A long and resilient life: The role of coping strategies and variability in their use in lifespan among women

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ABSTRACT

Objectives: Associations of stress-related coping strategies with lifespan among the general population are understudied. Coping strategies are characterized as being either adaptive or maladaptive, but it is unknown the degree to which variability in tailoring their implementation to different contexts may influence lifespan. **Method:** Women (N=54,353; M_{age}=47) completed a validated coping inventory and reported covariate information in 2001. Eight individual coping strategies (e.g., Acceptance, Denial) were considered separately. Using a standard deviation-based algorithm, participants were also classified as having lower, moderate, or greater variability in their use of these strategies. Deaths were ascertained until 2019. Accelerated failure time models estimated percent changes and 95% confidence intervals (CI) in predicted lifespan associated with coping predictors. **Results:** In multivariable models, most adaptive and maladaptive strategies were associated with longer and shorter lifespans, respectively (e.g., per 1-SD increase: Active Coping=4.09%, 95%CI=1.83%, 6.41%; Behavioral Disengagement=-6.56%, 95%CI=-8.37%, -4.72%). Moderate and greater (versus lower) variability levels were similarly and significantly related to 8-10% longer lifespans. Associations were similar across age, racial/ethnic, residential income, and marital status subgroups. **Conclusions:** Findings confirm the adaptive and maladaptive nature of specific coping strategies, and further suggest benefits from both moderate and greater variability in their use for lifespan among women.

Keywords (max 6): adjustment, flexibility, longevity, regulation, stress, variability

INTRODUCTION

Negative psychosocial stressors, like caregiving, and related psychological responses, including depression symptoms, are associated with greater morbidity risk and reduced lifespan (Cohen et al., 2016; Epel et al., 2018; Trudel-Fitzgerald et al., 2016). Yet, findings at times appeared weaker than expected, possibly because research often does not account for how individuals manage these stressors and responses. Prior theoretical work suggests various psychological regulatory processes, like how individuals cope with stressors, can help explain the impacts of diverse stressors and responses on physical health and lifespan (Cohen et al., 2016; Epel et al., 2018; Trudel-Fitzgerald et al., (in press)). However, the empirical examination of the association between stress-related coping and such health outcomes remains limited to date, particularly among non-medical populations.

Coping strategies are often conceptualized as being more or less adaptive depending on how they typically influence mental and physical health (Carver et al., 1989). Yet, any given strategy may not be intrinsically adaptive versus maladaptive; rather, its impact may depend on the flexibility with which it is used across contexts (Bonanno & Burton, 2013; Cheng et al., 2014). This perspective suggests optimal psychological functioning will be evident among individuals who demonstrate *variability* in their selection of strategies to possibly maximize appropriate use of specific strategies in any given context (Aldao et al., 2015; Cheng et al., 2014).

Most studies in the general population have examined individual coping strategies, rather than variability, with mortality risk. For example, one study assessed the role of religion/spirituality to cope with stressful situations with overall mortality risk among 36,613 initially-healthy Black U.S. women (VanderWeele et al., 2017). Compared to non-users, those who relied heavily on this strategy were 25% less likely (95% confidence interval [CI]=0.61-0.91) to die over follow-up in an

age-adjusted model; the estimate was attenuated after controlling for multiple covariates, including health behaviors (VanderWeele et al., 2017). Two other studies evaluated six coping strategies with cancer and cardiovascular disease (CVD) mortality among 55,130-57,017 initially-healthy Japanese adults, respectively, and found that only the use of positive reappraisal was associated with lower mortality risk (Svensson, Inoue, Sawada, Charvat, et al., 2016; Svensson, Inoue, Sawada, Yamagishi, et al., 2016).

To our knowledge, only one study has considered individual coping strategies and variability levels with longevity outcomes (Trudel-Fitzgerald et al., 2022). Results suggested maladaptive strategies (e.g., Denial) were related to shorter lifespan, whereas adaptive ones (e.g., Planning) were unrelated to lifespan, among 4,398 middle-aged adults. Coping variability was operationalized based on many coping strategies assessed once, at study's baseline. The calculated index reflects coping variability individuals display across situations *in general,* as one's habitual (or dispositional) way of handling stressors, where greater variability indicates greater unevenness or discrepancy in the use of these strategies. Compared to lower coping variability levels, moderate levels were marginally related to longer lifespan whereas greater levels were clearly associated with shorter lifespan, implying that the relation between coping variability and longevity outcomes may not be linear. Nonetheless, in this study, other individual strategies that may contribute to changes in lifespan directly or indirectly by enriching the coping variability construct were not considered (e.g., religion, self-blame). Moreover, the sample size was somewhat too small to conduct a meaningful investigation of moderation effects by key sociodemographic factors, including race/ethnicity and marital status, or did not have systemic indicators, like residential income levels, which may shape capacities and opportunities to cope with stressors (Mezuk et al., 2013; Pearlin & Schooler, 1978).

