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Clarifying Adversity in Aging: Developing a Novel Measure of Cumulative Life Stress in Older Adulthood

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CLARIFYING ADVERSITY IN AGING: DEVELOPING A NOVEL MEASURE OF CUMULATIVE LIFE STRESS IN OLDER ADULTHOOD

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As our global population age rises, so does the need for quality, age-informed healthcare (World Health Organization, n.d.). To clarify treatment priorities, age-appropriate measures are needed to articulate sources of adversity in aging (Wulsin et al., 2022). A key target proposed in the aging literature is cumulative life stress, or the totality of acute and chronic stress experiences that individuals encounter in their lifespan (Epel, 2020). Life course developmental theories point to the role of cumulative life stress in aging health outcomes. However, relevant research is limited and yields mixed results due in part to the lack of age-specific tools for quantifying cumulative life stress (Aldwin, 1990). Mindful of this gap, the present study sought to develop and validate a novel measure of cumulative life stress, the Older Adulthood Stress and Adversity Inventory (Older Adult STRAIN), to help 1) identify aging adults at higher risk for adverse health outcomes, 2) clarify personalized treatment targets, and 3) inform the development of effective individual and population level interventions for healthy aging.

Developed in collaboration with the target population and expert reviewers, the Older Adult STRAIN was then validated, using a cross-sectional design, in a sample of 126 community-dwelling older adults (ages 59-95 years). Participants completed the Older Adult STRAIN as well as measures of stress (past year, present, daily hassles), mental health

(depression, anxiety, quality of life, cognitive function), and physical health (sleep quality, doctor diagnoses). As expected, the Older Adult STRAIN demonstrated good concurrent validity with all stress measures as well as with those assessing mental and physical health. Findings also revealed significant variability in the associations between stress experiences and various health outcomes as a function of stressor type, timing, life domain, and psychosocial characteristic, highlighting the potential for and value of more granular analytical approaches.

The present study advances stress research by developing and providing initial validation for a precision tool for assessing cumulative life stress from the perspective of older adulthood. The Older Adult STRAIN is well-positioned to contribute to research that improves clinical care and healthcare policies for aging adults as well as their families and communities.

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CHAPTER 1: INTRODUCTION

Aging & Stress

Older adult health is a rising public health priority (Fulmer et al., 2021; National Institute on Aging, 2020). Our global population is aging at an unprecedented pace, with older adults being the fastest expanding subgroup (World Health Organization (WHO), n.d.). Today, most adults can expect to live well into their 60s as people across the globe increasingly stave off illness, compress morbidity into later years, and live longer. By 2050, it is expected that the world's population of adults aged 60 years and beyond will double to over 2 billion, and that of adults aged 80 and beyond will triple to 4.25 million (WHO, n.d.). This demographic shift will continue to exert profound impacts on health and social systems around the world, as the need for older adult-specific health care increases exponentially. Designing policies and infrastructures to meet this amplified need requires the clarification of key treatment targets for older adult health interventions. This effort requires precision tools for measuring and articulating adversity in older adulthood. Currently, very few measures for quantifying and/or qualifying older adulthood-specific stress have been developed. The current project seeks to develop and validate a theoretically driven and empirically grounded measure of older adulthood stress that can inform individual and population level interventions for health in aging.

Primary among the treatment targets proposed in the aging literature is stress, a complex construct central to human health and developmental research (Almeida et al., 2011; Epel, 2020). Classically conceptualized in the psychobiological context by Hans Selye (1976) as "the non-specific response of the body to any demand for change," existing literature now reflects myriad operationalizations of stress ranging in focus from objective environmental challenges or stimuli

to subjective appraisals and responses to physiological stress reactivity/recovery processes (Cohen et al., 2019). As a vast and interdisciplinary field, stress research reflects several key concepts for characterizing life stress. First, *stress dimensions* describe the ways in which stressors are encountered and may be measured as stress exposures (e.g., stressful life events), subjective experiences (e.g., perceptions or appraisals of stressors), and/or physiological reactions thereto (e.g., heart rate variability or psychoneuroimmunological impacts). Second, stressors may be categorized into *stressor types* related to their duration and magnitude (e.g., acute life events, chronic stressors, daily hassles) or their core characteristics (e.g., psychosocial or physiological stressors). Third, stress experiences may be organized into one or more *stress domains* or functional areas of life such as growth and maturity, relationships, housing, health, or finances. Fourth, stress experiences may be studied both in the context of the *developmental stage* in which they were encountered/experienced (e.g., prenatal periods, infancy, early childhood, adolescence, and/or various phases of adulthood) as well as via their cascading impacts across subsequent stages of development. Finally, while each of these aspects of stress may be measured in isolation, a growing body of theory and research implicates a role for their combined or *cumulative impacts* in conferring unique and additive risk for adverse health outcomes (Ferraro & Morton, 2016; O'Connor et al., 2021).

Cumulative life stress is broadly defined as the totality of acute and chronic stress exposures and experiences that individuals encounter over the course of their lifetime (Slavich, 2016; Slopen et al., 2018). This construct is particularly salient in the context of older adulthood because older adults have accrued experiences across the greatest span of developmental stages and are in a unique position to advance our collective understanding of how stress, and relatedly various

forms of resilience (e.g., psychological, social, physical), impact mental and physical health throughout later stages of life (Epel et al., 2018; Gorska et al., 2021). Research into cumulative life stress suggests several moderating and mediating pathways through which additive stress compounds adverse health outcomes. These include personal and environmental factors as well as characteristics of the stress exposure itself.

Regarding the first, studies have found that age, as a stable factor in relationship to other evolving sociodemographic, psychosocial, and situational factors, impacts both the exposure and experiential dimensions of stress (Almeida et al., 2011). In other words, both individuals' risk of encountering certain stressors as well as their psychological and physiological responses to stress are moderated by age-related strengths and vulnerabilities. Research in prenatal to adolescent samples has found evidence for the presence of critical or sensitive periods in development when cognitive, emotional, and biobehavioral systems are maximally influenced by stress exposures (Ben-Shlomo & Kuh, 2002; Hertzman & Boyce, 2010; Knudsen, 2004). However, further research is needed to ascertain the salience of critical periods across adult stages of development, including older adulthood (Slopen et al., 2018). Recent work also suggests the influence of cohort or period effects within developmental stages such that both exposures to and perceptions of stressors change based on cohort status. For example, currently middle-aged adults are projected to present a different relationship between stress and aging in older adulthood than present older adults, one driven by increased endorsements of stress that will have far-reaching impacts from individual to infrastructural levels (Aldwin et al., 2021; Almeida et al., 2020).

Regarding the differential impacts of various types of stress (e.g., major life events, daily hassles, chronic difficulties), studies suggest that the accumulated effect of interacting types of stressors over time has greater negative impacts on health than that of any single type of stressor or event alone (Almeida et al., 2011; Almeida & Wong, 2009). For instance, chronic difficulties, such as chronic pain or financial strain, may amplify emotion and physiological reactions to daily hassles by depleting psychological, physical, and/or monetary resources available for effective coping (Serido et al., 2004) and/or by increasing negative appraisal (Lazarus, 2006). This compounded stress response can, in turn, exacerbate reactivity to other concurrent stress experiences, of various types or life domains, resulting in increased vulnerability to adverse health outcomes (Kiecolt-Glaser et al., 2020).

Further, among stressor types, research has found that psychosocial stressors, defined as social or situational experiences that overwhelm individual adaptive capacities, have particularly adverse and cumulative impacts on mental and physical health (Cohen et al., 2007; Ferraro & Morton, 2016; McEwen, 1998; Turner & Lloyd, 1995). Taken together, this literature suggests that the character and timing of stress experience matter. However, while research in younger samples (e.g., children, adolescents, adults) has found robust support for the adverse impacts of intra- and inter-developmental stage cumulative life stress on various health parameters, scant work has been done to clarify the trajectories of this relationship in later stages of life, likely due to the lack of precision tools for age-attuned measurement. It follows that, to accurately assess stress in older adulthood and thereby to enable reliable prediction of health outcomes that will shape public health and policy for decades to come, research requires a cumulative life stress measure

that can capture not only the variety of stressors older adults encountered in previous developmental stages but also those introduced in or unique to their present.

In summary and preamble, the dramatic growth of our aging population has made the psychological and physical health of older adults a global public concern. The stress and health literatures point to stress as a primary treatment target due to its cumulative effects on aging at individual, community, and population levels. These resounding impacts highlight the need for research that focuses on cumulative life stress in older adulthood to advance the field's understanding of relevant mechanistic pathways and to support targeted, age-affirmative clinical intervention and care. At present, the dearth of precision tools for measuring cumulative older adult stress risks functioning as a barrier to studying it, let alone managing it (Wulsin et al., 2022). The following section reviews theories and research germane to the development of an older adulthood-specific measure of cumulative life stress. This literature clearly implicates a role for cumulative life stress in aging health and emphasizes the need for a tool to study this important construct in a population largely unrepresented in the literature.

Lifespan Developmental Theory & Research

Life course and developmental sciences posit profound, intersystemic linkages between cumulative life stress and various mental and physical health outcomes across the life span. Broadly, life span theories focus upon differences within and between individuals as they evolve in their unique biological, psychological, social, and historical contexts (Baltes et al., 1998; 1999). These theories assert that individuals accumulate experiences over the lifespan which, at any given point, reflect both the consequences of previous experiences and the antecedents of future experiences (Almeida et al., 2011). Viewed within this framework, older adult health is

characterized as the aggregation of distal and proximal factors which include the long-arm impacts of early childhood experiences as well as adverse experiences encountered in various stages of adulthood (Ben-Shlomo & Kuh, 2002). Although life span theories align in positing a role for cumulative life stress in disease etiology, they reflect several important and as yet unreconciled differences with regard to the impacts of age on stressor exposure and reactivity.

Literature positing decreased stress exposure and/or reactivity with aging. Two influential theoretical perspectives assert that older adulthood is associated with decreased stress exposure and/or reactivity. The Socioemotional Selectivity Theory (SST; Carstensen, 1987; Carstensen et al., 1999) posits that older adults experience fewer stressor exposures and reduced stress reactivity due to skillful emotion regulation, particularly situation selection and cognitive reappraisal, respectively. Situation selection describes the process whereby an individual chooses to engage or avoid situations associated with undesirable emotional outcomes (Sands & Isaacowitz, 2017). As such, it reflects early or preemptive emotion regulation that takes places prior to the anticipated emotion-inducing event. On the other hand, cognitive reappraisal, whereby an individual reinterprets an emotional situation to modify their emotional and physiological responses, takes place after the emotion-inducing event (Urry & Gross, 2010). These emotional regulation strategies may be employed independently or together to modulate the ultimate impact of a stressful experience.

According to SST, older adulthood is characterized by age-moderated motivational shifts towards fostering emotionally salient goals, promoting positive affect, and avoiding unnecessary stress, all of which are influenced by one's lifetime experiences as well as an awareness of one's finitude (Charles & Hong, 2016). The selectivity born out of this shift results in more intimate

social networks and predictable daily routines, which are in turn associated with fewer overwhelming stressors and less stress overall. However, an important caveat is that while the posited selectivity may result in fewer overall exposures, the composition of the exposures may change. For instance, an increased emphasis on select social relationships may, in turn, lead to increased incidents of "network stressors" or stressors encountered by loved ones within an older adult's social network that are experienced vicariously by the older adult (Almeida & Horn, 2004). This suggests that repeated exposures to network stressors may also be a key factor for age-appropriate health-prediction models. Stress measures that do not adequately account for the frequency or multiplicity of such experiences would fail to accurately reflect the individual's accumulated exposure and related risk.

Research has provided empirical support for several mechanisms of SST, finding that older adults tend to prioritize fewer, more intimate social connections (Carstensen, 1992), to endorse more positive and stable daily emotional experiences (Burr et al., 2020; Carstensen et al., 2011; Carstensen et al., 2020; see also Grossman et al., 2014; Li et al., 2021 for multicultural perspectives), to react less to negative situations (Reed et al., 2014), and to attend to positive, low-arousal affective experiences over those that are negative or emotionally demanding (Mather & Carstensen, 2005; Mather, 2012; Scheibe et al., 2013). However, research also suggests that SST-predicted trajectories may not hold across later stages of life (Stawski et al., 2004). For instance, a recent study of age differences in coping with daily hassles found that older adults reported similar stress exposures to younger adults though they tended to rate these events as less unpleasant and to engage more proactive coping strategies to mitigate negative impacts (Neubauer et al., 2019).

In line with SST, inoculation-based theories assert that older adulthood is associated with decreased stress reactivity. Accordingly, older adults are thought to become less reactive to stress because their accumulated experiences - the aggregation of understanding, knowledge, and resources that they gathered across their lives – mitigate their response (Baltes et al., 1999; Blanchard-Fields, 2007; Schiebe & Carstensen, 2010; Whitebourne, 1985, 1986). Research suggests that this reduced reactivity may be attributable to appraising fewer situations as stressful or perceiving upsetting contexts less intensely (Charles & Carstensen, 2010), enhanced emotion regulation (Labouvie-Vief & DeVoe, 1991; Lang et al., 1998), greater impulse control (Diehl et al., 1996), a sense of mastery (Kok et al., 2021), or the "dampening" effects of repeated exposure, and hence habituation, to negative affect states (Lawton, 1996). Dampening effects have also been proposed in the psychophysiological literature. Some biobehavioral research suggests that age-moderated reductions in interoception, or the awareness of bodily sensations that may shape or contribute to experiences of stress, could help to explain reduced stress experiences, however, more research is needed to clarify this relationship (Critchley et al., 2004; Mather & Ponzio, 2016).

Additionally, the "aging-brain model," posits that age-related declines in the structures tasked with monitoring for negative stimuli, namely the amygdala, leads to reduced activation and arousal (Cacioppo et al., 2011, p. 249). Notably, research comparing amygdala function in younger and older adults suggests relatively preserved detection abilities in older adulthood, with findings effectively reiterating key roles for emotion regulation and cognitive control, or the ability to direct attention in service of emotional goals (Mather, 2012). Taken together, SST and inoculation or dampening theories posit significant psychological and physiological pathways through which cumulative life experiences, including stress, are associated with decreased stress

exposure and/or reactivity in later life. However, further research, integrating age-informed measurement such as the Older Adult STRAIN, is needed to explore their implications across older adulthood, particularly to help clarify the independent and shared contributions of cognitive and affective function to stress experiences in aging.

Literature positing increased stress exposure and/or reactivity with aging. In contrast to theories proposing decreased stress exposure and/or reactivity in later life, several influential theories posit that older adulthood is associated with increased stress exposure and/or reactivity. Stress proliferation perspectives assert that stressors encountered in one role or domain of life can create or compound stressors in other roles and domains resulting in increased stress exposure (Pearlin et al., 1981; Pearlin, 2010). For example, in the context of an older adult who works full-time and acts as primary caregiver for their spouse or grandchild, stressors associated with one role (e.g., personal sickness or injury, loss of transportation, financial setback) can impact and potentially overwhelm the resources they have available to dedicate to the other, leading to cascading stress exposures between domains. Considering that aging is associated with greater risk for cognitive and/or physical health decline, this phenomenon is particularly detrimental for older adults, particularly those of lower socioeconomic status who have fewer financial and/or social resources with which to navigate amplified stress-related demands (Steptoe & Zaninotto, 2020; Warner Schaie & Willis, 2021).

