=618	1 Domain N=273	≥ 2 Domains N=262
Age								
45–54	361	21.9	20.9	37.1	46.4	29	30.8	37.4
55–64	359	28.7	31.8	31.3	33.6	29.9	34.8	30.2
65 and Over	433	49.4	47.3	31.6	20	41.1	34.4	32.4
Race								
White	309	22.8	28.5	31.6	24.4	29.4	26.7	20.6
Black/ African American	349	15.4	24.3	37.4	46.8	22.3	32.2	46.9
Hispanic/ Latino	495	61.8	47.3	31	28.8	48.2	41	32.4
Gender								
Women	618	48.8	58.2	55.2	53.6	59.5	50.5	42.7
Men	535	51.2	41.8	44.8	46.4	40.5	49.5	57.3
Education								
High School or Less	469	60.9	37.7	30.4	29.6	47.7	38.5	26.3
Some College/ Technical School	344	18.9	31.4	33.1	38.8	26.1	31.5	37
University Graduate	340	20.1	31	36.5	31.6	26.2	30	36.6
Income								
Less than $20,000	274	36.1	26.4	15.6	15.2	26.1	22.3	19.8
$20,000–49,999	491	41.1	41.4	46	41.2	41.9	46.5	40.1
$50,000–74,999	180	10.9	13.4	17.8	21.2	14.7	14.3	19.1
More than $75,000	208	11.8	18.8	20.6	22.4	17.3	16.8	21
Emoployment Status								
Un-Employed	489	54.7	47.3	35.3	30.4	46.4	40.7	34.7
Employed	664	45.3	52.7	64.7	69.6	53.6	59.3	65.3
Marital Status								
Not Married	496	38.2	46	44.2	45.2	40.9	46.9	43.9

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		Everyday Discrimination Scale (% or mean(sd))				Major Discrimination Scale (% or mean(sd))		
	N	None N=338	Low N=239	Moderate N=326	High N=250	None N=618	1 Domain N=273	≥ 2 Domains N=262
Married	657	61.8	54	55.8	54.8	59.1	53.1	56.1
Birth-Place								
United States	43	43.8	54.8	66.3	67.6	50.8	59	72.1
Puerto Rico	443	8.9	5.4	4.6	6.4	6.6	6.6	5.7
Foreign Country	667	47.3	39.7	29.1	26	42.6	34.4	22.1
Diabetes								
No	1008	84.9	88.3	88.7	88.4	89.5	83.9	86.3
Yes	145	15.1	11.7	11.3	11.6	10.5	16.1	13.7
Hypertension								
No	646	56.2	51.5	56.1	60	54.5	59.7	55.7
Yes	507	43.8	48.5	43.9	40	45.5	40.3	44.3
Cancer								
No	1080	93.8	90.8	95.1	94.4	93.7	92.7	94.7
Yes	73	6.2	9.2	4.9	5.6	6.3	7.3	5.3
Social Support								
Low	43	2.1	2.1	2.8	8.8	2.9	3.3	6.1
Moderate	443	28.7	41.4	38.3	48.8	35.8	41.8	41.2
High	667	69.2	56.5	58.9	42.4	61.3	54.9	52.7
Major Lifetime Discrimination								
None	618	67.2	62.8	50.3	30.8	–	–	–
One Domain	273	22.8	23	26.1	22.4	–	–	–
2 or more Domains	262	10.1	14.2	23.6	46.8	–	–	–
Everyday Discrimination				–	–	36.7	28.2	13
None	338	–	–	–	–	24.3	20.1	13
Low	239	–	–	–	–	26.5	31.1	29.4
Moderate	326	–	–	–	–	12.5	20.5	44.7
High	250	–	–	1.70 (0.20)	2.67 (0.66)	1.44 (0.62)	1.59 (0.65)	2.00 (0.78)
Mean Everyday Discrimination	–	1.00 (0.00)	1.23 (0.08)	29.49 (5.93)	29.54 (5.74)	28.92 (5.36)	28.75 (5.31)	29.89 (5.75)
BMI	–	28.27 (4.70)	29.27 (5.35)	9.92 (16.91)	11.01 (18.26)	8.03 (16.75)	9.02 (15.49)	10.63 (17.32)
Pack-years of Smoking	–	7.65 (17.19) 4796.49	6.83 (12.86) 5827.87	6883.29	6729.05	5636.97	5831.07	7117.40
Physical Activity	–	(4353.72)	(5401.07)	(8089.30)	(6213.81)	(5229.96)	(5252.14)	(8819.12)
Chronic Burden Scale	–	1.01 (1.05)	1.15 (1.14)	1.38 (1.17)	1.73 (1.36)	1.06 (1.12)	1.47 (1.19)	1.69 (1.28)
Depression Scale	–	6.39 (7.29)	6.45 (6.21)	7.65 (7.39)	11.68 (9.92)	7.63 (7.73)	7.10 (6.93)	9.40 (9.48)