The current study examined if the way one copes with stressful events at the study baseline, characterized by the frequency use of individual coping strategies and variability in their use, is related to changes in predicted lifespan over the follow-up period. Data are from the Nurses' Health Study II (NHSII), a national study in which a validated coping scale was administered and mortality follow-up was conducted. Following prior work (Carver et al., 1989; Penley et al., 2002; Trudel-Fitzgerald et al., 2022), we broadly hypothesized that adaptive strategies are related to a longer lifespan, while maladaptive strategies are related to a shorter lifespan. We examined baseline coping variability with lifespan without *a priori* hypotheses, given limited previous research. Analyses were adjusted for potential confounders, namely sociodemographics and health status, which may influence both the adoption of coping strategies and lifespan. Secondary models evaluated moderation of the main associations by age and racial/ethnic groups, as well as census track income levels and marital status. Additional analyses explored the role of health behaviors in the coping-lifespan relationship. Health behaviors are typically conceptualized as potential confounders or mediators of the association between psychological factors and health outcomes (Cohen et al., 2016; Epel et al., 2018; Trudel-Fitzgerald et al., (in press)). Yet, considering health behaviors in the coping-lifespan association is complex because they can be regulatory processes themselves, whereby individuals may smoke or eat to handle stressors and related distress (Mezuk et al., 2013; O'Leary et al., 2018; Park & Iacocca, 2014; Trudel-Fitzgerald et al., (in press)). Given data availability and to insure they at least do not confound the coping-lifespan association, we examine their role by further adjusting for them in exploratory analyses.

METHODS

Participants

NHSII is an ongoing cohort study that was launched in 1989 among 116,429 female nurses aged 25-42 years. Participants have completed biennial questionnaires on lifestyle, medical history, and newly diagnosed medical conditions, with sustained high response rates of >85% across cycles (Bao et al., 2016). The coping measure was administered in 2001, which constitutes the current analytic baseline, as part of a substudy on violence among a subset of NHSII participants (n=68,366). Exclusions, mainly because of missing data, led to an analytic sample of 54,353 (see Supplemental Figure 1). Included versus excluded participants were more likely to be non-hypertensive and non-obese, but did not differ meaningfully on other factors (see Supplemental Table 1). The study protocol was approved by the Institutional Review Boards of the Brigham and Women's Hospital and the Harvard T.H. Chan School of Public Health (number 1999P003389).

Measures

Details about the coping measure and the conceptual validation of the current dispositional coping variability construct, in addition to covariate measures, are provided in Supplemental Text 1.

Coping. How individuals typically cope with stressful events, as a dispositional style, was measured at study's baseline using a modified version of the validated self-report 60-item Coping Orientation to Problems Experienced (COPE) inventory (Carver et al., 1989). The NHSII 16-item version of the COPE inventory encompassed 8 subscales that represent individual coping strategies one typically uses, as a dispositional style. Four subscales are considered adaptive strategies: Active Coping, Use of Emotional Support, Acceptance, and Religion; another 4 subscales are considered maladaptive strategies: Denial, Behavioral Disengagement, Focus on & Venting of Emotions, and Self-Blame (Carver et al., 1989). Each subscale includes two items rated on a scale from 0=*"Not at all*" to 3=*"A lot*."

Computing Cronbach Alpha coefficients (α) based on 2-item measures is not informative (Eisinga et al., 2013). However, the original COPE scale, which relies on a greater number of items per subscale, has showed strong psychometric properties among University students: its validation study reported moderate-to-excellent alpha values for internal consistency, ranging from α=0.62 to 0.92, and correlations across 2 months ranging from r =0.48 to 0.86 for the subscales administered in NHSII (e.g., Acceptance, Self-Blame) (Carver et al., 1989). In another sample of U.S. adults from the general population, 4-item coping subscales of the COPE inventory had acceptable-to-good internal consistency reliability, ranging from α=0.65 to 0.79 (Trudel-Fitzgerald et al., 2022). Scholars have previously noted that coping scales tend to have somewhat lower internal consistency values compared to those of other psychological measures (Greenaway et al., 2014; Kato, 2015), possibly because some subscales combine items that capture more than one strategy (e.g., Focus on & Venting of Emotions). Given the lack of consensus about how subscales should be combined to define coping styles subsuming multiple strategies (e.g., problem- versus emotion-focused), because of empirical and theoretical reasons explained elsewhere (Trudel-Fitzgerald et al., 2022) and consistent with the latest recommendations regarding use of the COPE inventory (Carver, 2019), we considered the eight subscales separately. We summed the 2 item scores for a given subscale to yield a score ranging from 0 (lower use) to 6 (greater use) for each individual coping strategies. Continuous scores from subscales were standardized using *z*-scores to facilitate comparisons with prior work.