Further, stress proliferation effects may include exposures within developmental stages as well as interactions therebetween across the lifespan, including adversities encountered in younger stages of life as well as subsequent trajectories influenced by social determinants of health (Hammen, 2005). Research regarding stress proliferation theories and aging has found that early

childhood adversity predicts greater stress exposures in older adulthood which are in turn associated with increased adverse mental and medical health impacts (Arpawong et al., 2022). By extension, a recent study by Inoue and colleagues (2022) also suggests that stress exposures in older adulthood are independently associated with the onset of later life depression when holding childhood adversity constant. These findings highlight the value of research methods that can reliably model stress experiences, including duration and frequency, both within and between developmental stages to help target older adults who are at greater risk.

Several perspectives also posit increased reactivity to stressors due to psychological and physiological factors. In contrast to the inoculating impacts proposed above, sensitization or "kindling" theories assert that repeated stressor exposures can lead to increased reactivity to stress, which may occur via affective (Mroczek & Almeida, 2004; Almeida et al., 2011) as well as neuroplastic adaptation pathways (Van der Kolk, 1997; Woolf & Costigan, 1999). For instance, regarding affective pathways, research with older adult samples has found trait neuroticism to be positively associated with stress reactivity in older adulthood (Mroczek & Almeida, 2004; Mroczek et al., 2006; Ready et al., 2011). Similarly, Kendler and colleagues (2001) found that the repeated experience of depressive episodes lowers individual thresholds for slipping into a subsequent depressive state even without a catalyzing event. These findings suggest that neural networks may be molded by an environmental stimulus to become increasingly attuned and reactive to it. Related work in neuropsychology suggests that age-related shifts in the brain also impact emotional experience, particularly that of negative affect, as structures that contribute to emotion regulation (e.g., amygdala, limbic system) and its physiological response (e.g., sympathetic-adreno-medullar (SAM) axis, hypothalamus-pituitary-

adrenal (HPA) axis) grow increasingly sensitive with age (McEwen & Morrison, 2013; Panksepp & Miller, 1991; Seeman et al., 2001; Uchino et al., 2010).

Similarly, allostatic load theories posit greater reactivity to stressors in older adulthood due to the impacts of chronic activation and its cumulative "wear and tear" on psychophysiological functions (McEwen, 1998; McEwen & Stellar, 1993; Seeman et al., 1997). Research in adult samples has found that allostatic load increases across adulthood into older adulthood (Juster et al., 2010; Moore et al., 2021), with higher allostatic load being associated with depression, cardiovascular disease, diabetes, impaired cognitive function, premature aging, and mortality (Booth et al., 2015; Guidi et al., 2021; Juster et al., 2010; Mayer et al., 2019; Parker et al., 2022; Seplaki et al., 2006; Thayer et al., 2021). Important gender and cultural differences have also emerged that have significant implications for public health and policy. For instance, studies have found that allostatic load is higher among men than women, with differential medical and mental-health related impacts therebetween (Burroughs Peña et al., 2019; Juster et al., 2016; Kerr et al., 2020; Tampubolon & Maharani, 2018). Additionally, studies investigating racial disparities in health outcomes in the U.S. have found that Non-Hispanic Black and Latino individuals demonstrate higher risks of allostatic load and concomitant physiological dysregulation than their white counterparts (Geronimus et al., 2006; Langellier et al., 2021; Moore et al., 2021). The allostatic load research emphasizes the key role that studies using cumulative markers of stress can play in informing policies to reduce exposure to environmental and structural risks and to foster equity and inclusion in access to healthcare. That said, while the stress proliferation, stress sensitization, and allostatic load literatures demonstrate a compelling role for cumulative life stress in adulthood generally, further research is needed to clarify how

this relationship manifests and shifts across later stages of life. To accomplish this goal, studies will require a precision tool for measuring older adulthood-specific cumulative life stress.

Literature positing mixed impacts of aging on stress exposure and/or reactivity.

Finally, several theories attempt to account for these complex, and in some cases contradictory, findings of increased or decreased stress exposures and reactivity in aging by considering the availability of resilience factors or resources for coping with or adapting to stress exposures. For instance, the Selection, Optimization, and Compensation theory (SOC; Baltes & Baltes, 1990) and related Selection, Optimization, and Compensation with Emotion Regulation theory (Urry & Gross, 2010), assert that as older adults encounter normative declines in biological, psychological, and/or social resources, they must 1) select which endeavors to invest in, 2) optimize their engagement in these areas, and 3) compensate for existing limitations. A core tenet of the SOC perspective is that older adults are not just managing losses or coping with decline; they are also continuing to actively enrich themselves and their lives (Lang et al., 2011). Moreover, the SOC theories emphasize that the relationship between stress exposures and experiences is fundamentally moderated by the availability of coping resources, which are accumulated across the life span and meaningfully impacted by age-normative declines in later life (Brose et al., 2013). While few studies have explicitly tested SOC predictions, extant research has found that, in divided attention or dual task paradigms, older adults tend to focus on one task rather than to divide their attention (Huxhold et al., 2006; Li et al., 2001). Further, in this modified context (i.e., focusing on one activity), older adults tend to be able to perform generally as well as younger adults up until task complexity or distractions overwhelm cognitive resources (Krampe & Baltes, 2003; Li et al., 2005). Interestingly, a similar relationship has been found in postural control studies that use dual task walking and talking or memorizing

paradigms. Older adults have been found to prioritize balancing over memorizing or to slow down their speech rate, ostensibly to enable dedication of attention to both tasks (Kemper et al., 2003; Li et al., 2001). While this literature does not settle the matter of whether and to what degree these differences are due to diminished capacities or, alternatively, to implicit or explicit resource conservation efforts (Hobfoll, 2011), it does suggest important intersystemic impacts of shifts in resource availability that are moderated by both age and accumulated stress experiences.

A second perspective salient to cumulative life stress impacts in older adulthood is the theory of Strength and Vulnerability Integration (SAVI; Charles, 2010; Charles & Piazza, 2009). SAVI posits that well-being in older adulthood is associated with strengths, particularly enhanced skills in situation appraisal, selection, and emotion regulation, that allow older adults to avoid and/or mitigate negative experiences. This would suggest that older adulthood is associated with decreases in stress exposures, like the SST discussed above, as well as in stress reactivity, similar to the stress inoculation theories. However, SAVI further asserts that when older adults cannot apply these strengths of aging to mitigate or avoid a negative stress exposure, such as with a demanding or highly arousing event, then they become particularly vulnerable to adverse health outcomes due to their less robust physiological systems (Charles & Carstensen, 2014; Charles & Luong, 2013), as in the allostatic load perspective. Consistent with SAVI, research has found that older adults experience less affective reactivity than younger adults when they are able to avoid stressful experiences but similar levels of reactivity when they cannot (Birditt, 2014; Charles et al., 2009). Recent work also supports that high levels of chronic or sustained stress significantly attenuate the relationship between age and favorable emotional experience (Sliwinski et al., 2021; Sun & Sauter, 2021).

Like SAVI, the Coping, Appraisal, and Resilience in Aging model (CARA; Aldwin & Igarashi, 2016) asserts that due to an awareness of their greater physiological vulnerability to stressors, older adults tend to downplay the stressfulness of situations. This appraisal process is informed and enabled by a lifespan of experiences in building self and situational awareness as well as a sense of what coping strategies are personally most efficient and effective. Cross-sectional and longitudinal research suggests that coping efficacy is relatively stable across the lifespan, while coping effort may decline, possibly due to increased efficiency (Aldwin et al., 2017; Berg & Upchurch, 2007; Newth & DeLongis, 2004). However, recent work by Brennan and colleagues (2012) suggests that while an overall decline in coping may reflect a normative change in later life, this trajectory is impacted by gender, stressors, and appraisal of stressor severity as well as available personal and social coping resources. These findings accentuate the role that stress exposures and experiences across the life span play both in creating contexts of vulnerability but also in potentiating adaptive stress responses.

Taken together, the SOC, SAVI, and CARA literatures emphasize the dynamic contributions of life course stress experiences as well as more proximal occurrences of unavoidable, high-stress exposures and chronic stress to older adult health. They also suggest that aging health trajectories are not monotonic but rather flex in response to experiences of relative vulnerability or strength. However, further research is needed to build a more comprehensive picture of the interactive impacts of stress and resilience across older adulthood, which in turn, necessitates the development of valid tools, like the Older Adult STRAIN, that enable researchers to build increasingly sophisticated and informative models of cumulative life stress in aging.

Overall, these theories are meaningful in suggesting that predictions may be made based upon them as they independently and interactively contribute to a higher-resolution model of stress, and its counterpart resilience, in older adulthood. Although they diverge in their predictions regarding increased or decreased stress exposure and experience across later stages of life, they agree on the relevance of cumulative life stress and the need for precision tools to enable accurate assessment, complex predictive modeling. Research investigating these theories clearly implicates a role for cumulative life stress in older adult health. However, it also reflects conflicting evidence regarding stress impacts as well as outright gaps regarding older adult samples. Considered in concert with the rising priority of older adult health in public policy, these limitations highlight the need for a valid, efficient, and usable measure of older adult cumulative life stress to enable a more complete picture of health and aging moving forward.

Measuring Cumulative Life Stress

The following section provides a scoping overview of cumulative life stress measurement and its limitations with respect to older adult research. First, it will review stressful life event checklists, their designs, benefits, and constraints, as well as related findings in older adult samples. It will then discuss the relative advantages and disadvantages of interview-based methods, which were developed to surmount the shortcomings of checklist measures but, as yet fall short of meeting the need for precision tools for measuring cumulative life stress in older adulthood.

Stressful life event checklists. Since its inception in research over 60 years ago, life stress has largely been queried using self-report life event checklists modeled upon Holmes and Rahe's Social Readjustment Rating Scale (SRRS; 1967) (Dohrenwend, 2006). Checklist measures, such as the List of Threatening Events (LTE; Brugha et al., 1985) the Adverse

Childhood Experiences questionnaire (ACES; Felitti et al., 1998) or the Life Events Checklist (LEC; Gray et al., 2004), query a pre-selected inventory of significant life events each of which may be pre-assigned an impact or stress rating by the scale developer. Exposure is generally assessed dichotomously (i.e., present or absent) with the summation of endorsed items being indicative of total stress. Checklists have also been augmented with items designed to capture the respondent's appraisal of the stressfulness of an event in order to study the impacts of subjective experience alongside objective exposures.

Although life event checklists are economical and flexible to implement in research, they generally cover a limited, often more recent, scope of time (e.g., 6-12 months), focus only on major life events (i.e., not chronic difficulties), and tend to prioritize objective stress exposures over subjective stress responses. For instance, individuals endorsing a particular life event, such as the loss of a loved one, may be assigned the same stress impact rating despite having meaningfully different appraisals of that event and its effect on their lives (e.g., profoundly impairing grief versus relief that the loved one's suffering is over). Checklists have also been criticized for being unreliable, imprecise, biased, and generally vulnerable to the vagaries of mood and memory (Monroe, 2008).

Research using standard adult life checklists (i.e., not older adult-specific measures) with older adults reflects mixed findings regarding the impact of accumulated life stress on health in aging. Studies generally report a negative or no relationship, often finding that older adults endorse less stress than individuals in earlier stages of adulthood (Aldwin, 1990). However, critics suggest that these results are confounded by the fact that standard adult inventories tend to query events

more salient to earlier stages of adulthood, such as reproduction, starting jobs, or getting married and, as such, older adults would tend to endorse fewer items (Pearlin & Skaff, 1995; Zautra et al., 1994). Related findings risk reflecting the composition of the measure more than the respondents' actual stress exposures and, in this, muddle efforts to predict age-relevant health outcomes (Aldwin, 1990).

For this reason, two life event inventories with items of greater relevance to older adulthood have been developed, including the Elders Life Stress Inventory (ELSI; Aldwin, 1990), and the Louisville Older Person Events Scale (LOPES; Murrell & Norris, 1984; Murrell et al.,1984). The ELSI is a 30-item self-report scale that assesses the occurrence over the last year of stressful life events that, based on previous research and target population feedback, older adults are more likely to experience, such as the death of a friend or caretaking for a spouse. For any item endorsed, respondents rate the impact severity of the item on a 5-point Likert-type scale, with higher total exposures and/or severity indicating greater stress experiences. Similarly, the LOPES, is a 54-item inventory of life events experienced over the last 6 months. However, the LOPES includes positive life events, such as a substantial improvement in health or the birth of a grandchild, in addition to more negative events, such as hospitalizations or the death of a grandchild. For each item endorsed, respondents indicate if the event was "good" or "bad" and then rate the impact severity on a 4-point Likert-type scale, with higher total exposures and/or severity indicating greater stress experiences.

Research implementing the ELSI or the LOPES is limited, and the measures' psychometric properties are as yet unexamined. While both measures collect data regarding stressor exposure

and impact severity, neither the ELSI nor the LOPES capture data on the frequency of events over the time period queried, which limits their ability to accurately reflect cumulative stress. However, studies using them have associated cumulative life stress in older adulthood with several adverse health outcomes, including reduced mental and physical health (Blazer et al., 2003; De Frias & Whyne, 2015; De Paula Couto et al., 2011; Owen et al., 2002), poorer quality of life (Kahana et al., 2012), and impaired cognition (O'Hara et al., 2007; VonDras et al., 2005), as well as increased disability (Smith et al., 2020a) and mortality (Lee et al., 2019). While these older adulthood-specific measures remain vulnerable to the general checklist critiques discussed above, findings based upon their implementation in research also suggest a different relationship between aging and stress than previously found. Specifically, in contrast to prior research reporting null or negative findings, studies employing older adult-specific measures indicate significant and positive associations between cumulative life stress and poorer mental and physical health outcomes. In doing so, they highlight the need for precision, age-attuned measures of cumulative life stress.

Interviews. To move beyond the constraints of stressful life event checklist measures (e.g., limited time, stressor type, and dimensional scope), interview-based methods were developed to provide a more comprehensive assessment of stress exposure and experience. Investigator-based interview methods, like the Life Events and Difficulties Schedule (LEDS; Brown & Harris, 1978), Kendler's Life Stress Interview (Kendler et al., 1998), and the UCLA Life Stress Interview (LSI; Hammen et al., 1987), have meaningfully advanced our understanding of cumulative life stress by querying across multiple stressor types, domains, and developmental stages. They also gather contextual information regarding the frequency, intensity, and duration of stress exposures as well as a severity assessment that is informed by

the interviewee but coded according to a manual. This method enables an increasingly complex model of individual stress experiences without being reliant upon subjective stress appraisals that are vulnerable to the pitfalls of any self-report measure (e.g., bias, mood, memory) (Harkness & Monroe, 2016; Slavich, 2016).

While investigator-based interview measures demonstrate superior validity to stressful life event checklist measures, they are also highly resource intensive, requiring significant training and time to administer. Existing investigator-based measures generally also query only the more recent past (e.g., 1 year) and so must be used serially or beyond their intended design for longitudinal designs exceeding that timeframe (Epel et al., 2018). In answer to the resource challenges associated with implementing investigator-administered interview measures and to expand the timeframe queried within the assessment, the UCLA Laboratory for Stress Assessment and Research developed an automated, online interview system, the Stress and Adversity Inventory for Adults (Adult STRAIN; Slavich & Shields, 2018).

The Adult STRAIN (Slavich & Shields, 2018) uses intelligent logic processes to inquire about 55 different stressors that have been found to confer vulnerability to adverse mental and physical health outcomes. The inventory's items were generated based upon extensive reviews of the stress and health literatures to identify stressors that were frequently assessed as well as those that reliably predicted poorer health outcomes. Then, in consultation with stress assessment experts, including raters trained in gold standard investigator-based interview methods like the LEDS (Brown & Harris, 1978), candidate items were refined for comprehensiveness and clarity. Finally, items were integrated into preliminary measure form and pilot tested with members of the target population whose feedback informed the final question set, order, and wording.