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Table A2:

Mean Difference in Leukocyte Telomere Length Associated with Continuous Measure of Everyday Discrimination within Categories of Social Support; The Multi Ethnic Study of Atherosclerosis 2000–2002 (N=1,153).

	Everyday Discrimination			P (χ^2)
	β	95% CI	P	
Social Support				0.169
Low	−0.004	−0.063	0.056	0.903
Moderate	0.013	−0.015	0.042	0.351
High	−0.020	−0.044	0.004	0.096

*Models adjusted for Demographic Characteristics, Health Behaviors, and Health Conditions

Abbreviations

LTL	Leukocyte Telomere Length
MESA	Multi Ethnic Study of Atherosclerosis

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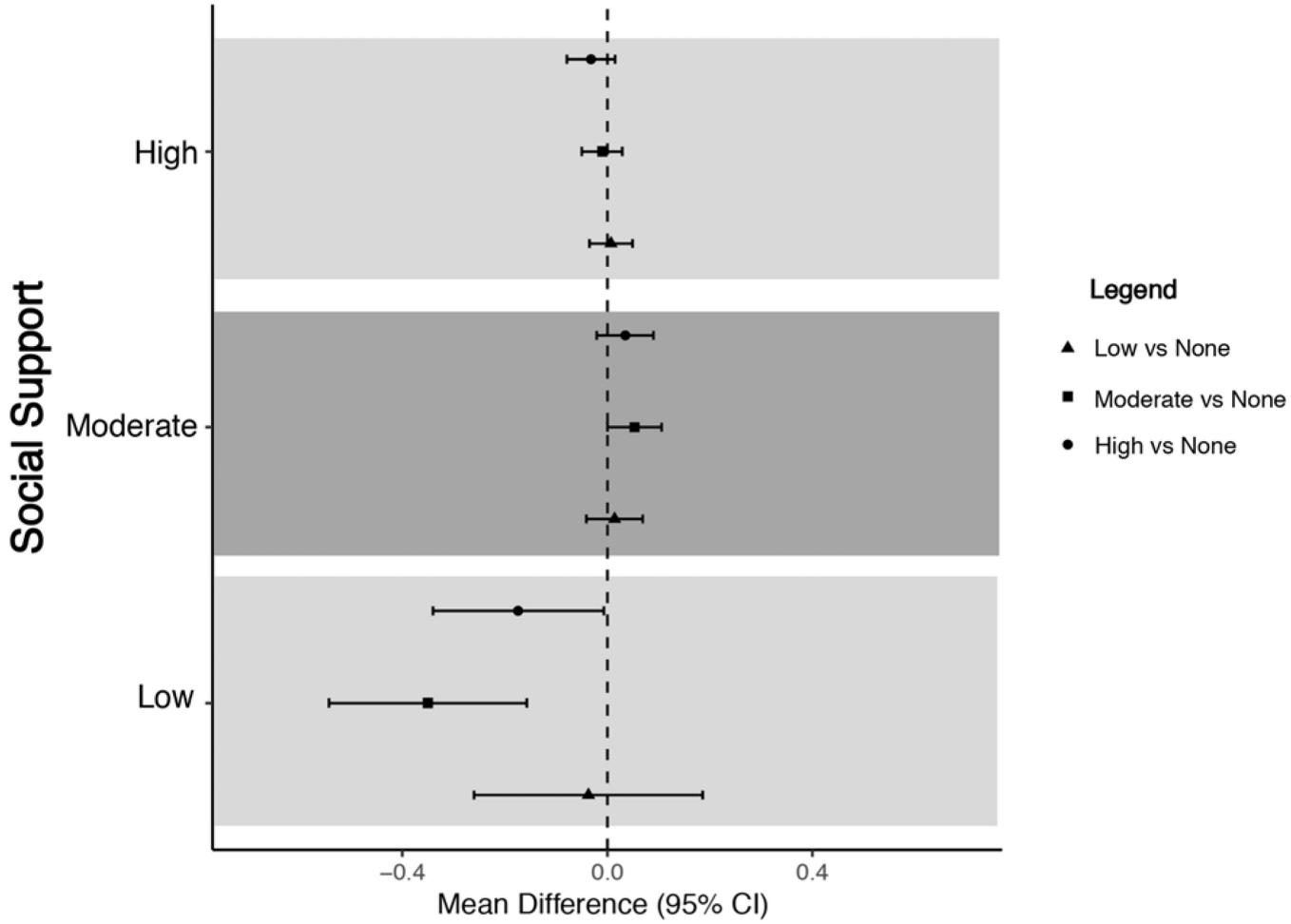