Coping variability has been conceptualized in diverse ways by scholars. For instance, an earlier approach referred to the "repertoire," whereby the sum of more (versus less) used strategies represents the breadth of strategies one can rely on to cope with stressors, with a higher score indicating a broader coping repertoire (Bonanno & Burton, 2013; Cheng et al., 2014). Conversely,

recent research introduced the "Between-Strategy Index", a standard deviation algorithm that characterizes differences between the score related to frequency of use for each strategy assessed and the respective mean frequency score across all strategies (Blanke et al., 2020). It is worth noting that this index was initially developed in studies using repeated, intensive measurement of strategies to regulate stressors and emotions in specific contexts (Blanke et al., 2020). Yet, recent research has adapted this algorithm to epidemiological cohort studies in which the use of distinct coping strategies are often measured only once; this operationalization uses a dispositional Between-Strategy Index to capture a general tendency (Trudel-Fitzgerald et al., 2022). More specifically, between-strategy variability indicates the extent to which each strategy is generally used, on the full spectrum of frequency and *in relation to others* (e.g., relying exclusively on one or two strategies versus using all strategies to a similar extent across stressors), which differs from the repertoire approach that more crudely sums independent strategies that are considered in a dichotomized format. Thus, the Between-Strategy Index is more likely to capture with more nuance attempts to find the best strategy or favor certain strategies for a given situation compared to the repertoire approach.

In the current study, because we used the COPE inventory, we followed recent work that has adapted the Between-Strategy Index to capture the variability one typically displays in the use of their coping strategies, as a dispositional style, and only queried once (Trudel-Fitzgerald et al., 2022). Although the current index is derived from a one-time assessment of how individuals *typically* cope with stressors rather than repeated assessments across *specific* situations, prior COPE research found moderate-to-high concordance between dispositional and situational versions of the inventory (Carver & Scheier, 1994; Carver et al., 1989). The dispositional Between-Strategy Index was calculated as:

$$SD_{(\text{between})\text{i}} = \sqrt{\frac{1}{L-1} \times \sum_{s=1}^{L} \left(x_{si} - M_{(between)i}\right)^2}$$

where $M_{(between)i}$ corresponds to the mean frequency score across coping subscales and x_{si} corresponds to the subscale score denoting the degree of use of strategy *s* by individual *i* for the total number of strategies *L*. Thus, this $SD_{between}$ captures the amount of variation in usage across the eight coping strategies generally displayed by a participant. By doing so, individuals categorized with lower variability are more likely, for instance, to have a tendency to use all strategies simultaneously to a similar extent (displaying similar scores across coping strategies), whereas those with greater variability are more likely to select and rely on just a few strategies in their repertory (displaying widely varying coping scores); by contrast, individuals categorized with moderate variability tend to use most or all strategies to varying extent, perhaps reflecting efforts to find the best fit for or to prioritize a given strategy for a given context (Blanke et al., 2020). Table 1 shows the calculation of the dispositional Between-Strategy Index with fictitious data.

To investigate potential discontinuity/threshold effects (Aldao et al., 2015; Cheng et al., 2014), for the current statistical analyses we tertiled the dispositional Between-Strategy Index (lower, moderate, greater levels). Characterizing coping variability with a standard deviation (*SD*) score can be confounded by the average level of strategies favored (Blanke et al., 2020); namely, individuals who have consistently low or high mean levels in frequency of use across strategies cannot display high variability levels due to floor/ceiling effects. Therefore, following prior research (Blanke et al., 2020; Trudel-Fitzgerald et al., 2022), we further controlled for mean level of frequency of endorsing strategies used at baseline in all models.

Lifespan. Lifespan was operationalized as changes in predicted lifespan, following previous studies investigating the association of psychological factors with predicted lifespan (Costa et al., 2014; Lee et al., 2019). Information on vital status was obtained from the family members, the

National Death Index, or the U.S. Postal Service (Rich-Edwards et al., 1994) through June 2019, the most recently available data.