In its validated form, the Adult STRAIN's 55 items query 26 acute life events (i.e., time-limited, resolving in 1-2 months) and 29 chronic difficulties (i.e., ongoing, unresolved). Stressors that are conceptualized as being acute, such as being in a car accident, are followed by a count-based query: "How many times has this happened to you?" Alternatively, stressors that are conceptualized as being chronic, such as ongoing marital or financial difficulties, are followed by a duration-based query: "For how long did you experience this?" Both count and duration queries are then followed by questions regarding the timing of the exposure along the respondent's lifespan (i.e., How old were you when this happened?) as well as the respondent's subjective appraisal of its impact on a 5-point, Likert-type scale.

To score the Adult STRAIN, items endorsements are summed to create a total stressor count, which includes both acute and chronic items endorsed. Likewise, impact severity ratings are also summed to create a total severity score. These summary scores may be analyzed in their aggregate forms (i.e., count or severity) or they may disaggregated in several ways to inform various research purposes. First, items may be explored based upon being acute or chronic in nature. A robust literature has found differential impacts related to the chronicity of stress exposure, with ongoing stressors often associated with greater adverse mental and physical health impacts (Mayer et al., 2019; Thayer et al., 2021; see Burani et al., 2023 for contrasting finding). Second, summary scores may be analyzed according to the timing of stress exposures, including early life stress (i.e., before the age of 18), adult life stress, or recent life stress (i.e., past year). This method aligns with research finding meaningful differences in the impact of stress based upon the timing or developmental stage in which it is encountered (Inoue et al., 2022; Polick et al., 2022; Shields et al., 2017). For example, in a recent study of the impacts of

cumulative life stress on physiology and decision-making, McMullin and colleagues (2023) found that a combination of early life stress and recent life stress conferred the greatest risk for both poorer physiological reactivity (e.g., cortisol response) and risky decision-making, particularly among older adult participants. These findings may assist in the development of age-informed interventional strategies to support more adaptive decision-making across adulthood.

Third, items may be investigated according to 12 primary life domains, including housing, education, work, treatment/health, marital/partner, reproduction, financial, legal/crime, other relationships, death, life-threatening situations, and possessions (See Table 1). These categories were rationally derived by the Adult STRAIN scale developers to reflect areas in which stressors have been most frequently reported, investigated, and found to associate with or predict adverse health outcomes (Slavich & Shields, 2018). Each item, whether acute or chronic, is categorized under one primary life domain. For example, the acute stress of losing one's home is categorized under the primary life domain of housing. The chronic stress of ongoing financial strain is categorized under the primary life domain of financial stressors. In addition to reflecting information pertaining to medical factors known to influence health outcomes (e.g., significant illness, hospitalizations, substance use), several primary life domains also map onto key social, or non-medical, determinants of health (e.g., education, job stability and working life conditions, financial strain, housing, and discrimination) that can be valuable in characterizing trajectories of risk and resilience. For instance, in a recent study of the impact of cumulative life stress on prenatal health behaviors, Smith and colleagues (2020b) found that the risk for negative prenatal health behaviors was greatest for women who endorsed stressors related to the education, housing, or marital/partner life domains. These results are poised to inform policies and

interventions that reduce prenatal risk by clarifying the life domains most salient to improving maternal health and subsequent birth outcomes.

Finally, based upon extensive research associating stressors related to psychosocial threat with elevated vulnerability, the Adult STRAIN developers rationally organized the inventory's items under five core psychosocial characteristics including entrapment, humiliation, interpersonal loss, physical danger, and role change/disruption (Dickerson & Kemeny, 2004; Gruenewald et al., 2004; Monroe & Slavich, 2016; Slavich & Shields, 2018; see Table 1). The first, entrapment, targets stressors related to being in a potentially overwhelming situation, such as chronic caregiving or living in unsafe housing. Second, humiliation includes stressors related to exclusion, isolation, or rejection, such as relational infidelity or bullying. Third, interpersonal loss encompasses losses due to separation, such as parental divorce or the dissolution of an important friendship, as well as losses due to death. Fourth, physical danger targets stressors associated with corporal threat, including being assaulted, abused, or receiving a life-threatening diagnosis. Finally, role change/disruption includes stressors related to shifts in identity, purpose, or place, such as experiencing infertility, needing caregiving, or moving to a new home, respectively. These categories offer researchers the opportunity to examine the differential impacts of stressors characterized by certain types of psychosocial threat. For example, in a recent study investigating the relation between social threat stress severity, fronto-cingulate-limbic gray matter volumes, and depressive symptoms in adolescents, researchers found that social threat, operationalized as stressors related to interpersonal loss or humiliation, was associated with greater depressive symptoms at baseline and at 9 months follow-up (Ojha et al.,

2022). These results help to highlight the value of early intervention programs for socioemotional and behavioral health.

The Adult STRAIN's multi-dimensional approach to stress assessment aligns with best practices for the conceptualization and measurement of life stress, which emphasize the value of 1) distinguishing between different categories and types of stress exposures, 2) assessing timing exposure, and 3) gathering both objective and subjective reports of the stress experience (Cohen et al., 1995; Dohrenwend, 2006; Monroe, 2008). By collecting this richly layered data, the Adult STRAIN allows researchers to quantify and qualify stress experiences along the timeline of respondents' lifespans, thus enabling sophisticated investigations of age by developmental exposure stage interactions as well as nuanced analyses of individual differences in stress and related health trajectories.

Table 1: Example Stressors by Primary Life Domain and Core Psychosocial Characteristic

Primary Life Domain	
Death	Death of close friend or loved one from illness, accident, suicide, etc.
Education	Dropping or flunking out of school, suspension, etc.
Financial	Significant financial strain in adulthood, loss of income, etc.
Housing	Losing a home, having no stable home, unsafe neighborhood, frequent moves, etc.
Legal/Crime	Arrest, court appearance, legal problems with spouse, etc.
Life-threatening situations	Physical or sexual abuse, serious accidents, being attacked/assaulted, etc.
Marital/Partner	Chronic conflict, divorce or serious break-up, infidelity, isolation, etc.
Other Relationships	Parental separation or conflict, loss of close friendship, bullying, abuse, etc.
Possessions	Household break-in or robbery, etc.
Reproduction	Pregnancy, infertility, abortion, etc.
Treatment/Health	Hospitalization, major health concern, poor prognosis, substance abuse, etc.
Work	Being laid off/fired, inadequate support, discrimination, etc.
Core Characteristic	
Entrapment	Overwhelming work demands, ongoing caregiving responsibilities, food insecurity, etc.
Humiliation	Discrimination, bullying, harsh parental discipline, marital infidelity, etc.
Interpersonal Loss	Death of close friends or loved ones, parental divorce, separation from parents, etc.
Physical Danger	Being attacked or assaulted, life-threatening illness, unsafe living conditions, etc.
Role Change/Disruption	Needing caregiving, starting a new job, infertility, difficult changes in residence, etc.

Since its original validating study in 2018 (Slavich & Shields), the Adult STRAIN has been validated in German (Sturnbauer et al., 2019) and Brazilian Portuguese (Cazassa et al., 2020). In each case, the validity of the proposed STRAIN version was investigated in relationship to concurrent measures of stress (e.g., childhood adversity, present perceived stress), potential confounds (e.g., socioeconomic status, personality traits, social desirability, negative affect), mental health (e.g., cognitive function, distress), and physical health (e.g, sleep quality, physical health complaints, doctor diagnoses). An adolescent version was also validated in 2019 (Adolescent STRAIN; Slavich et al., 2019), in which the developers included measures of depression, anxiety, and anhedonia as well as of developmentally salient constructs including peer stress and bullying and risky behaviors. The development of the Adolescent STRAIN helped to highlight both the need for and the opportunity to develop an age-informed version for older adulthood which became the impetus for the present study.

Although substantial progress has been made in developing sophisticated and usable measures to assess cumulative life stress, research using interview-based measures to investigate this construct in older adulthood remains limited, likely due to the high costs of investigator-based interview methods and, further, the lack of a precision, automated tool for measuring it. Several studies that include older adults in their general adult sample and use standard (i.e., not older adulthood-specific) cumulative life stress measures have associated cumulative life stress exposure with adverse mental and physical health outcomes including depression (Kok et al., 2021), anxiety (Brown et al., 2022), poorer psychiatric functioning (Cazassa et al., 2020; Senft Miller et al., 2021; Sturmbauer et al., 2019), impaired cognition (Marshall et al., 2016, 2018; see Juster et al., 2010 for review), increased risk for age-related cognitive pathology (Marshall &

Cooper, 2017), cancer-related fatigue (Bower et al., 2014), circadian rhythm disruption (Cuneo et al., 2017), accelerated aging (Puterman et al., 2016), and lower self-reported physical health (Moseley et al., 2021), the latter being arguably the strongest predictor of well-being and resilience in older adulthood. Notably, a recent study by Dooley and colleagues (2017) also found a quadratic relationship between cumulative life stress and positive affect such that moderate, but not lower or higher, acute stress exposure was associated with psychological resilience in middle to older adulthood. These findings with general adult samples clearly implicate a vital role for cumulative life stress in priority areas of older adult health (e.g., mental and physical health, cognition, stress-mediated disease), one that likely includes both negative and positive impacts (Epel et al., 2018), but few studies have focused specifically upon older adults or reported separate analyses for older adults within a general adult sample.

The paucity of later life cumulative life stress research is surprising given that older adulthood is a period marked not only by complex, age-related transitions that are associated with various forms of psychological, social, biological stress but also by significant age-related shifts in the resources available to foster adaptation to these transitions (Aldwin et al., 2021). While each of the cumulative life stress measures reviewed above reflects elements of stress exposure and/or reactivity that may occur in various spans of adulthood, including older adulthood, none are targeted to capture stressors unique to this developmental stage. Additionally, approaches that have attempted to approximate cumulative life stress by expanding or combining life event checklists in ways that they were not intended to be used offer limited benefit in predicting health outcomes given their eclectic composition, unknown psychometric characteristics, and inconsistent use between studies. Further research, supported by precision measurement tools, is

needed to clarify the arc of the relationship between stress and aging, to chart its trajectories across later stages of life, and to support high quality diagnosis, prediction, and clinical care.

The Current Study

Building on research that highlights the need for a precision tool to assess cumulative life stress in older adulthood, the current study sought to develop and validate a novel measure, the Older Adulthood Stress and Adversity Inventory (Older Adult STRAIN). To achieve these goals, items for the Older Adult STRAIN were first developed and refined in collaboration with members of the target population as well as expert reviewers from the fields of geropsychology, stress, and health. The proposed measure was then validated in a cross-sectional study that incorporated concurrent measures of stress (past year, present perceived, daily hassles), mental health (depression, anxiety, quality of life, cognitive function), and physical health (sleep quality, doctor diagnoses). Aims and hypotheses specific to the present study included:

Aim 1: Measure Development, Usability, and Acceptability. To develop a precision measure of older adulthood cumulative life stress in collaboration with members of its target population and academic experts, and to investigate its usability and acceptability in a target population of older adults.

Hypothesis 1: The Older Adult STRAIN would be easy, efficient, and non-distressing to complete as measured via average time to complete, discontinuation rates, completed attention checks, pre- and post-measure affect, and two brief questions querying participant ratings of the measure's usability and acceptability.

Aim 2: Concurrent Validity – Stress. To examine the Older Adult STRAIN's concurrent validity in relation to a) a checklist measure of stress in older adulthood, the Elder Life Stress Inventory (ELSI; Aldwin et al., 1990), b) a measure of present perceived stress, the Perceived Stress Scale (PSS; Cohen et al., 1983), and c) a measure of daily hassles, the Hassles and Uplifts Scale (HUS; Kanner et al., 1981).

Hypothesis 2a: The total count and severity of cumulative life stressors as measured by the Older Adult STRAIN would significantly positively correlate with participants' total ELSI score.

Hypothesis 2b: The total count and severity of cumulative life stressors as measured by the Older Adult STRAIN would significantly positively correlate with participants' total PSS score.

Hypothesis 2c: The total count and severity of cumulative life stressors as measured by the Older Adult STRAIN would significantly positively correlate with participants' total HUS score.

Aim 3: Concurrent and Discriminant Validity – Mental and Physical Health. To examine the concurrent and discriminant validities of the Older Adult STRAIN in relationship to several measures of a) mental health and b) physical health.

Hypothesis 3a: Regarding mental health, the total count and severity of cumulative life stressors as measured by the Older Adult STRAIN would positively associate with depression and anxiety. In contrast, they would inversely associate with quality of life.

Hypothesis 3b: Regarding physical health, the total count and severity of cumulative life stressors as measured by the Older Adult STRAIN would positively associate with poor sleep quality, doctor diagnosed general health complaints, and auto-immune disorders.

CHAPTER 2: METHODS

The development and validation of the Older Adult STRAIN were guided by best practices derived from the scale development literature (discussed below) and substantially informed by those employed in previous STRAIN studies. For instance, consistent with both scale development recommendations and prior STRAIN methods, the study's item generation and refinement processes integrated feedback from the measure's target population as well as from experts in the fields of stress and health (Boateng et al., 2018; Slavich & Shields, 2018). Additionally, as in the STRAIN validating studies, the current study investigated the proposed measure's validity in relation to concurrent measures of stress, mental health, and physical health (Cazassa et al., 2020; Slavich et al., 2019; Sturnbauer et al., 2019). However, the present study also incorporated innovations recommended in the literature, such as integrating target population focus groups in the item generation process and employing developmentally informed measures to explore concurrent validities (Balsamo et al., 2018; Bowling et al., 2012; Stewart & Prem, 2015).

Measure Development

The scale development literature recommends using both deductive and inductive methods to develop items for a new measure (Carpenter, 2018; Fenn et al., 2020). Deductive methods involve extensive literature reviews to clarify the proposed measure's conceptual domain and to develop preliminary items based on alignments or, conversely, gaps in the existing research (Morgado et al., 2017). Alternatively, inductive methods prioritize engagement with key stakeholders, namely target populations and expert reviewers, to enhance the proposed measure's face and content validities by evaluating candidate items for relevance, representativeness, and

technical quality (Boateng et al., 2018). Accordingly, the Older Adult STRAIN was developed in three broad phases: deductive item generation through literature review, inductive item development via focus groups with the target population, and, finally, refinement through expert review and comment.

Participants. To support inductive item generation for the Older Adult STRAIN, four 75-minute focus groups were held, each including four to seven older adults, totaling 22 participants. Focus group participants were recruited via individual email from a previous study sample of individuals who had taken the STRAIN in the last two years, had some familiarity with its form and content, and expressed interest in being contacted about future studies. See Table 2 for demographic characteristics. Focus group facilitation research recommends that group membership be purposefully and systematically anchored in the participants' shared target experience (Morgan & Scannell, 1998). As such, inclusion criteria for the study focus groups were: (a) older adult of 60 years of age or beyond, (b) completed the STRAIN in a previous study, and (c) English-speaking.

Table 2: Focus Group Participant Demographics

Age M(SD)	Gender Identity	Ethnicity	Education Level	Average Income[a]
74.05(6.21)	68.2% female 31.8% male	5% Black or African American 95% White	86.36% completed bachelor's degree or greater	93.75% reporting $35,000 per annum or greater

[a]8 of the 22 participants declined to report an annual income.

Materials. Prior to the focus group meetings, participants were emailed an agenda that included a brief description of the STRAIN framework. This agenda served to orient participants

to the architecture of the focus group session, to define session goals, to introduce relevant concepts and language, and to serve as a visual aid for the subsequent session. See Appendix B.