Figure 1:

Mean Difference in Leukocyte Telomere Length Associated with Categories of Everyday Discrimination within Groups of Social Support; The Multi Ethnic Study of Atherosclerosis 2000–2002 (N=1,153).

Error bars indicate 95% Confidence Intervals. Results are from models adjusted for demographic characteristics, health behaviors, and health conditions

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Table 1:

Distribution of Population Characteristics and Leukocyte Telomere Length; The Multi Ethnic Study of Atherosclerosis 2000–2002 (N=1,153).

	N (%)	Mean LTL (Sd)
Overall	1153 (100)	0.916 (0.205)
Everyday Discrimination		
None	338 (29.3)	0.910 (0.212)
Low	239 (20.7)	0.912 (0.207)
Moderate	326 (28.3)	0.922 (0.198)
High	250 (21.7)	0.919 (0.203)
Major Lifetime Discrimination		
None	618 (53.6)	0.919 (0.209)
One Domain	273 (23.7)	0.903 (0.196)
2 or more Domains	262 (22.7)	0.923 (0.204)
Age		
45–54	361 (31.3)	0.978 (0.214)
55–64	359 (31.1)	0.934 (0.186)
65 and Over	433 (37.6)	0.848 (0.192)
Race		
White	309 (26.8)	0.934 (0.206)
Black/African American	349 (30.3)	0.894 (0.196)
Hispanic/Latino	495 (42.9)	0.921 (0.209)
Gender		
Women	618 (53.6)	0.938 (0.203)
Men	535 (46.4)	0.890 (0.204)
Education		
High School or Less	469 (40.7)	0.916 (0.214)
Some College/Technical School	344 (29.8)	0.927 (0.209)
University Graduate	340 (29.5)	0.905 (0.186)
Income		
Less than $20,000	274 (23.8)	0.900 (0.212)
$20,000–49,999	491 (42.6)	0.917 (0.207)
$50,000–74,999	180 (15.6)	0.924 (0.201)
More than $75,000	208 (18.0)	0.927 (0.195)
Employment Status		
Un-Employed	489 (42.4)	0.892 (0.201)
Employed	664 (57.6)	0.934 (0.206)
Marital Status		
Not Married	496 (43.0)	0.894 (0.203)
Married	657 (57.0)	0.932 (0.205)
Social Support		
Low	43 (3.7)	0.959 (0.205)