Covariates. Following prior research (Costa et al., 2014; Lee et al., 2019; Trudel-Fitzgerald et al., 2021), sociodemographics, health status, and behavioral factors were considered as covariates, which were all self-reported at the 2001 baseline unless noted otherwise. Sociodemographics included age (continuous), race (White, racially-underrepresented individuals [Asian, Black, Amerindian, and Hawaiian women]; queried in 1989), census tract median income based on residential address (continuous), and marital status (married/in a relationship, divorced/ separated/widowed). Health status was characterized according to having high risk chronic conditions (yes, no), namely hypertension or obesity ($\geq$30 kg/m^2), separately. In NHSII, behavioral factors were queried as habitual behaviors (e.g., "*Do you currently smoke cigarettes?*") rather than coping-motivated strategies (e.g., "*Do you smoke to handle stress?*"). Given data availability, we used the following behavioral factors collected at the 2001 analytic baseline, unless otherwise noted: physical activity, alcohol consumption, diet quality (queried in 1999), and smoking status.

Statistical analysis

Descriptive statistics. All statistical analyses were conducted using SAS v9.4. We first calculated the means and standard deviation (SD) or frequencies for each covariate within the analytic sample (N=54,353) and across coping variability levels. We then computed Pearson and Spearman correlations across the scores of the eight COPE subscales and three variability levels to evaluate the associations between individual strategies and with the variability scores.

Primary models. Accelerated failure time models estimated the proportion by which participants' predicted lifespan differed in association with individual coping subscales and variability levels assessed at baseline, while accounting for potential confounders. In all models, we

applied the transformation 100(eβ − 1) to the regression coefficient for the primary predictors to facilitate interpreting the findings as the percent change in a) the expected survival time for each 1-SD increase in frequency of use of an individual coping strategy and b) the comparison of each coping variability level to the reference levels (lower or moderate variability level, depending on the models; looking at all possible contrasts). A positive coefficient indicates that the predictor is associated with greater longevity. Model 1 adjusted only for age, Model 2 further controlled for race/ethnicity, census tract residential income, and marital status, and Core Model 3 additionally included prevalent chronic conditions. Exploratory Model 4 further adjusted for alcohol consumption, physical activity, diet quality, and smoking status.

Secondary models. Two sets of secondary analyses were conducted. First, to reduce potential concerns about reverse causation, whereby underlying declining physical health could impact the use/report of coping strategies, the primary models were re-evaluated after excluding participants who died ≤2 years of baseline (n_{deaths}=42; analytic subsample: N=54,311). Second, given documented sociodemographic differences in coping strategies used (Brantley et al., 2002; Brennan et al., 2012), we evaluated moderation by age (median-split: ≤47 years [n=28,180] versus >47 years [n=26,173]), racial/ethnic subgroups (Whites [n=52,777] versus racially-underrepresented individuals [n=1,576]), census tract residential income (median-split: ≤$61,500 [n=27,141] versus >$61,500 [n=27,212]), and marital status (married/in a relationship [n=43,647] versus divorced, separated, or widowed women [n=10,706]). Interaction terms with continuous coping scores were added to the primary models; if found statistically significant (p<0.05), stratified analyses by relevant subgroups were performed.

RESULTS

Baseline characteristics

Table 2 shows the main characteristics of the analytic sample at baseline. Participants were on average 47 years old (SD=5; range=36-56). Most participants were White and married/in a relationship. Slightly over a fifth of the analytic sample were obese but <10% had hypertension. Few participants were current smokers and half of them consumed 1 alcoholic drink per day on average. When examining the distribution of covariates across coping variability levels, no meaningful differences were noted, except that women with lower variability were slightly more likely to be obese, current smokers, and daily alcohol consumers. Supplemental Table 2 presents descriptive statistics and a correlation matrix of coping variables. Correlation coefficients were of varying magnitude and modest at best ($|r|$=0.00-0.53), further supporting the study of subscales separately. Adaptive coping strategies were, in most cases, inversely and modestly correlated with maladaptive ones (Carver et al., 1989). The magnitude of coefficients between coping variability and individual strategies was null-to-moderate, highlighting the unique nature of coping variability.

Associations of coping strategies with predicted lifespan

Over the follow-up period (mean=16.08 years, SD=1.19, range=0.17-18.00 years), 1614 participants died (2.97%). Associations of baseline coping variables with percent changes in predicted lifespan over follow-up are reported in Table 3. When considering individual adaptive strategies, even if age-adjusted estimates became slightly attenuated after further adjusting for other sociodemographics in Model 2 and then health status in core Model 3, associations remained evident with Active Coping, Religion, and Use of Emotional Support (4.09%, 3.16%, and 3.50%, respectively). Acceptance was unrelated to lifespan. Similarly, the strength of age-adjusted estimates with maladaptive strategies was slightly diminished after adding other sociodemographic

and health status covariates, but remained present for Denial, Behavioral Disengagement, and Self-Blame (-4.05%, -6.56%, and -2.85%, respectively). However, Focus on & Venting of Emotions was unrelated to lifespan. Compared to lower coping variability levels, moderate and greater levels at baseline were associated with 7.51% and 9.86% longer lifespan, respectively, in fully-adjusted Model 3. Greater variability levels, though, were not associated with additional gains in lifespan when compared to moderate levels. After including behaviors in the core Model 3, Active Coping and Use of Emotional Support remained associated with gains in lifespan, but Religion became unrelated with lifespan. In the Religion model, the strongest coefficients of behavioral covariates were those of current and past smoking. Although Denial, Behavioral Disengagement, and Self-Blame estimates as well as those for coping variability were slightly attenuated after additionally controlling for health behaviors, these associations remained present.