Procedure. A three-step process was used to develop the Older Adult STRAIN. First, as recommended in the scale development literature, a detailed literature review was conducted to specify the measure's target domain (i.e., cumulative life stress from the perspective of older adulthood) and facilitate preliminary item generation (Boateng et al., 2018, Morgado et al., 2017). This deductive process laid the groundwork for the proposed measure by identifying stressors commonly reported by older adults, clarifying those that are consistently associated with poorer health outcomes, and developing a catalog of stressors that have been assessed in older adult research along with existing methods of measurement (Aldwin, 1990; Kahana & Kahana, 1998; Murrell et al., 1984).

Second, focus groups with the target population were held to support inductive item generation. Focus group sessions were facilitated by the primary investigator (PI) with the support of two research assistants who served as observers and recorders. Each focus group session began with individual introductions and a brief informed consent to being videotaped followed by an overview of the session agenda. The session goal was defined as identifying elements of stress unique to older adulthood such as experiences related to retirement, caregiving or care-partnering, mental and physical health changes, and shifts in social connectivity. The group then engaged in an open discussion of older adulthood stressors. Themes that emerged across focus groups at this stage included changes in lifestyle and financial status after retirement, the death of a spouse/partner, caring for a sick spouse/partner, concerns about not being able to function or live independently, and chronic illness and the deterioration of mental and physical function.

This free-form discussion was followed by a review of the Adult STRAIN structure and content, including the 12 domains and 5 core characteristics. The goals of reviewing the STRAIN were two-fold: first, to inform a more focused discussion of candidate stressors unique to older adulthood either for their type (i.e., having not occurred until older adulthood), frequency (i.e., being experienced more often in older adulthood), or their intensity (i.e., being experienced more strongly in older adulthood), and, second, to explore and clarify the ways in which older adult stressors may or may not map onto the existing STRAIN framework. Notably, while several of the stressors discussed may also be experienced in earlier stages of adulthood, such as job loss or discrimination, participant reports indicated that these were significantly different when experienced as motivated by or attributed to age-related causes such as being the target of ageism or being forced into retirement due to age. After the discussion of stressors was complete, focus groups shifted their attention to a discussion of resilience factors - psychological, physical, and social - which contribute to navigating stressful experiences in older adulthood. Finally, participants were given an opportunity to ask any additional questions and invited to contact the group facilitator with further thoughts or comments regarding the focus group topic. All participation was voluntary, and participants were emailed a $25 Amazon e-gift card as compensation for their participation in the focus group.

Once the focus groups were completed, the PI and assistants consolidated discussion notes to distill candidate, or newly proposed, items. The PI also reviewed the focus group session videotapes to ensure that no potential items were missed. Candidate items were then thematically analyzed and compared with existing Adult STRAIN items to ascertain which items were adequately assessed and could be carried over to the new measure with no revision, which items

required adaptation to clarify their salience in older adulthood, and which items needed to be drafted as new queries specific to the Older Adult STRAIN. Items were also considered in the context of the existing STRAIN's framework of life domains and core characteristics to inform their development as an adjacent measure.

Based on the focus group feedback, 28 potential stressors were identified as being particularly salient to older adulthood. These stressors included 4 items that were carried over from the Adult STRAIN, 6 items that required adaptation, and 18 new items unique to the Older Adult STRAIN. See Table 3 for the list of stressors generated by the focus groups, delineated under their proposed STRAIN core psychosocial characteristic and primary life domain, and noted as carried over, adapted, or new.

Table 3: Older Adulthood Stressors Identified Through Focus Groups

Entrapment

- Financial – Experienced financial strain, such as adapting to fixed income or paying for necessities [c]
- Legal/Crime – Exploited or taken advantage of due to age [a]
- Other relationships – Caretaking for someone close to you [b]
- Other relationships – Difficulty caring for grandchildren or great-grandchildren [b]
- Work – Having to work beyond planned retirement to make ends meet [a]
- Work – Unable to get a job due to age [a]

Humiliation

- Other relationships – Social stigma of aging, discrimination, treated as "invisible" [a]
- Work – Age discrimination (unfair treatment, forced retirement) [b]

Interpersonal Loss

- Marriage/Partner – Death of spouse or partner [a]
- Marriage/Partner – Adaptation to living alone after death of spouse or partner [a]
- Other relationships – Death of grandchild, great-grandchild [b]
- Other relationships – Decrease in social supports (emotional, instrumental) [a]
- Other relationships – Social isolation [c]

Role Change/Disruption

- Death – End of life concerns (down-sizing, long term care, death with dignity) [a]
- Financial – Losing ability to conduct own finances or make legal or medical decisions [a]
- Housing – Forced to live somewhere that did not want to [b]
- Marriage/Partner – Loss of physical intimacy (affectionate touch, sex) [a]
- Treatment/Health – Someone close to you diagnosed with cognitive decline that impacted you [a]
- Treatment/Health – Reduction in or loss of physical function
- Treatment/Health – Made significant life changes due to concern about risk for physical illness or injury (giving up exercise, physical activities, or traveling) [a]

Table 3 continued

Treatment/Health – Needing caretaking or assistance with Activities of Daily Living (ADLs) [c]
Treatment/Health – Reduced cognitive function (memory, ability to focus) [a]
Treatment/Health – Made significant life changes due to concern about potential for cognitive decline (reducing responsibilities at home or work, avoiding driving) [a]
Treatment/Health – Chronic physical health conditions (pain, reduced/slower recovery, auto-immune condition, difficult menopause) [a]
Treatment/Health – Difficulty accessing healthcare (technology, telehealth, travel, communications) [a]
Treatment/Health – Polypharmacy [a]
Treatment/Health – Adaptation to retirement (time management, staying engaged, finding enriching activities) [a]
Treatment/Health – Hospitalizations [c]

[a] New item created for Older Adult STRAIN [b] Item adapted from Adult STRAIN. [c] Item carried over from Adult STRAIN

The 4 older adulthood items that were carried over from the existing Adult STRAIN included queries regarding financial strain, social isolation, hospitalizations, and requiring care or support for a health-related concern. For each of the 6 items that required adaptation, existing Adult STRAIN items were revised to enhance their salience to older adulthood. For instance, the item querying discrimination in the workplace was expanded to include "age" in addition to other identity factors, such as gender and race, that may serve as a foundation for unfair treatment. Also, "grandchildren" and "great-grandchildren" were added to items querying relationships with children, to better account for intergenerational care-giving roles.

Third, the 28 candidate items were then submitted to a multidisciplinary panel of experts in aging and stress research for evaluation and refinement. Expert reviewers included five clinical psychologists and researchers from various academic and medical settings in the U.S., four of whom specialize in geriatric psychology, as well as a geriatric neuropsychologist and a doctorate-level social worker who specializes in aging research and advocacy. Using an online survey distributed by the PI, reviewers rated each candidate item for relevance (i.e., How relevant is this question to cumulative life stress in older adulthood?) and clarity (i.e., How easy is this question to understand?) on a 5-point Likert-type scale. They were also invited to suggest omissions and/or alternative language for the proposed items. All candidate items met an average

relevance rating of at least “3” or “moderately relevant” and so were maintained. Additionally, any items that received a clarity rating of less than “4” or “easy” were revised in accordance with reviewer feedback to eliminate technical jargon, align language with conventional cohort usage, and reduce syntactic and/or cognitive complexity.

Finally, once the language for each item was optimized, the 28 older adulthood-specific questions were integrated with the 55 items carried forward from the existing Adult STRAIN, which queried stress experiences salient to earlier developmental stages as well as recent health, to comprise the proposed Older Adult STRAIN. The resultant measure was then incorporated into the IRB application for the present validation study to evaluate its usability, acceptability, and psychometric properties.

Measure Validation

Once the Older Adult STRAIN was developed and refined into its final form, the proposed index measure of cumulative life stress was then validated in a cross-sectional study with a sample of 126 community-dwelling older adults (*Mean age* = 73.36, *SD* = 6.58, *Range* = 59-95). To investigate the concurrent validity of the Older Adult STRAIN in relation to other commonly used measures of stress, participants also completed assessments of recent (past year) and present perceived stress as well as a measure of daily hassles. Additionally, to explore the concurrent validity of the Older Adult STRAIN in relation to measures of mental and physical health, participants also completed assessments of depression, anxiety, and quality of life, as well as sleep quality and doctor diagnoses.

Participants. Participants were recruited from the older adult community through paper flyers and social media postings with online resources (e.g., Eastern Area Agency on Aging). See Appendix A for copy of recruitment flyer. Invitations were also emailed to prospective candidates who were identified via the University of Maine Center on Aging Older Adult Research Registry as well as those on the Maine Mood Lab's existing registry of older adults who had expressed interest in future study participation. Eligible participants were approximately 60 years of age or beyond and fluent in English with access to a computer on which to interview via a secure telehealth platform and to complete the study measures. With the goal of recruiting a broad, heterogenous, and representative sample, no additional exclusion criteria were used.

Materials. The following measures were used to describe the study sample and to investigate the usability, acceptability, and psychometric properties of the Older Adult STRAIN.

Sample Characteristics. Sample characteristics (e.g., age, gender identity, race/ethnicity, socioeconomic status, cognitive function) were queried to enable a dimensional understanding of the participant population, to identify potential co-variates, and to inform the limits of generalizability for future research and implementation.

Demographic Information was collected with a questionnaire assessing race, years of formal education, and annual income. See Appendix C. Additional demographic data, including age, gender, and relationship status were collected via the Older Adult STRAIN.

Cognitive Function was screened using the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005), a 30-item measure that queries multiple cognitive domains including visuoconstructional skills, executive functions, naming skills, memory, attention and concentration, language, abstract thinking, and delayed recall, as well as orientation to time and place (e.g., full date, day of the week, place, city). The MoCA was administered by the PI via a protected online telehealth platform (e.g., Zoom Healthcare) during the Session 1. Due to the online context of the administration, "place" and "city" queries were stated as "For which university are we doing this research?" and "Where is it located?", respectively. Scores were calculated in accordance with developer guidelines, with higher summed scores indicating greater cognitive function. Unfortunately, in the present study, the MoCA demonstrated poor internal reliability ($\alpha = .351$). Further, an examination of the measure's inter-item correlations indicated that only one set of items met a minimum recommended correlation threshold of $r = .3$ (Field, 2009). Several factors may help to account for these findings. First, previous studies have found the MoCA's internal reliability to be lower in healthy, non-clinical samples than in clinical samples and to be impacted by education, both of which factors can lead to greater variability in responses and greater dimensionality in factor structure (Bernstein et al., 2011; Ratcliff et al., 2023). As the present sample was characterized as healthy, non-clinical, and highly educated, these factors likely impacted this metric in the current study. Second, the MoCA was delivered via online videoconferencing platform, rather than in-person in a controlled laboratory setting, as it was in its original validating study. Variations in these contexts may have had unintended and unmeasured impacts on the current results. Third, MoCA data for the present study was non-normal (i.e., negatively

skewed, leptokurtic), a characteristic which has been found to negatively impact the performance of the alpha coefficient (Sheng & Sheng, 2012, Xiao & Hau, 2023). The MoCA is not included in the present Appendix due to copyright protections.

Usability and Acceptability. Usability and acceptability were evaluated to ascertain whether the Older Adult STRAIN was feasible for measuring the target construct, cumulative life stress, from the perspective of older adulthood as well as whether it was agreeable to the target population of older adults.

Assessment Experience was measured with a 2-item survey that queried the respondent's agreement with statements regarding the measure's usability (i.e., "The cumulative life stress measure was easy to use.") and acceptability (i.e., "The cumulative life stress measure meets my approval as an inventory of older adulthood stress.") on a 5-point Likert-type scale (completely disagree/disagree/neither agree nor disagree/agree/ completely agree). The Assessment Experience survey demonstrated good internal reliability ($\alpha = .759$). See Appendix F.

Affect was assessed with pre- and post-measure administrations of the Positive and Negative Affect Schedule – Short Form (PANAS-SF; Watson et al., 1988), a 20-item self-report measure of present affect, with two separate 10-item subscales assessing positive and negative mood. Respondents indicate the extent to which they generally experience each emotion using a 5-point Likert scale (very slightly/a little/ moderately/quite a bit/extremely), with higher scores indicating greater positive affect (for the positive subscale) or more negative affect (for the negative subscale). Example

positive affect items include, “strong,” “inspired,” and “attentive,”; example negative affect items include, “distressed,” “guilty,” and “hostile.” In the present study, the PANAS-SF demonstrated good to excellent internal reliability at both pre- and post-measure administrations (positive scale $\alpha = .913$, negative scale $\alpha = .837$; positive scale $\alpha = .915$, negative scale $\alpha = .758$, respectively). See Appendix D.

Concurrent Validity - Stress. To evaluate the Older Adult STRAIN’s concurrent validity regarding stress measurement, or the extent to which results of the Older Adult STRAIN corresponded with those of existing measures of stress, participants were asked to complete assessments of recent stressful life events (i.e., past year), present perceived stress, and daily hassles, in addition to the Older Adult STRAIN.

Cumulative Life Stress was measured with the Older Adulthood Stress and Adversity Inventory (Older Adult STRAIN), the study’s index assessment of stress exposures and experiences from the perspective of older adulthood. Respondents answer demographic questions regarding age and gender identity as well as inquiries about various types of stressors, including acute life events (e.g., present for a day or two, such as negative health events, deaths, job losses) and chronic difficulties (e.g., present for at least one month, such as ongoing health problems, relationship issues, financial problems). For any item endorsed, follow-up questions are posed regarding frequency, duration, timing, and severity, the latter being rated on a 5-point Likert scale (very slightly/a little/moderately/ quite a bit/extremely). Various cumulative scores are created by summing participants’ acute and chronic stressor count and severity ratings together and separately. Internal

reliability is not reported for the Older Adult STRAIN. As a broadband inventory of multi-dimensional rather than single-domain or discrete stress exposures, it has no presumed latent construct and, therefore, internal consistency is a less useful and potentially misleading metric (Cleary, 1981; Gray et al., 2004; Netland, 2001). See Limitations and Future Directions for further discussion. The Older Adult STRAIN is not included in the present Appendix due to copyright protections.

Recent Stressful Life Events were measured with the Elders Life Stress Inventory (ELSI; Aldwin, 1990), a 30-item self-report scale that assesses the occurrence over the last year of events that older adults are likely to experience, such as the death of a friend or caretaking for a spouse. Respondents rate the impact of any endorsed item on a 5-point Likert scale (not at all/a little/ somewhat/very much/extremely), with higher total exposures and/or severity indicating greater stress experiences. In the present study, the ELSI demonstrated low internal reliability ($\alpha = .560$). However, consistent with the assertions above regarding the inappropriateness of internal consistency as an index of reliability for stress exposure checklists, this lower alpha is similar to those reported for other commonly used stressful life events checklists ($\alpha = .41$-$.53$; Burton et al., 2004; Hurst et al., 1978). See Appendix G.

Perceived Stress was measured with the Perceived Stress Scale (PSS; Cohen et al., 1983), a 10-item self-report scale for assessing subjective stress over the last month. Respondents rate the frequency of items, such as “In the past month, how often have you felt that you were on top of things,” on a 5-point Likert scale (never/almost

never/sometimes/fairly often/very often) with higher scores indicating greater perceived stress. In the present study, the PSS demonstrated excellent internal reliability (α = .900). See Appendix H.