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	N (%)	Mean LTL (Sd)
Moderate	443 (38.4)	0.910 (0.209)
High	667 (57.8)	0.917 (0.202)
Birth-Place		
United States	664 (57.6)	0.912 (0.200)
Puerto Rico	74 (6.4)	0.876 (0.196)
Foreign Country	415 (36.0)	0.930 (0.213)
Hypertension		
No	646 (56.0)	0.930 (0.207)
Yes	507 (44.0)	0.897 (0.201)
Diabetes		
No	1008 (87.4)	0.917 (0.204)
Yes	145 (12.6)	0.910 (0.210)
Cancer		
No	1080 (93.7)	0.920 (0.206)
Yes	73 (6.3)	0.862 (0.176)

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Table 2:

Association between Discrimination and Leucocyte Telomere Length; The Multi Ethnic Study of Atherosclerosis 2000–2002 (N=1,153).

	Model 1				Model 2				Model 3			
	β	95% CI		P	β	95% CI		P	β	95% CI		P
Everyday Discrimination (mean score)	0.003	−0.014	0.020	0.734	−0.010	−0.028	0.007	0.239	−0.006	−0.025	0.012	0.500
None	–	–	–	–	–	–	–	–	–	–	–	–
Low	0.002	−0.032	0.036	0.896	0.001	−0.032	0.034	0.941	0.004	−0.030	0.037	0.820
Moderate	0.123	−0.019	0.044	0.441	−0.006	−0.038	0.026	0.701	0.001	−0.031	0.033	0.952
High	0.009	−0.024	0.043	0.587	−0.020	−0.055	0.015	0.260	−0.010	−0.047	0.027	0.583
Major Discrimination												
None	–	–	–	–	–	–	–	–	–	–	–	–
1 Domain	−0.159	−0.045	0.013	0.286	−0.011	−0.039	0.017	0.437	−0.006	−0.035	0.022	0.664
2 or more domains	0.004	−0.026	0.034	0.794	0.015	−0.014	0.045	0.309	0.026	−0.004	0.057	0.094

Model 1: Discrimination measure

Model 2: Model 1 + race + age + gender + educational status + income + employment + marital status + Birth place

Model 3: Model 2 + BMI + diabetes status + hypertension status + cancer diagnosis + physical activity + CESD + chronic burden scale + pack-years of smoking

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Table 3:

Mean Difference in Leukocyte Telomere Length Associated with Everyday Discrimination and Major Discrimination within Categories of Social Support; The Multi Ethnic Study of Atherosclerosis 2000–2002 (N=1,153).

	Everyday Discrimination												
	Low vs None				Moderate vs None				High vs None				
	Estimates	95% CI		P	Estimates	95% CI		P	Estimates	95% CI		P	P (χ^2)
Social Support													**0.001**
Low	−0.037	−0.260	0.186	0.746	−0.350	−0.543	−0.157	**0.000**	−0.174	−0.340	−0.007	**0.041**	
Moderate	0.014	−0.041	0.069	0.608	0.053	0.000	0.106	0.050	0.035	−0.021	0.090	0.222	
High	0.007	−0.035	0.049	0.751	−0.010	−0.050	0.029	0.604	−0.032	−0.079	0.015	0.183	

	Major Discrimination							
	1 domain vs None				2 or more domains Vs None			
	Estimates	95% CI		P	Estimates	95% CI		P	P (χ^2)
Social Support									0.1733
Low	−0.087	−0.244	0.070	0.275	0.037	−0.096	0.169	0.587	
Moderate	−0.010	−0.055	0.035	0.659	0.059	0.012	0.105	0.013	
High	0.003	−0.034	0.041	0.866	0.001	0.041	−0.039	0.965	

*Models adjusted for Demographic Characteristics, Health Behaviors, and Health Conditions

*Note: Boldface indicates statistical significance (p<0.05)