Secondary analyses

When excluding participants who died within the first two years after baseline, associations were largely unchanged (data not shown). The inclusion of interaction terms between age, race/ethnicity, residential income levels, and marital status, respectively, and each coping variable to Model 3 revealed limited evidence of moderation by sociodemographic factors. Among the sixteen interaction terms tested, only four were statistically significant: two varied by age and one by income levels and marital status, respectively. In stratified models, confidence intervals overlapped across all respective subgroups and several included the null (Focus on & Venting of Emotions: younger=3.30%, 95%CI=-0.35, 7.09, older=-2.86%, CI=-5.67, 0.04; $p_{interaction}$=.01; Denial: younger=-6.28%, CI=-9.11, -3.37, older=-2.96%, 95%CI=-5.46, -0.39; $p_{interaction}$=.04; Emotional Support: lower residential income=5.54%, 95%CI=2.42, 8.76, higher residential income=0.82%, CI=-2.49, 4.26; $p_{interaction}$=.0496; Religion: married/in a relationship=4.93%,

95%CI=2.00, 7.93, divorced, separated, or widowed=-0.36%, CI=-4.13, 3.56; $p_{interaction}$=.04). No significant interaction term was observed by racial/ethnic groups.

DISCUSSION

This study characterized the associations of individual coping strategies and coping variability at study's baseline with changes in predicted lifespan among initially-healthy midlife women over 18 years, beyond traditional sociodemographic and medical risk factors. As hypothesized, results indicated that greater use of various adaptive coping strategies (active coping, religion, emotional support) was associated with up to 4% longer lifespan, whereas greater use of several maladaptive strategies (denial, behavioral disengagement, self-blame) was related with up to 7% shorter lifespan. Moreover, participants who showed greater versus lower dispositional coping variability levels in the use of these strategies at baseline had up to 10% longer lifespans. With the life expectancy of U.S. 65-year old women being 85.7 years in 2018 (National Center for Health Statistics, 2021), a 4-10% longer lifespan represents 3-9 added years of life. These associations were generally maintained when further adjusting for health behaviors and after introducing a 2-year lag. A handful of interaction terms of age, residential income levels, and marital status, with individual coping strategies, respectively, were statistically significant. In stratified analyses, the clearest distinction between confidence intervals appeared with the use of Focus on & Venting of Emotions across age groups: younger women had a marginal 3% longer lifespan whereas older women had a marginal 3% shorter lifespan with every 1-SD increase in the use of this strategy. It is possible that, for younger individuals in particular, the focus on emotions may serve as a way to understand one's emotional experience and reinterpret the stressful situation, and the venting of emotions to others may prompt guidance- and support-seeking to handle the stressor. Alternatively,

older relative to younger women may understand or interpret these items somewhat differently. Nonetheless, in the present study the confidence intervals of all stratified analyses overlapped and several included the null, somewhat attenuating plausible meaningful distinctions in the coping-lifespan linkage across these sociodemographic subgroups.

At first, the current main results with individual coping strategies appear inconsistent with those obtained from the two Japanese studies described earlier in which only the adaptive strategy of reappraising was associated with reduced mortality (Svensson, Inoue, Sawada, Charvat, et al., 2016; Svensson, Inoue, Sawada, Yamagishi, et al., 2016). However, in these studies, the number of deaths by level of coping strategy used was, at times, relatively small (<50); cultural differences and the investigation of cause-specific mortality risk rather than changes in predicted lifespan might also explain such discrepancies. Nonetheless, the present primary results are consistent with the ones observed in U.S. Black women that showed a lower mortality risk with greater reliance on religion/spirituality (VanderWeele et al., 2017). The current findings based on individual coping strategies also replicate findings obtained in U.S. middle-aged adults that found shorter lifespan was associated with greater use of Denial and Behavioral Disengagement (Trudel-Fitzgerald et al., 2022). However, while this prior study found a protective role of moderate coping variability levels but a detrimental role of greater coping variability levels on lifespan, the current study findings suggest that both moderate and higher variability levels at baseline may promote longer lives.