Daily Hassles were measured with the hassles portion of the revised Hassles and Uplifts Scale (HUS; Kanner et al., 1981), a 53-item self-report measure of the frequency of hassles over the last month. Adapted from the original 117-item Hassles and Uplifts Scale (Delongis et al.,1982), the HUS queries multiple life domains including health, money, environment, interpersonal conflict, community obligations, and daily household tasks. Examples include worries about health, not having enough money for necessities, feeling lonely, and problems with grandchildren. For each hassle endorsed, respondents rate the hassle's intensity on a 4-point Likert scale (none or not applicable/somewhat/quite a bit/a great deal) with higher scores indicating greater frequency and/or intensity of hassles. In the present study, the HUS demonstrated good internal reliability (α = .892). See Appendix I.

Concurrent and Discriminant Validity – Mental and Physical Health. To evaluate the Older Adult STRAIN's validity regarding concurrent measures of mental and physical health, or the extent to which cumulative life stress, as measured by the Older Adult STRAIN, corresponded with each health outcome, participants were asked to complete assessments of anxiety, depression, quality of life, sleep quality, and lifetime doctor-diagnoses of general health and auto-immune conditions. These health outcomes were selected based on existing research that associates older adulthood stress with higher risk

for depression (Blazer et al., 2003; Kok et al., 2021), anxiety (Brown et al., 2020), poor quality of life (Kahana et at al., 2012), impaired sleep quality (Lücke et al., 2022), and physical health concerns (Bower et al., 2014; Moseley et al., 2021; Puterman et al., 2016). They were also informed by previous STRAIN validating studies, which assessed mental health, operationalized as distress, depression, and/or anxiety, as well as sleep quality and doctor-diagnosed general health and auto-immune conditions (Cazassa et al., 2020; Slavich et al., 2019, Slavich & Shields, 2018; Sturmbauer et al., 2019).

Anxiety was measured with the Geriatric Anxiety Scale - Ten Item Version (GAS-10; Segal et al., 2010), a 10-item self-report measure of the severity of generalized anxiety symptoms in older adults. Respondents rate the frequency of specific anxiety symptoms over the past week on a 4-point Likert scale (not at all/sometimes/most of the time/all of the time) with higher summed scores indicating greater anxious experience. In the present study, the GAS-10 demonstrated good internal reliability ($\alpha = .798$). See Appendix J.

Depression was measured with the Geriatric Depression Scale-Short Form (GDS-SF; Sheikh & Yesavage, 1986), a 15-item instrument for assessing current depression in older adults. Respondents answer yes or no to experiences over the past week, such as “Are you basically satisfied with your life?” One point is given for each answer endorsed that indicates depression with higher summed scores indicating greater depressive experience. In the present study, the GDS-SF demonstrated good internal reliability ($\alpha = .814$). See Appendix K.

Quality of Life was measured with the Older People's Quality of Life Questionnaire - Brief (OPQoL-Brief; Bowling et al., 2012), a 13-item measure of quality of life in older adulthood. Respondents indicate their level of agreement with statements such as "I am healthy enough to get out and about" or "My family, friends, or neighbors would help me if needed," on a 5-point Likert scale (strongly agree/agree/neither agree nor disagree/disagree/strongly disagree). Items are reverse coded, so that higher scores represent higher Qol. In the present study, the OPGoL-Brief demonstrated good internal reliability (α = .885). See Appendix L.

Sleep Quality was measured with the 10-item Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The PSQI assesses objective indices of sleep quality (e.g., how often participants wake up during the night) and subjective indices of sleep quality (e.g., how rested they typically feel after a night of sleep). Answers on the PSQI were scored using the standard scoring system and summed to create a global PSQI score, with higher scores indicating worse sleep quality. In the present study, the PSQI demonstrated good internal reliability (α = .742). See Appendix M.

Doctor Diagnosed General Health Conditions were ascertained via phone interview by asking participants whether a medical doctor had ever diagnosed them with any of the following conditions: anxiety, arthritis (not rheumatoid or psoriatic), asthma, cancer, chronic pain, coronary heart disease, depression, diabetes, gastroesophageal reflex disease (or chronic heartburn), heart attack, high blood pressure, insomnia, kidney

stone(s), metabolic syndrome, migraines, overweight, posttraumatic stress disorder, stomach ulcer(s), or stroke. See Appendix N(i).

Doctor Diagnosed Auto-Immune Conditions were ascertained via phone interview by asking participants whether a medical doctor had ever diagnosed them with any of the following conditions: Addison's disease, celiac disease, dermatomyositis, Grave's disease, Hashimoto's thyroiditis, inflammatory bowel disease (i.e., Crohn's disease, ulcerative colitis), multiple sclerosis, myasthenia gravis, pernicious anemia, psoriasis (or psoriatic arthritis), rheumatoid arthritis, Sjögren's syndrome, lupus (systemic lupus erythematosus), or other autoimmune disorder to be specified by the participant. See Appendix N(ii).

Procedure. The measurement validation study took place via two online sessions: Session 1, an interview with the PI, and Session 2, a self-administered battery of questionnaires. To participate, interested individuals contacted the PI via email to determine eligibility and, if criteria were met, schedule a first meeting (i.e., Session 1), generally within two weeks. Session 1 included informed consent, followed by a self-report measure of sleep quality (PSQI), a short interview regarding doctor diagnosed general health and auto-immune conditions, and a brief cognitive screener (MoCA). Finally, participants scheduled Session 2, also generally within two weeks. This session took approximately 25-30 minutes. At the completion of Session 1, participants were emailed a link and a unique participant code to access and complete Session 2 at their scheduled date and time. This email also included the PI’s contact information should any changes or trouble-shooting needs arise.

For Session 2, participants used their unique participant code to access and complete an online battery of questionnaires that took approximately 60-90 minutes. Questionnaires included measures of mood (PANAS-SF, GDS-SF, GAS-10), stress (Older Adult STRAIN, ELSI, PSS, HUS), and quality of life (OPQoL-Brief). Two attention checks were built into the STRAIN and two more were included in the remainder of the battery. At the end of this session, participants received a debriefing document as well as an invitation to follow-up with any questions. See Appendix P. All participants were also mailed a personalized thank you letter with $25 cash as a token of appreciation for their participation.

In cases where a participant's responses on the depression measure (i.e., GDS-SF) met or exceeded the clinical screening threshold (≥ 5 points per scale guidance), the Session 2 survey platform automatically sent an email to the PI who, in turn, sent a personalized email to the participant to offer assistance, share support resources, and encourage follow-up with a health provider. Participants who replied to this email requesting further assistance were directed to the University of Maine Psychological Services Center or encouraged to contact the Maine crisis hotline in cases of emergency.

CHAPTER 3: ANALYSES

All analyses were conducted using IBM SPSS Statistics Version 28.0 (IBM Corporation, 2021).

Preliminary Analyses. Descriptive statistics (i.e., means, standard deviations) were computed for all variables to determine sample characteristics, clarify missing data, facilitate visual and statistical outlier identification, and enable assumption checks requisite to subsequent analyses (Field, 2018). Data were inspected for univariate outliers, defined as having Z-scores greater than ± 3.29 standard deviations from the mean (Tabachnick & Fidell, 2013), and as appropriate, multivariate outliers, defined via Mahalanobis distance (Mahalanobis, 1930). Outliers were winsorized to reflect a score ±1 point from the next most extreme score to reduce the skew of data distribution and to preserve organic patterns of variability therein (Field, 2018). As data for several variables violated the assumption of normality (e.g., having skew > 3 and/or kurtosis > 10), appropriate transformations (e.g., log10, square root) were tested (Tabachnick & Fidell, 2013). However, transformations were unable to bring the data distribution within the requirements for parametric testing and so non-parametric tests were used with the untransformed data. Where necessary and appropriate, pairwise deletion was prioritized over listwise deletion to preserve power (Allison, 2001).

Aim 1 Analyses – Measure Development, Usability, and Acceptability. The Older Adult STRAIN was developed through deductive and inductive processes consistent with both previous STRAIN validation studies and best practices recommended in the scale development literature (See Methods). Descriptive statistics derived through the validation study were then used to examine the measure's usability and acceptability as measured via assessment experience

questionnaire ratings, time to complete, discontinuation rates, and completed attention checks. A paired samples t-test was also used to ascertain pre-post mean differences in negative affect.

Aim 2 Analyses – Concurrent Validity – Stress. Pearson product moment correlations or, in the case of non-normal data, Spearman's rank correlations were used to examine the Older Adult STRAIN's concurrent validity in relation to other measures of stress including a) the ELSI, b) the PSS, and c) the HUS. Interpretations of effect size align with those proposed by Dancey & Reidy (2007). For analyses employing multiple comparisons, significance values were adjusted using a Bonferroni correction.

Aim 3 Analyses – Concurrent and Discriminant Validity – Mental and Physical Health. Pearson product moment correlations or, in the case of non-normal data, Spearman's rank correlations were used to examine the Older Adult STRAIN's concurrent validity in relation to measures of mental health (e.g., GDS-SF, GAS-10, OpQol-Brief) and physical health (e.g., PSQI, doctor diagnoses). Interpretations of effect size align with those proposed by Dancey & Reidy (2007). Regression analyses were used for the limited purpose of investigating the impact of demographic variables on the relation between cumulative life stress and the various health outcomes assessed. For analyses employing multiple comparisons, significance values were adjusted using a Bonferroni correction.

CHAPTER 4: RESULTS

Sample Descriptives

Demographics. Descriptive statistics of the demographic characteristics for the entire sample are presented in Table 4. Participants (N = 126) were older adults (M = 73.36, SD = 6.583) who predominantly identified as female (n = 93, 73.8%), White (n = 119, 94.4%), married or partnered (n = 78, 61.9%,), and college-educated (n = 102, 81.0%), with average personal incomes of at least $25,000 per annum ($n$ = 67, 54.9%) and average family incomes of at least $50,000 per annum ($n$ = 83, 67.5%).

Table 4: Sample Descriptives – Demographics

Participant Characteristics	*n*	*%*
Age		
59 – 69	41	32.5
70 – 79	67	53.2
80 – 89	16	12.7
90 – 99	2	1.6
Race/Ethnicity [a]		
Asian	0	0
Black or African American	2	1.6
Native American or Alaska Native	1	.8
White	119	97.5
Franco-American	12	9.8
Hispanic	2	1.6
Multiple Races	0	0
Missing	4	3.2
Gender		
Female	93	73.8
Male	31	24.6
Non-Binary	2	1.6
Education		
10 years	1	.8
12 years	8	6.3
14 years	15	11.9
16 years	18	14.3
More than 16 years	84	66.7

Table 4 continued

Relationship Status [b]		
Dating	2	1.6
In a Serious Relationship	5	4.0
Married or Living with Domestic Partner	78	61.9
Single	23	18.3
Widowed	12	9.5
Missing	6	4.8
Personal Income (per annum) [c]		
Less than $5,000	24	19.7
$5,000 - $11,999	11	9.0
$12,000 - $15,999	7	5.7
$16,000 - $24,999	13	10.7
$25,000 - $34,999	8	6.6
$35,000 - $49,999	12	9.8
$50,000 - $74,999	20	16.4
$75,000 - $99,999	17	13.9
$100,000 and greater	10	8.2
Missing	4	3.2
Family Income (per annum) [d]		
Less than $5,000	1	.8
$5,000 - $11,999	1	.8
$12,000 - $15,999	2	1.6
$16,000 - $24,999	11	8.9
$25,000 - $34,999	3	2.4
$35,000 - $49,999	22	17.9
$50,000 - $74,999	25	20.3
$75,000 - $99,999	22	17.9
$100,000 and greater	36	29.3
Missing	3	2.4

Stress. Descriptive statistics for the sample's stress variables are presented in Table 5. Regarding cumulative lifetime stress as measured by the Older Adult STRAIN, participants endorsed an average of 32.01 total stressors (*SD* = 13.14), including both acute and chronic stressors, with an average total stress severity score of 65.69 (*SD* = 29.59). Each of the 18 new stressor items were endorsed in the current sample except one item regarding losing the ability to do one's own finances or to make medical or legal decisions, which non-endorsement likely reflects the sample's relatively good health status. Items were endorsed with frequencies ranging from

3.17% (age exploitation) to 80.95% (making end-of-life preparations) and met average severity ratings ranging from 1.94 (a little) to 3.53 (moderate to quite a bit).

Regarding past-year stress as measured by the ELSI, participants experienced an average of 3.67 stressors (*SD* = 2.32), with an average total stress severity score of 6.27 (*SD* = 5.67). Regarding perceived stress over the last month as measured by the PSS, participants endorsed a low to moderate level of stress (*M* = 10.75, *SD* = 6.90). Finally, regarding daily hassles over the past month, participants endorsed an average stress impact score of 18.85 (*SD* = 11.63). As the findings for stressor count and impact severity were not significantly different for either measure that addressed these constructs (i.e., Older Adult STRAIN, ELSI), the main results will focus on stressor counts for ease of interpretation.

Table 5: Sample Descriptives – Stress

Variable (Measure)	*n*	Missing(%)[a]	M(SD)	Minimum	Maximum	Inter-Quartile Range	Total Possible
Cumulative Life Stress (Older Adult STRAIN)	126	0(0%)	32.01(13.14)	5	78	24.00 - 36.25	NA
Past Year Stress (ELSI)	124	2(1.6%)	3.65(2.31)	0	11	2.00 – 5.00	30
Perceived Stress (PSS)	122	4(3.2%)	10.75(6.90)	0	29	5.75 – 16.00	40
Daily Hassles (HUS)	111	15(12%)	18.73(12.09)	0	58	9.00 – 24.00	159

[a] Little's missing variables analyses indicated that data for each measure were missing completely at random.

Mental and Physical Health. Descriptive statistics for the sample's mental and physical health variables are presented in Table 6. Regarding mental health, on average participants endorsed minimal depression (*M* = 2.44, *SD* = 2.59), minimal anxiety (*M* = 4.17, *SD* = 3.30), higher quality of life (*M* = 58.35, *SD* = 5.74), and normal cognitive function (*M* = 26.63, *SD* = 2.30). Additionally, pre-measure mood assessments indicated moderate positive affect (*M* =

33.44, *SD* = 7.35) and lower negative affect (*M* = 15.29, *SD* = 4.72). Regarding physical health, participants reported mild to moderately impaired sleep quality (*M* = 6.12, *SD* = 3.73), an average of four general health-related doctor diagnoses over the course of their lifespan (*M* = 4.73, *SD* = 2.62), and less than one auto-immune doctor diagnosis over the course of their lifespan (*M* = .40, *SD* = .65).

Table 6: Sample Descriptives – Mental and Physical Health

Variable (Measure)	*n*	Missing(%)[a]	M(SD)	Minimum	Maximum	Inter-Quartile Range	Total Possible
Positive Affect (pre-measure) (PANAS-SF)	126	0(0%)	33.44(7.35)	14	50	29.00 – 38.00	50
Negative Affect (pre-measure) (PANAS-SF)	126	0(0%)	15.29(4.72)	10	31	12.00 – 18.00	50
Depression (GDS-SF)	123	3(2.4%)	2.46(2.62)	0	11	.75 – 3.00	15
Anxiety[a] (GAS-10)	123	3(2.4%)	4.17(3.30)	0	14	2.00 – 6.00	30
Quality of Life[a] (OPQoL-Brief)	123	3(2.4%)	58.35(5.74)	44	65	53.00 – 64.00	65
Cognitive Function[a] (MoCA)	125	1(.8%)	26.63(2.30)	20	30	25.50 – 28.00	30
Poor Sleep Quality (PSQI)	126	0(0%)	6.12(3.73)	1	17	3.00 – 9.00	21
Doctor-Diagnosed General Health Conditions	126	0(0%)	4.73(2.62)	0	13	3.00 – 6.00	NA
Doctor-Diagnosed Autoimmune Conditions	126	0(0%)	.40(.65)	0	3	.00 – 1.00	NA

[a] Little's missing variables analyses indicated that data for each measure were missing completely at random but for regarding the OPQoL-Brief. Inspection of OPQoL-Brief responses did not indicate any pattern of missingness.