A monotonic relationship between coping variability and favorable outcomes suggesting more variability is better has been a source of debate (Aldao et al., 2015; Cheng et al., 2014). The current results hint that more dispositional coping variability may be advantageous for physical health, at least to a certain level. It is indeed possible that when much greater variability exists, such higher levels relate to negative health outcomes, by reflecting the rigid use of the same few

strategies across distinct situations, regardless of their fit with the context, and a less effective attempt to handle stressors and their related psychological responses (Aldao & Nolen-Hoeksema, 2013). To empirically validate the present dispositional Between-Strategy Index, we calculated coefficient correlations between each individual coping strategy by coping variability levels at baseline (see rationale and results in Supplemental Text 1) and results are aligned with this hypothesis. Or it may be there is a point beyond which greater variability is simply not beneficial. In both the current study and the prior one (Trudel-Fitzgerald et al., 2022), variability levels were based on a set of coping strategies that encompassed an equal number of strategies deemed adaptive and maladaptive; yet, individual strategies themselves only partly overlapped across the two studies, which could also explain the different patterns obtained between coping variability levels and lifespan changes.

In exploratory analyses, further controlling for behavioral factors slightly attenuated estimates, particularly for Religion, like in prior research (VanderWeele et al., 2017). Although most associations remained evident, such attenuation could suggest that health behaviors partially mediate the coping-lifespan relationship. It is well-established that detrimental health behaviors (e.g., smoking) predict shorter lives (Loef & Walach, 2012). Limited research, mostly cross-sectional or experimental in design, has also indicated that regulatory processes like coping are associated with certain behavioral factors, especially for strategies deemed maladaptive (Doron et al., 2015; Taut et al., 2012). Because health behaviors can be regulatory processes themselves (Mezuk et al., 2013; O'Leary et al., 2018; Park & Iacocca, 2014), the current results may imply that individuals who use religious coping strategies to handle challenges are less likely to smoke to handle stressors and in turn, live longer than their less religious and smoker counterparts. Yet, future studies that evaluate specifically whether individuals are using cigarettes, alcohol

consumption, unhealthy foods, or physical activity as means of coping with stressors will help determine to what extent these behavioral strategies explain the coping-lifespan association.

Biological mechanistic pathways may also be involved. Notably, hypertension is an established determinant of chronic conditions that increase mortality risk (Lloyd-Jones, 2014). However, adjusting for this condition did not meaningfully change the present estimates, which is consistent with prior research finding no clear association of religious/spiritual coping with hypertension among midlife women (Cozier et al., 2018; Spence et al., 2020) nor substantial attenuation after controlling for major cardiovascular conditions in prior coping-lifespan research (Trudel-Fitzgerald et al., 2022). In parallel, limited longitudinal findings on inflammation suggest increasing use of emotional expression over five years, but not of other strategies like emotional support, was associated with a decrease in C-reactive protein (CRP) over that same period among women but not men (Shimanoe et al., 2018). In two cross-sectional studies, avoidance but not other strategies like problem-solving was related to higher allostatic load levels, a marker of physiologic dysregulation across bodily systems (Juster et al., 2016), and unhealthier cholesterol and microalbuminuria, an early sign of vascular damage levels (du Plessis et al., 2010).

This study has several limitations. First, the COPE inventory does not capture the nature of stressful events experienced, which impedes the study of strategy-context match itself. Stressors can also vary widely in intensity (e.g., death of versus argument with a spouse) and across participants, which may influence which coping strategies are employed and the amount of effort devoted in the use of each one. However, prior findings on the coping-health relationship have indicated similar results when specific stressors were imposed by researchers (e.g., all participants reported how they cope with the death of a spouse) and when participants selected stressors (Penley et al., 2002). Furthermore, coping was assessed only once in the NHSII, which prevents the investigation of how

dynamic changes in these regulatory processes across days or contexts may affect lifespan. Yet, previous studies documented meaningful associations of between-strategy variability at only one time assessment with within-strategy variability of various strategies across multiple assessments (meta-analytic r=.47, p<.001), suggesting individuals who prioritize some strategies over others at any given moment, as habitual coping tendencies, are also likely to select some strategies over others across diverse situations over time (Blanke et al., 2020).

Lastly, participants involved in this study consisted mainly of female nurses, which limits generalization of the present results to men because they could differ both in terms of coping strategies used and longevity. For instance, evidence suggests that, relative to women, men are less likely to engage in strategies like seeking social support and venting emotions when facing stressors (Brennan et al., 2012; Carver et al., 1989) and also have a shorter life expectancy (National Center for Health Statistics, 2021). Yet, the prior similar study conducted in another sample of U.S. adults found no significant difference in the coping-lifespan association by gender (Trudel-Fitzgerald et al., 2022), suggesting that even if differences in which coping strategies are used and in longevity exist between men and women, they might not be consequential in the coping-lifespan association. Besides, the current sample is homogenous with regard to occupation. Data suggest health status and behavioral factors predict physical health outcomes similarly in occupational cohorts versus population- and community-based samples (Batty et al., 2014). However, nurses may be more emotionally resilient and exhibit greater conscientiousness (e.g., show self-discipline) particularly with regard to health factors than other women and men in the general population who may or may not be working (Louwen et al., 2023; Williams et al., 2009). While the present results with the individual coping strategies replicated those of prior work conducted among the general population, these traits often observed among nurses specifically might explain why lifespan benefits were

observed even among women with greater coping variability levels. Lastly, most participants involved in this study were White and the number of distinct racially-underrepresented individuals (e.g., Asians women) in this sample was too limited to study them separately.

Many strengths should be underlined too. We relied on richly-characterized longitudinal data obtained in a large sample and considered multiple relevant covariates in the current statistical analyses. The present study used a validated coping scale that captured various ways midlife adults may typically face stressors and handle their related responses, which permitted the comparison across multiple coping strategies at baseline with predicted lifespan. Moreover, we moved beyond the inherent (mal)adaptive nature of strategies by exploring whether variability in their use, as defined by the dispositional Between-Strategy Index, may relate to lifespan. Lastly, we contributed to ongoing replication efforts by investigating if the association of coping strategies and variability with lifespan in this sample aligns with findings from a prior similar study led in a distinct cohort (Trudel-Fitzgerald et al., 2022); we also extended this work by exploring whether these associations were universally beneficial/detrimental across various sociodemographic subgroups.

Altogether, stress-related coping strategies were associated with 4-7% changes in predicted lifespan in expected directions and beyond traditional risk factors. These associations existed across several sociodemographic subgroups, suggesting that adaptive and maladaptive strategies might be broadly beneficial or detrimental, respectively, within women regardless of their age, race/ethnicity, residential income levels, and marital status. Moreover, greater variability in strategies generally used was related with up to 10% gains in lifespan, which translates into 9 additional years. Further insight will be gained from studies in which repeated information about specific stressors, related coping strategies, and their impact are reported (Blanke et al., 2020), along with long-term health outcomes. Such investigation will permit the examination of participants' perception of how

successful specific strategies are to decrease stress across situations and, consequently, may provide information about coping flexibility beyond numerical variability. Building such empirical evidence may be a promising avenue for developing and evaluating transdiagnostic prevention strategies that would require less resources than those needed to separately address distinct emotions or stressors.

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Table 1. Example of the dispositional Between-Strategy Index to capture an individual's general level of coping variability with fictitious data.

Participant number	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Dispositional Between-Strategy Index	Mean strategies endorsement
1	4	4	4	3	3	3	0.55	3.50
2	1	1	1	2	2	2	0.55	1.50
3	6	1	3	1	1	1	2.04	2.17
4	0	0	3	3	3	0	1.64	1.50
5	6	6	6	0	0	0	3.29	3.00
6	0	0	6	6	0	0	3.10	2.00

Notes. The Dispositional Between-Strategy Index and this example table are adapted from Blanke and colleagues' study on the Between-Strategy Index (Blanke et al., 2020) and is based on a prior similar study conducted in another longitudinal cohort study that also used the COPE inventory at study's baseline (Trudel-Fitzgerald et al., 2022). Data are from six fictitious participants and their rating of the frequency with which they used six coping strategies on a scale from 0 (not at all) to 6 (all the time). Individuals displaying lower variability scores (e.g., participants 1 and 2) would generally use all strategies simultaneously to a similar extent (displaying high evenness in their coping scores across strategies) across circumstances, whereas those with greater variability scores (e.g., participants 5 and 6) would be more likely to select only a few strategies from their repertory and rely heavily on them without using other strategies (displaying high unevenness in their coping scores). By contrast, individuals exhibiting moderate variability scores (e.g., participants 3 and 4) might use several strategies but each to a different extent or use a few strategies to a modest extent, possibly reflecting an attempt to find the best strategy in a given context (displaying moderate unevenness in their coping scores) (Blanke et al., 2020; Trudel-Fitzgerald et al., 2022).

Table 2. Age-standardized characteristics of participants at the 2001 baseline.