Analyses (e.g., Spearman's rho, Kruskal-Wallis), as summarized in Table 7, indicated that stressor count was associated with age ($r_s(124) = -.35$, $p = <.001$), gender ($H(2,126) = 6.88$, $p = .032$), and personal income ($r_s(120) = -.19$, $p = .037$), but not race ($H(2,122) = 3.35$, $p = .188$), education ($r_s(124) = -.10$, $p = .265$), or relationship status ($H(5,120) = 1.06$, $p = .900$). Pre-measure affect ratings also reflected a significant inverse association between positive affect and stressor count ($r_s(124) = -.20$, $p = <.001$, two-tailed) and a significant positive association between negative affect and stressor count ($r_s(124) = .35$, $p = <.001$, two-tailed), such that

respondents who endorsed greater positive affect tended to endorse fewer stressors and those who endorsed greater negative affect tended to endorse a greater number of stressors.

Table 7: Cumulative Lifetime Stressor Count by Participant Characteristics

Participant Characteristics	*n*	M(SD)
Age and Gender		
59 – 69		
Female	31	35.97(12.93)
Male	8	36.25(26.69)
Non-Binary	2	44.50(10.61)
70 – 79		
Female	50	32.58(10.10)
Male	17	27.06(11.06)
80 – 89		
Female	11	27.09(8.78)
Male	5	21.00(8.57)
90 – 99		
Female	1	16.00 [a]
Male	1	31.00 [a]
Gender		
Female	93	32.88(11.73)
Male	31	28.58(16.37)
Non-Binary	2	44.50(10.61)
Race/Ethnicity		
Black or African American	2	43.50(13.44)
Native American or Alaska Native	1	38.00 [a]
White	119	32.00(13.21)
Franco-American	12	40.17(16.35)
Hispanic	2	27.50(9.19)
Education		
10 years	1	77.00 [a]
12 years	8	37.88(14.54)
14 years	15	31.67(5.27)
16 years	18	28.00(12.06)
More than 16 years	84	31.83(13.28)
Relationship Status		
Dating	2	41.5(19.09)
In a Serious Relationship	5	32.00(6.04)
Married or Living with Domestic Partner	78	31.64(13.43)
Single	23	33.91(15.11)
Widowed	12	29.00(7.29)
Personal Income (per annum)		
Less than $5,000	24	35.17(16.05)
$5,000 - $11,999	11	28.91(8.78)

Table 7 continued

$12,000 - $15,999	7	38.29(17.67)
$16,000 - $24,999	13	34.77(10.92)
$25,000 - $34,999	8	39.88(14.67)
$35,000 - $49,999	12	29.58(10.18)
$50,000 - $74,999	20	31.3(14.12)
$75,000 - $99,999	17	29.35(9.95)
$100,000 and greater	10	24.60(12.50)
Family Income (per annum)		
Less than $5,000	1	32.00 [a]
$5,000 - $11,999	1	52.00 [a]
$12,000 - $15,999	2	33.00(2.83)
$16,000 - $24,999	11	39.09(17.73)
$25,000 - $34,999	3	34.00(1.73)
$35,000 - $49,999	22	29.82(11.09)
$50,000 - $74,999	25	35.36(11.96)
$75,000 - $99,999	22	29.45(16.79)
$100,000 and greater	36	30.00(11.66)

[a] *Represents data for the single person in this demographic category.*

Aim 1 Results: Measure Development, Usability, and Acceptability. The study's first aim was to develop the Older Adult STRAIN (See Appendix E) and then, through the present validation study, to examine the measure's usability and acceptability via both objective and self-report measures. Objective indices of usability and acceptability included completion time, discontinuations, failed attention checks, and over all completions rates as well as self-reported ratings of usability and acceptability. Of the 126 participants who began the measure, none discontinued, and all passed the four embedded attention checks, resulting in a 100% completion rate. Time stamps tracking the length of time required to complete the Older Adult STRAIN were erroneously set to include respondents' preliminary PANAS-SF responses as well, the latter of which is estimated to take 7.5 minutes on average. As such, times are here reported both with and without the PANAS-SF. When including the PANAS-SF, on average, respondents took 41 minutes and 24 seconds to complete (M = 41.40, SD = 16.21), with an interquartile range of 30 minutes 50 seconds – 48 minutes 17 seconds. Subtracting the estimated 7.5 minutes average

completion time for the PANAS-SF, it is estimated that the Older Adult STRAIN took approximately 33 minutes and 54 seconds to complete.

Additionally, on a self-report measure, participants indicated their level of agreement with statements regarding the Older Adult STRAIN's usability and acceptability on a 5-point, Likert-type scale (1 - completely disagree / 2 - disagree / 3 - neither agree nor disagree / 4 - agree / 5 - completely agree). On average, respondents endorsed agreement with statements that the Older Adult STRAIN was "easy to use" and "met [their] approval" as an inventory of older adulthood stress. See Table 8 for qualitative details.

Table 8: Qualitative Details for Usability and Acceptability Ratings

Query	*n*	Missing (%)	Mean (SD)	Median	Mode
The cumulative life stress measure was easy to use.	126	0 (0%)	4.06 (.93)	4.00	4
The cumulative life stress measure meets my approval as an inventory of older adulthood stress.	125	1 (.8%)	3.67 (.95)	4.00	4

Finally, analyses of pre- and post-measure affect indicated that taking the Older Adult STRAIN did not increase negative mood. Rather, results of a Wilcoxon signed rank test, employed as both pre- and post-measure negative affect data were positively skewed despite transformation, indicated a significant decrease in negative affect after completing the measure (M_{NA} = 15.32, SD_{NA} = .44, M_{NA} = 11.97, SD_{NA} = .27, respectively) (n = 120, Z = -7.39, p <.001, d =.67). Conversely, pre-post analyses also indicated a statistically significant decrease in positive affect upon measure completion (M_{PA} = 33.40, *SDPA* = 7.51, M_{PA} = 31.79, SD_{PA} = 8.52, respectively) (n = 117, t (116) = 2.73, p = .007, d = 6.39). Please note that affect data was not available for the

entire sample as 9 respondents did not completely fill out the measure and, as such, summed scores could not be calculated for their responses.

Aim 2 Results: Concurrent Validity – Stress. The study's second aim was to examine the concurrent validity of the Older Adult STRAIN in relation to three measures of stress: a) the Elder Life Stress Inventory (ELSI; Aldwin et al., 1990), a checklist measure of stress experience over the last year, b) the Perceived Stress Scale (PSS; Cohen et al., 1983), a measure of stress as perceived over the last month, and c) the hassles portion of the Hassles and Uplifts Scale (HUS; Kanner et al., 1981), a measure of the experience of day-to-day daily hassles over the last month. It was predicted that cumulative lifetime stressor count, as measured by the Older Adult STRAIN, would positively correlate with participant's scores on each of these past and present stress assessments. Nonparametric Spearman's rank-order tests of monotonic correlation were used for all analyses as one or more variables in each correlation violated the assumptions of normality, even when subjected to transformation.

Consistent with hypotheses 2a-c, findings indicated significant correlations between cumulative life stress, past-year stress, present perceived stress, and daily hassles, as presented in Table 9. Specifically, cumulative life stress demonstrated weak, positive associations with past-year stress and present perceived stress, and a moderate, positive association with daily hassles. Taken together, these findings provide support for the concurrent validity of the Older Adult STRAIN in relation to a measure of stress that is tailored to older adults (i.e., ELSI) as well as to two commonly used measures of present stress experience (i.e., PSS, HUS).

Table 9: Correlations between Older Adult STRAIN and Concurrent Stress Measures

Variable (Measure)	Cumulative Life Stress (Older Adult STRAIN)	Past Year Stress (ELSI)	Perceived Stress (PSS)	Daily Hassles (HUS)
Cumulative Life Stress (Older Adult STRAIN)	–			
Past Year Stress (ELSI)	$r_s(122) = .29$**	–		
Perceived Stress (PSS)	$r_s(120) = .38$**	$r_s(120) = .36$**	–	
Daily Hassles (HUS)	$r_s(109) = .46$**	$r_s(109) = .53$**	$r_s(106) = .66$**	–

Note: Bonferroni-adjusted threshold for significance is 0.008.
** Spearman's *rho* correlation is significant at the 0.001 level (1-tailed).

Aim 3 Results: Concurrent and Discriminant Validity – Mental and Physical Health. The study's final aim was to examine the concurrent and discriminant validity of the Older Adult STRAIN in relation to several measures of a) mental health and b) physical health. Mental health variables included depression, as measured by the Geriatric Depression Inventory-Short Form (GDS-SF; Sheikh & Yesavage, 1986), anxiety, as measured by the Geriatric Anxiety Scale-Ten Item Version (GAS-10; Segal et al., 2010), and quality of life, as measured by the Older Persons Quality of Life-Brief (OPQoL-Brief; Bowling et al., 2012). It was hypothesized that cumulative lifetime stressor count, as measured by the Older Adult STRAIN, would positively correlate with participant endorsements of a) depression and anxiety and negatively correlate with quality of life. Physical health measures included sleep quality over the last month, as measured by the Pittsburgh Sleep Quality Inventory (PSQI; Buysse et al., 1989), and lifetime doctor-diagnosed general and autoimmune conditions, as reported in Session 1 interviews. It was predicted that lifetime stress count would positively correlate with poor sleep quality and both categories of doctor-diagnosed conditions. As in Aim 2 analyses, nonparametric Spearman's rank-order tests of monotonic correlation were used as one or more variables in each correlation violated the assumptions of normality, including when subjected to transformation.

Regarding Hypothesis 3a, findings are consistent with predictions in reflecting significant correlations between cumulative life stress and all measures of mental health, as presented in Table 10. Specifically, cumulative life stress demonstrated a moderate, positive association with anxiety as well as a weak, positive association with depression, offering preliminary support for the concurrent validity of the Older Adult STRAIN in relation to two commonly used, older adult-specific measures of mood and anxiety. Findings also reflect a moderate, negative correlation between cumulative life stress and quality of life ($r_s(121) = -.35$, $p < .001$), providing evidence for the discriminant validity of the Older Adult STRAIN in relation to an older adult-specific quality of life measure. Regression analyses indicated that these associations remained significant when adjusting for participants' age, gender, race, and education.

Table 10: Correlations between Older Adult STRAIN and Mental Health Measures

Variable (Measure)	Cumulative Life Stress (Older Adult STRAIN)	Depression (GDS-SF)	Anxiety (GAS-10)	Quality of Life (OPQoL-Brief)
Cumulative Life Stress (Older Adult STRAIN)	–			
Depression (GDS-SF)	$r_s(121) = .30$**	–		
Anxiety (GAS-10)	$r_s(121) = .43$**	$r_s(118) = .58$**	–	
Quality of Life (OPQoL-Brief)	$r_s(121) = -.35$**	$r_s(118) = -.63$**	$r_s(118) = -.54$**	–

Note: Bonferroni-adjusted threshold for significance is 0.008.
** Spearman's *rho* correlation is significant at the 0.001 level (1-tailed).

Comparative analyses of the relationships between each of the stress measures and the mental health outcomes assessed revealed a consistent pattern whereby the associations were strongest for perceived stress, followed by daily hassles, then cumulative life stress, and finally past-year stress (see Table 11). Additionally, in a comparison of the discriminant validities of each of the stress measures with regard to quality of life, both present perceived stress and daily hassles

yield stronger, negative associations with quality of life (strong and moderate, respectively) than cumulative life stress or past-year stress.

Table 11: Comparative Correlations – Stress Measures and Mental Health Outcomes

Variable (Measure)	Cumulative Life Stress (Older Adult STRAIN)	Past Year Stress (ELSI)	Perceived Stress (PSS)	Daily Hassles (HUS)
Depression (GDS-SF)	$r_s(121) = .30$**	$r_s(119) = .27$**	$r_s(117) = .57$**	$r_s(106) = .50$**
Anxiety (GAS-10)	$r_s(121) = .43$**	$r_s(119) = .26$*	$r_s(117) = .68$**	$r_s(106) = .63$**
Quality of Life (OpQoL-Brief)	$r_s(121) = -.35$**	$r_s(119) = -.23$	$r_s(118) = -.63$**	$r_s(108) = -.43$**

Note: Bonferroni-adjusted threshold for significance is 0.004.
** Spearman's *rho* correlation is significant at the 0.001 level (1-tailed).
* Spearman's *rho* correlation is significant at the 0.002 level (1-tailed).

As to Hypothesis 3b, findings are again consistent with predictions in indicating significant correlations between cumulative life stress and all measures of physical health. As presented in Table 12, cumulative life stress demonstrated a weak, positive association with poor sleep quality and a moderate, positive association with doctor diagnosed general health conditions, lending support for the concurrent validity of the Older Adult STRAIN in relation to measures of physical health. Regression analyses indicated that these associations remained significant when adjusting for participants' age, gender, race, and education. No significant associations were found between cumulative life stress and doctor diagnosed auto-immune conditions.

Table 12: Correlations between Older Adult STRAIN and Physical Health Measures

Variable (Measure)	Cumulative Life Stress (Older Adult STRAIN)	Poor Sleep Quality (PSQI)	Doctor-Diagnosed General Health Conditions	Doctor-Diagnosed Autoimmune Conditions
Cumulative life stress (Older Adult STRAIN)	–			
Poor Sleep Quality (PSQI)	$r_S(124) = .25$*	–		
Doctor-Diagnosed General Health Conditions	$r_S(124) = .47$**	$r_S(124) = .50$**	–	
Doctor-Diagnosed Autoimmune Conditions	$r_S(124) = .17$	$r_S(124) = .05$	$r_S(124) = .14$	–

Note: Bonferroni-adjusted threshold for significance is 0.008.
** Spearman's *rho* correlation is significant at the 0.001 level (1-tailed).
* Spearman's *rho* correlation is significant at the 0.002 level (1-tailed).

Comparative analyses of the relationships between each of the stress measures and the physical health outcomes assessed revealed stronger associations between poor sleep quality and perceived stress or daily hassles than between poor sleep quality and cumulative life stress or past-year stress (see Table 13), suggesting that proximal stress experiences may have a more immediate impact on sleep. Notably, the Older Adult STRAIN yielded the strongest association with doctor-diagnosed general health conditions, which was the most objective outcome assessed. No significant associations were found between any of the stress measures and doctor diagnosed auto-immune conditions.