		Coping variability levels		
	Entire sample (N=54,353)	Lower (n=18,021)	Moderate (n=18,263)	Greater (n=18,069)
*Age, mean (SD)	46.7 (4.7)	46.6 (4.6)	46.6 (4.7)	46.7 (4.7)
White, %	97.1	97.1	97.0	97.2
Married, %	80.3	78.9	80.4	81.6
Census tract income in thousands of $US, mean (SD)	66 (24)	66 (24)	66 (24)	66 (24)
Prevalent/history of hypertension, %	8.6	9.2	8.4	8.2
Prevalent obesity, %	22.0	24.7	21.6	19.8
Smoking status				
- Never smoker, %	66.2	64.5	66.4	67.6
- Former smoker, %	25.7	25.9	25.7	25.5
- Current smoker, %	8.1	9.5	7.9	6.8
METS/week of physical activity, mean (SD)	21.1 (26.4)	19.3 (25.0)	21.3 (26.1)	22.9 (27.9)
**Diet quality, mean (SD)	47.2 (11.0)	46.3 (10.8)	47.4 (11.0)	48.0 (11.1)
Alcohol consumption				
- 0 drink/day, %	39.0	37.3	38.0	41.7
- 1 drink/day, %	57.9	59.6	58.8	55.5
- ≥2 drinks/day, %	3.0	3.1	3.2	2.8

Notes. Values are means (SD) for continuous variables; percentages or Ns or both for categorical variables, and are standardized to the age distribution of the study population. Values of polytomous variables may not sum to 100% due to rounding.

* Value is not age adjusted.

** Based on the Alternative Healthy Eating Index score without alcohol, where scores range from 0 [poorer] to 100 [healthier].

Table 3. Percent differences in predicted lifespan associated with the adoption of coping individual strategies and variability levels.

	Model 1 % (95% CI)	Model 2 % (95% CI)	Core Model 3 % (95% CI)	Exploratory Model 4 % (95% CI)
Individual coping strategies (per 1-SD increase)				
Active Coping	5.16 (2.87, 7.50)**	4.54 (2.28, 6.87)**	4.09 (1.83, 6.41)**	3.66 (1.39, 5.97)**
Acceptance	0.36 (-1.93, 2.70)	0.60 (-1.69, 2.94)	0.49 (-1.79, 2.83)	0.66 (-1.62, 2.99)
Religion	2.70 (0.40, 5.05)*	3.18 (0.85, 5.56)**	3.16 (0.82, 5.54)**	1.55 (-0.78, 3.94)
Use of Emotional Support	4.28 (1.97, 6.64)**	3.70 (1.41, 6.05)**	3.50 (1.22, 5.84)**	3.02 (0.76, 5.35)**
Focus on & Venting of Emotions	-0.65 (-2.91, 1.65)	-0.81 (-3.06, 1.49)	-0.77 (-3.01, 1.54)	-0.11 (-2.37, 2.20)
Denial	-4.84 (-6.73, -2.92)**	-4.26 (-6.16, -2.32)**	-4.05 (-5.96, -2.10)**	-3.88 (-5.37, -1.49)**
Behavioral Disengagement	-7.65 (-9.44, -5.83)**	-7.01 (-8.81, -5.17)**	-6.56 (-8.37, -4.72)**	-5.88 (-7.70, -4.03)**
Self-Blame	-3.75 (-5.90, -1.55)**	-3.24 (-5.40, -1.03)**	-2.85 (-5.01, -0.64)**	-2.42 (-4.58, -0.20)*
Variability in coping strategies used				
Moderate versus lower variability	9.10 (3.12, 15.43)**	8.36 (2.42, 14.64)**	7.51 (1.62, 13.75)**	6.60 (0.77, 12.77)*
Greater versus lower variability	12.48 (5.95, 19.41)**	11.04 (4.60, 17.87)**	9.86 (3.49, 16.61)**	8.40 (2.12, 15.06)**
Greater versus moderate variability	3.10 (-2.80, 9.34)	2.47 (-3.38, 8.68)	2.17 (-3.65, 8.36)	1.68 (-4.11, 7.83)

Notes. N=54,353, n_{deaths}=1614 (deaths per level of variability: lower=495, moderate=520, greater=599). Although individual coping strategies and coping variability levels are presented in the same table, they represent distinct analyses. *$p \leq 0.05$; **$p \leq 0.01$. CI=confidence interval, SD=standard deviation.
Model 1 adjusted for baseline age. Model 2 adjusted for baseline age, race, census tract income, and marital status. Model 3 adjusted for Model 2 + baseline hypertension and obesity. Model 4 adjusted for Model 3 + alcohol consumption, physical activity, diet quality, and smoking status. All variability models further adjusted for the mean level of strategies used. As detailed in the Methods section, individuals categorized with lower variability may be more likely to use all strategies simultaneously to a similar extent, whereas those with greater variability are more likely to select and rely on just a few strategies in their repertory; by contrast, individuals categorized with moderate variability tend to use most or all strategies to varying extent.