Table 13: Comparative Correlations – Stress Measures and Physical Health Outcomes

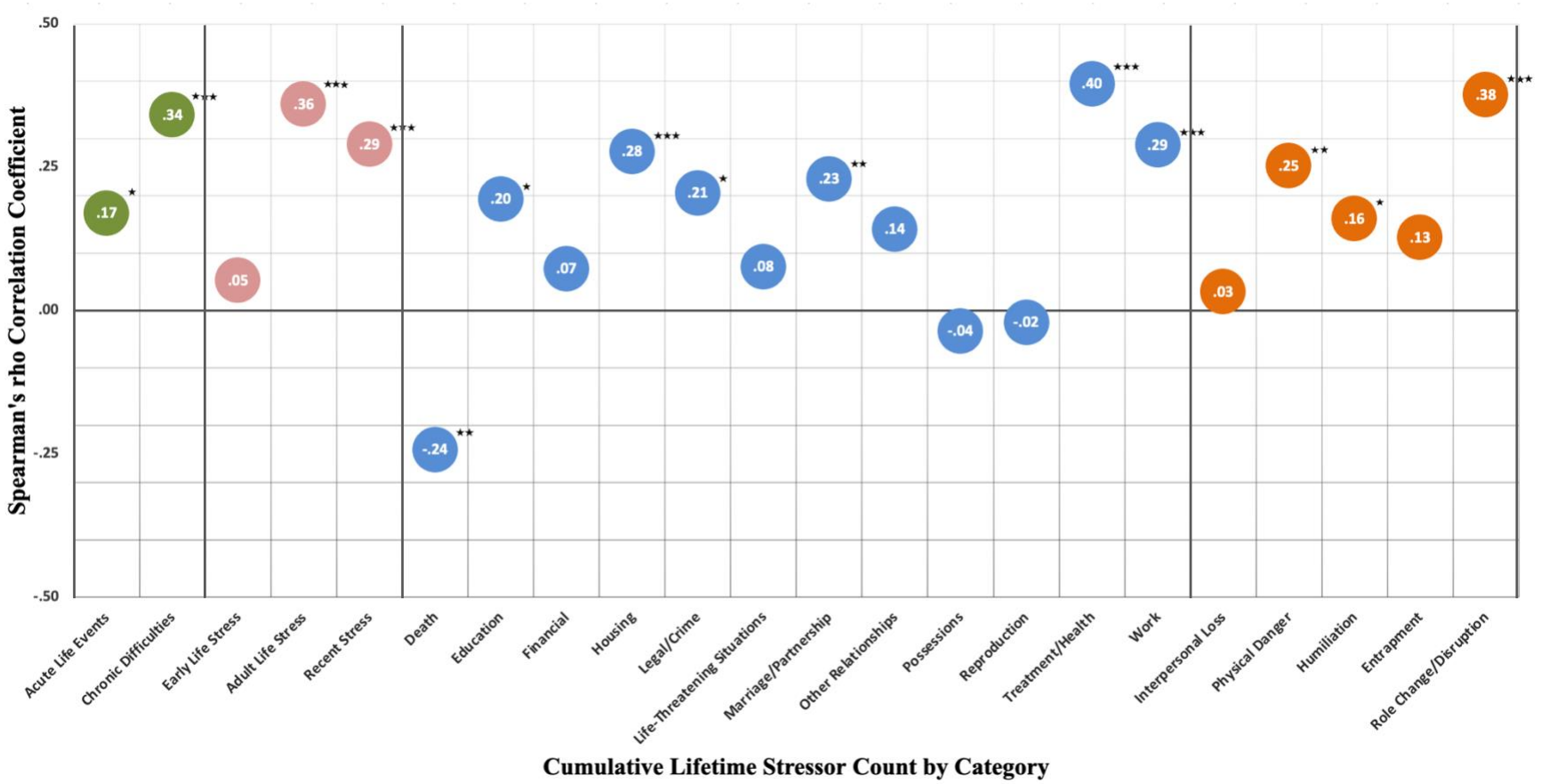
Variable (Measure)	Cumulative Life Stress (Older Adult STRAIN)	Past Year Stress (ELSI)	Perceived Stress (PSS)	Daily Hassles (HUS)
Poor Sleep Quality (PSQI)	$r_s(124) = .25$*	$r_s(122) = .19$	$r_s(120) = .41$**	$r_s(109) = .39$**
Doctor-Diagnosed General Health Conditions	$r_s(124) = .47$**	$r_s(122) = .12$	$r_s(120) = .32$**	$r_s(109) = .30$**
Doctor-Diagnosed Auto-Immune Health Conditions	$r_s(124) = .17$	$r_s(122) = .05$	$r_s(120) = .10$	$r_s(109) = .03$

Note: Bonferroni-adjusted threshold for significance is 0.004.
** Spearman's *rho* correlation is significant at the 0.001 level (1-tailed).
* Spearman's *rho* correlation is significant at the 0.002 level (1-tailed).

Finally, the summary data captured by the Older Adult STRAIN was disaggregated into categories (e.g., type, timing, life domain, and core psychosocial characteristic) and examined in relation to each mental and physical health outcome. Results revealed significant differences in the associations between each mental or physical health outcome and the various categories of stress. These findings lend support for a stress characteristics perspective, whereby different stress experiences are posited to affect unique rather than uniform biobehavioral stress responses.

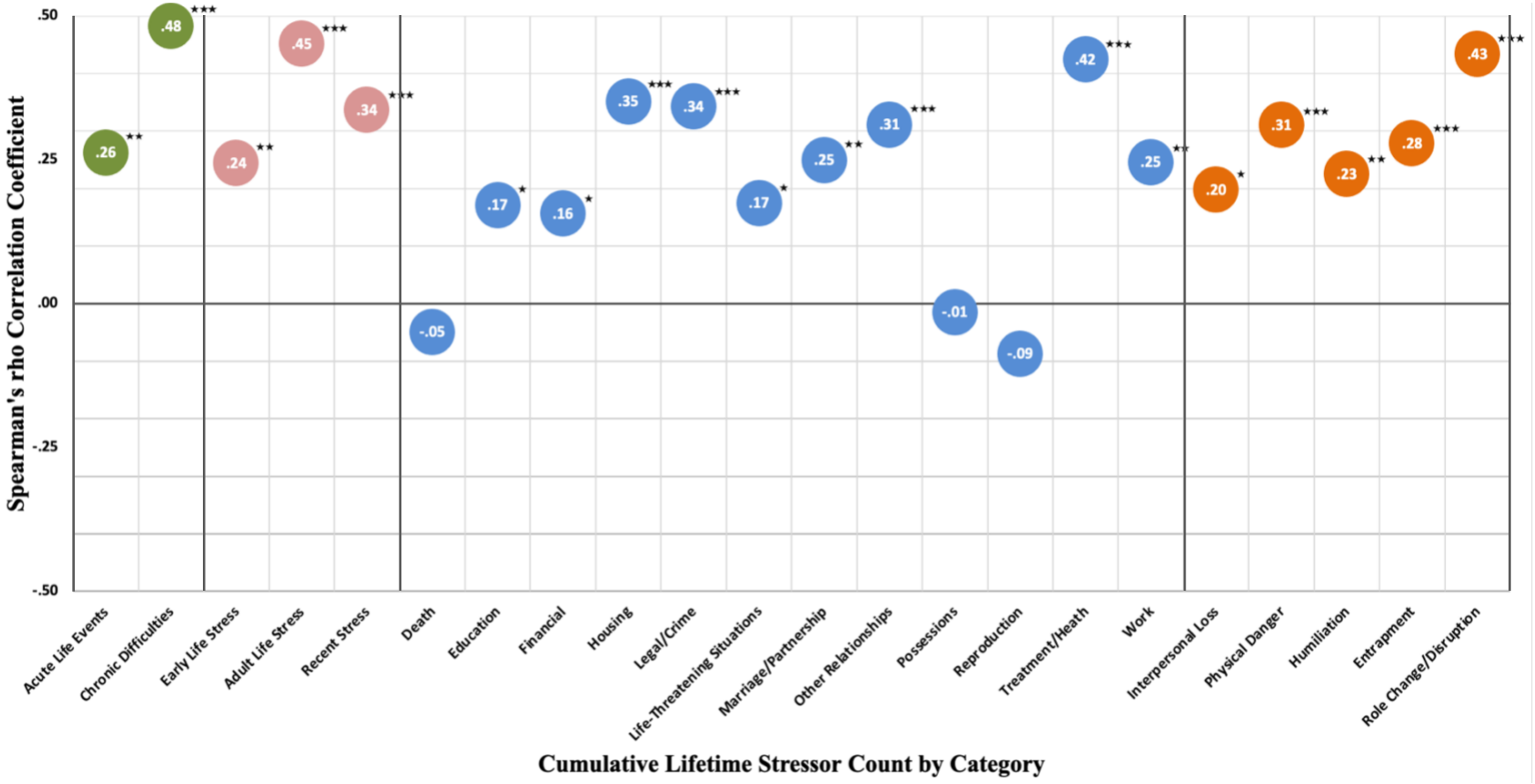
For example, depressive symptoms demonstrated significant, weak to moderate associations with several stress categories but no association with others (see Figure 1a). Specifically, while depressive symptoms were positively associated with both acute and chronic stressors, the strength of this association was stronger for chronic difficulties than for acute life events. Regarding the timing of stress experiences, adult life stress and recent stress both positively associated with depressive symptoms in this sample, whereas early life adversity did not. Concerning life domains, depressive symptoms were positively associated with stressors related to education, housing, legal/crime, marriage/partnership, treatment/health, and work. Notably, a negative association was indicated between depressive symptoms and death. No significant relations were found between depressive symptoms and finances, life-threatening situations, other relationships, possessions, or reproduction. Additionally, an examination of the associations between depression and the five core psychosocial stressor characteristics further indicated positive associations with physical danger, humiliation, and role change/disruption, but none with interpersonal loss or entrapment.

Figure 1a: Health Outcome Correlations by Stressor Type, Timing, Domain, and Characteristic – Depression



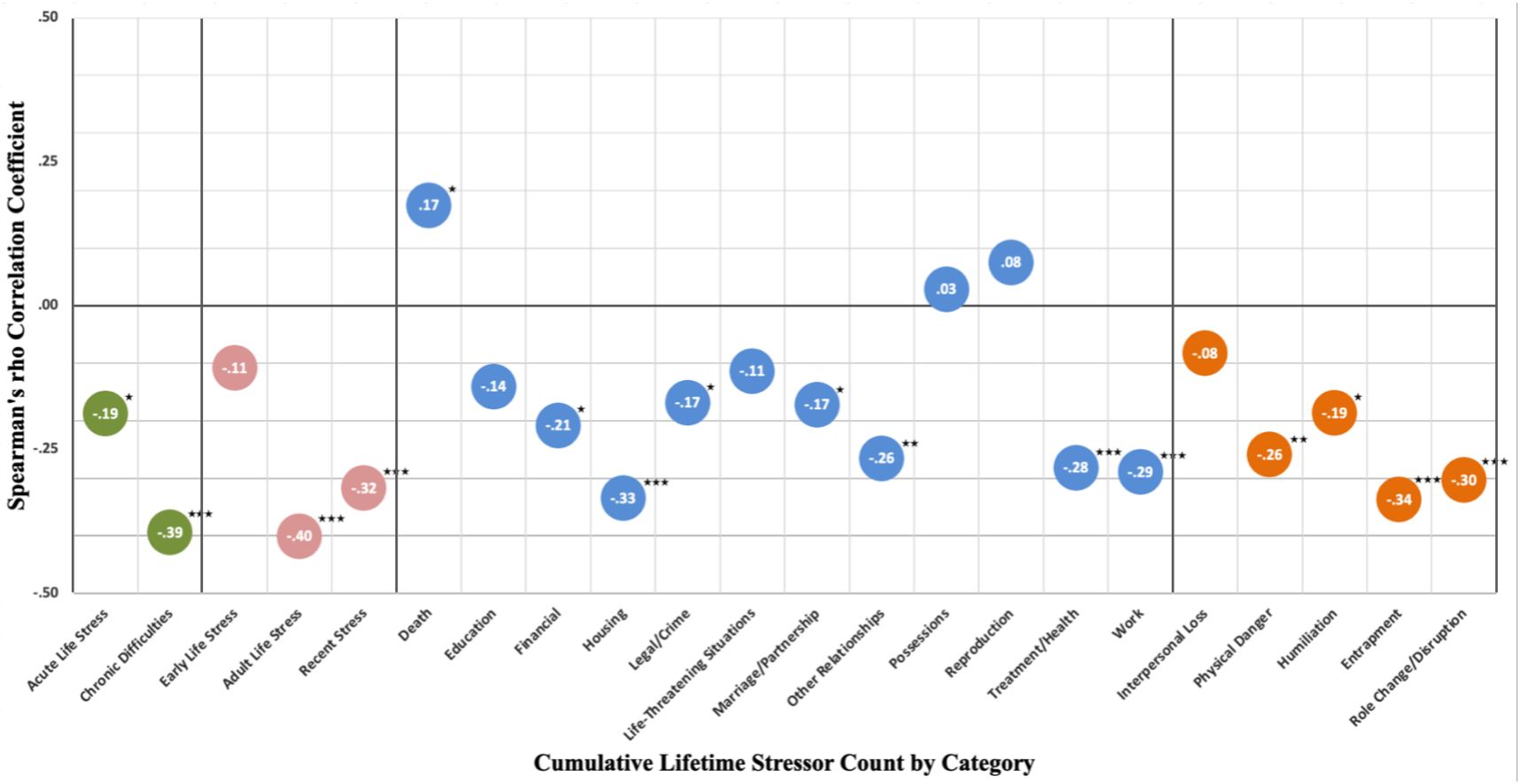
*** Correlation is significant at the 0.001 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Figure 1b: Health Outcome Correlations by Stressor Type, Timing, Domain, and Characteristic – Anxiety



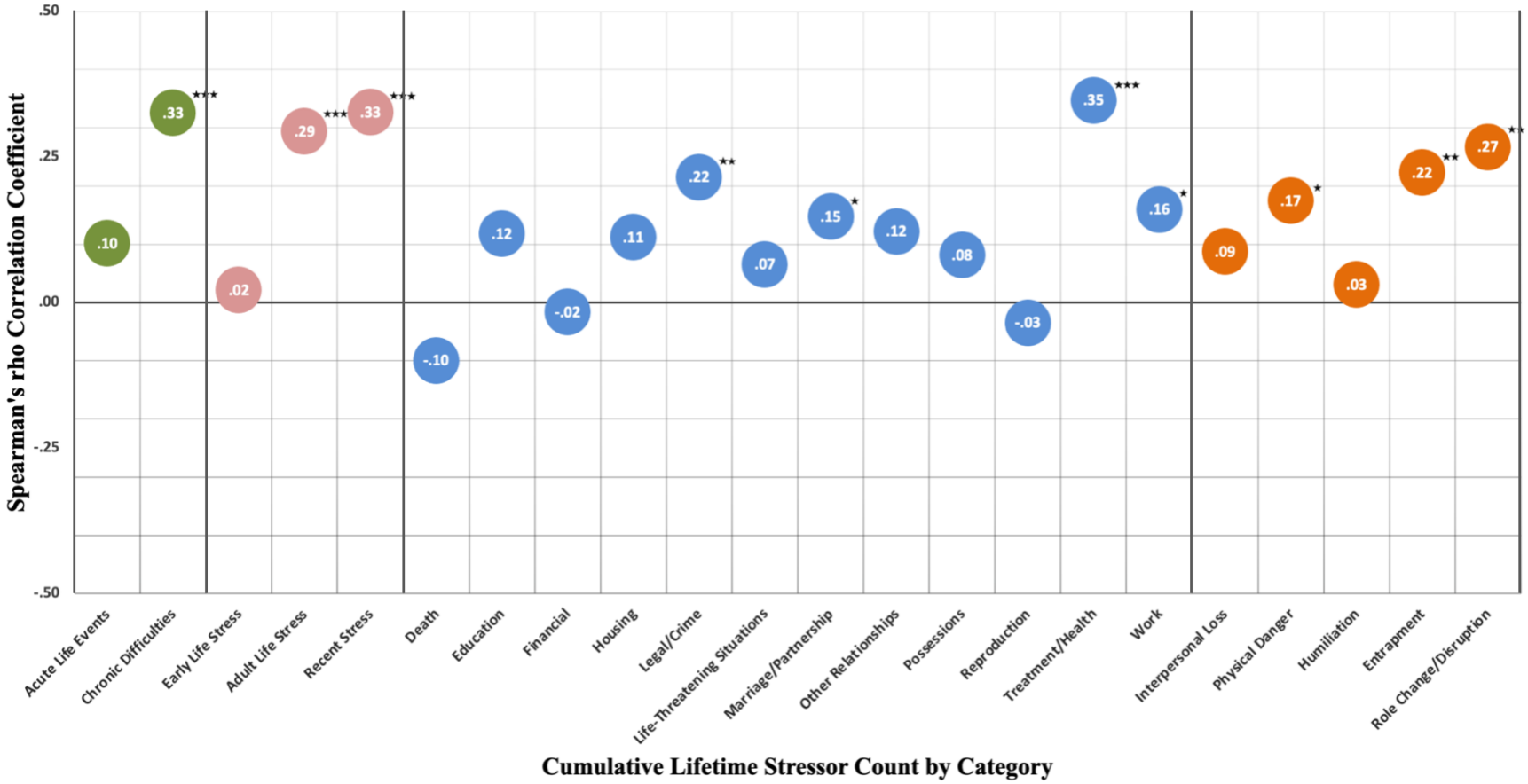
*** Correlation is significant at the 0.001 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Figure 1c: Health Outcome Correlations by Stressor Type, Timing, Domain, and Characteristic – Quality of Life



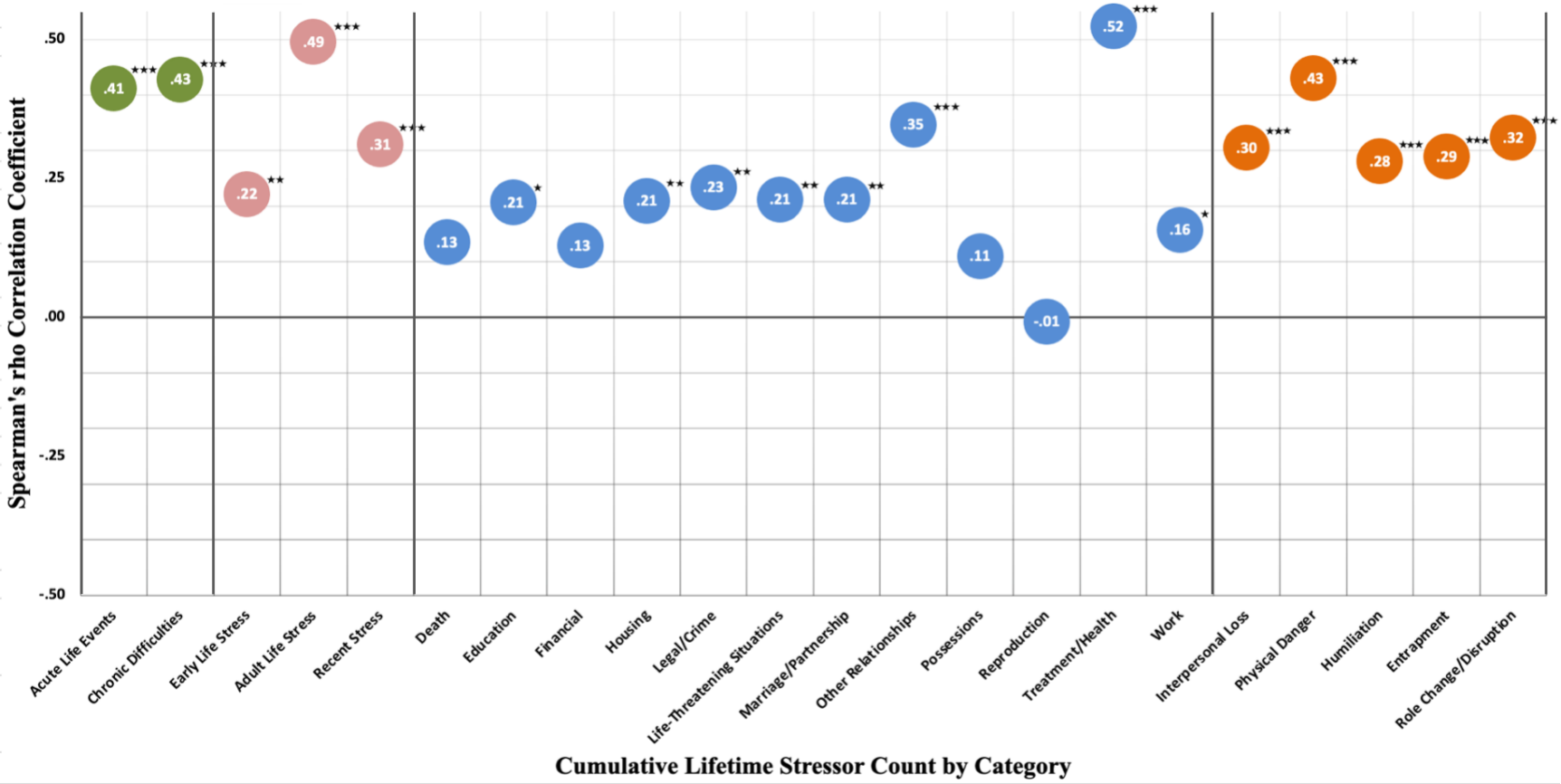
*** Correlation is significant at the 0.001 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Figure 1d: Health Outcome Correlations by Stressor Type, Timing, Domain, and Characteristic – Poor Sleep Quality



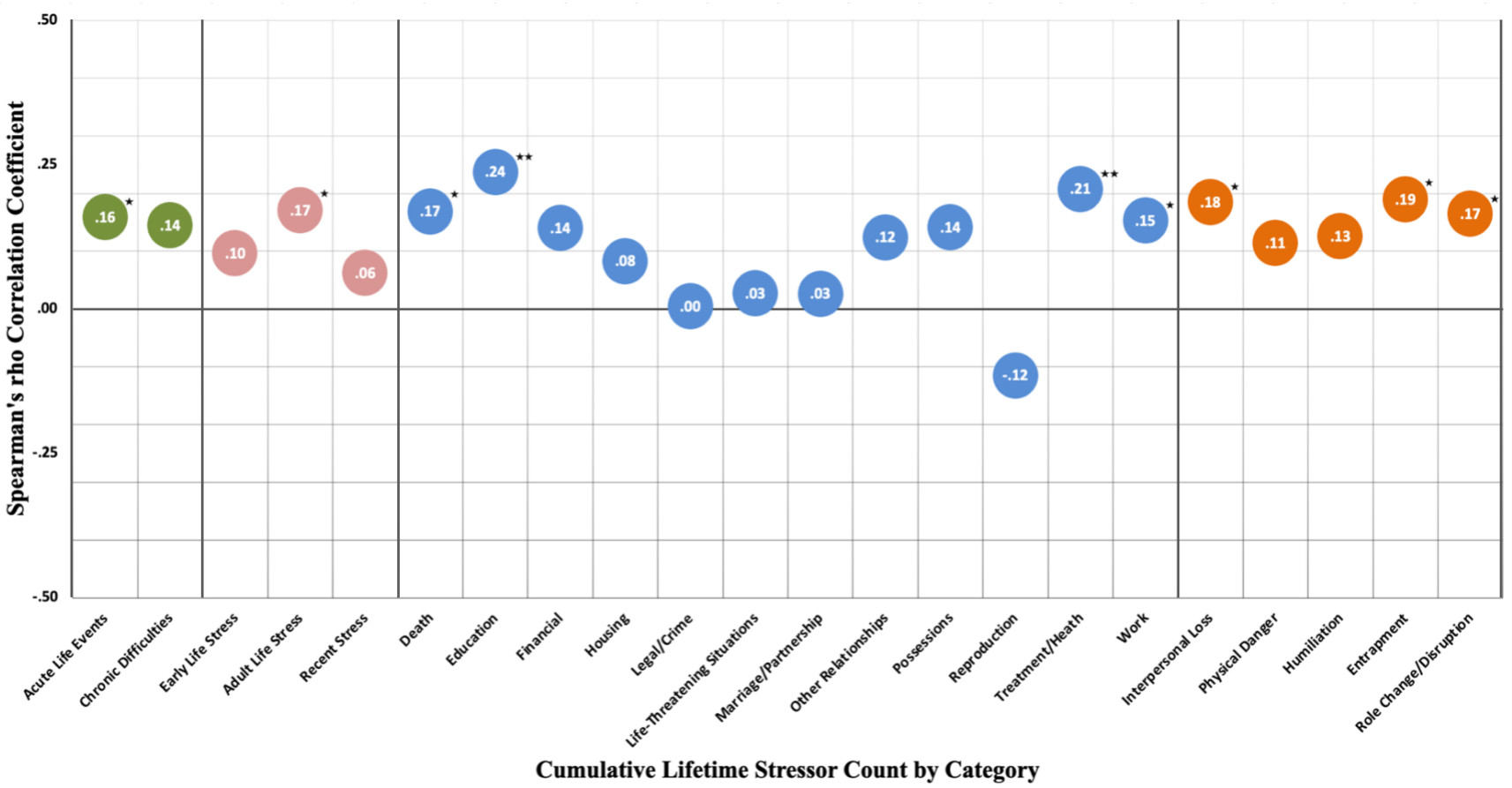
*** Correlation is significant at the 0.001 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Figure 1e: Health Outcome Correlations by Stressor Type, Timing, Domain, and Characteristic – General Health Diagnoses



*** Correlation is significant at the 0.001 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Figure 1f: Health Outcome Correlations by Stressor Type, Timing, Domain, and Characteristic – Auto-Immune Diagnoses



*** Correlation is significant at the 0.001 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Findings regarding anxiety, as demonstrated in Figure 1b, reflect a similar pattern of significant, weak to moderate associations concerning the type and timing of stressors. Anxious symptoms were positively associated with both acute life events and chronic difficulties, though more strongly with chronic difficulties. In addition to evidencing significant, positive associations with adult life stress and recent stress, anxiety was also significantly associated with early life stress. Analyses of the relation between cumulative life stress and anxiety by primary life domain indicate that anxiety was significantly, positively associated with stressors related to education, finances, housing, legal/crime, life-threatening situations, marriage/partnership, other relationships, treatment/health, and work, though not with those concerning death, possessions, or reproduction. Further, anxiety significantly correlated with all psychosocial characteristics, including interpersonal loss, physical danger, humiliation, entrapment, and role change/disruption.

In contrast, data concerning quality of life reflect a largely inverse pattern of weak to moderate associations with the various stress categories (see Figure 1c). For instance, quality of life was significantly, negatively associated with acute life stress and chronic difficulties. However, like depression and anxiety, evidenced a stronger correlation with chronic difficulties. Quality of life was also negatively associated with both adult life stress and recent stress, though not early life stress. Regarding potential differences in the association of quality of life with the various primary life domains, quality of life significantly, negatively associated with stressors related to finances, housing, legal/crime, marriage/partnership, other relationships, treatment/health, and work, but evidenced no significant relations with those related to education, life-threatening situations, possession, or reproduction. Notably, quality of life was positively associated with stressors related to death, demonstrating an inverse relation to that seen regarding depression.

Finally, concerning core psychosocial characteristics, quality of life was significantly, negatively associated with physical danger, humiliation, entrapment, and role change/disruption but not interpersonal loss.

Turning toward measures of physical health, results regarding the relations between sleep quality and the type and timing of cumulative life stress indicate that poorer sleep quality demonstrated a weak, positive association with chronic difficulties but none with acute life events (see Figure 1d). Further, poorer sleep quality was positively associated with adult life stress and recent stress but demonstrated no relationship with early life stress. Concerning primary life domains, poorer sleep quality was weakly and positively associated with stressors related to legal/crime, marriage/partnership, treatment/health, and work. No significant associations were found with death, education, finances, housing, life-threatening situation, other relationships, possessions, or reproduction. Regarding psychosocial characteristics, poorer sleep quality demonstrated weak, positive associations with physical danger, entrapment, and role change/disruption but not interpersonal loss or humiliation.

Doctor-diagnosed general health conditions demonstrated moderate, positive associations with acute life events and chronic difficulties as well as weak to moderate, positive associations with all timing parameters, including early life stress, adult life stress, recent stress (see Figure 1e). Analyses of the relations between general health diagnoses and the various life domains indicated weak to moderate, positive associations with education, housing, legal/crime, life-threatening situations, marriage/partnership, other relationships, treatment/health, and work, but none with death, finances, possessions, or reproduction. Further, general health diagnoses were

positively related to all psychosocial characteristics, including interpersonal loss, physical danger, humiliation, entrapment, and role change/disruption.

Finally, doctor-diagnosed auto-immune conditions demonstrated notably fewer and weaker associations with the various stress categories, which may reflect the relatively low levels of auto-immune conditions reported in the present sample (see Figure 1f). Auto-immune diagnoses positively associated with acute life events but not chronic difficulties, which is notable given the chronic nature of auto-immune conditions. They were also positively associated with adult life stress but not early life stress or recent stress. Concerning primary life domains, auto-immune diagnoses were positively associated with death, education, treatment/health, and work but not finances, housing, legal/crime, life-threatening situations, marriage/partnership, other relationships, possessions, or reproduction. Additionally, they evidenced positive relations with interpersonal loss, entrapment, and role change/disruption but none with physical danger or humiliation.

In summary, consistent with hypothesis regarding Aim 3, cumulative life stress, operationalized as total stressor count, significantly associated with five of the six mental and physical health outcomes assessed. Specifically, cumulative life stress demonstrated positive correlations with depression, anxiety, poor sleep quality, and doctor-diagnosed general health, as well as an inverse correlation with poor sleep quality. No significant association was found between cumulative life stress and doctor diagnosed auto-immune conditions, which is likely impacted by the minimal endorsement of such diagnoses in the present sample. Further, an examination of the Older Adult STRAIN's disaggregated data revealed significant variability in the strength of the associations between cumulative life stress and each health outcome based on stressor type,

timing, primary life domain, and core psychosocial characteristic, thus providing compelling support for theoretical perspectives positing that stress effects are not uniform but rather vary across contexts and characteristics.

CHAPTER 5: DISCUSSION

General Discussion

The stress literature reflects increasingly sophisticated theories for how stress impacts biobehavioral, psychological, and social health over the life course. Moreover, methodological innovation has enabled progressively complex modeling of stress impacts across and between developmental stages, lending valuable insight into trajectories of both risk and resilience. While substantial research has been accomplished with younger adult samples, older adult research and related care continue to be hindered by a lack of precision tools for measuring cumulative life stress from an age-informed perspective. Mindful that older adult health is also a fast-rising public health priority, the present study sought to address this gap by developing and validating an efficient, user-friendly cumulative life stress measure, the Older Adult Stress and Adversity Inventory (Older Adult STRAIN), to assess stress exposures and experiences salient to older adulthood in addition to earlier developmental stages.

The development of the Older Adult STRAIN was guided by recommendations derived from the scale development literature and informed by methods used in prior STRAIN validation studies (Cazassa et al., 2020; Slavich et al., 2019, Slavich & Shields, 2018; Sturmbauer et al., 2019). First, items were generated through an extensive literature review to identify stressors commonly assessed in older adulthood as well as those frequently associated with poorer health outcomes. Second, preliminary items were then developed and consolidated into a set of 28 candidate items through focus group sessions with the proposed measure's target population to pinpoint additional stressors and inform item language. Third, the 28 candidate items, including 18 new items, 6 adapted items, and 4 items carried over from the Adult STRAIN, were evaluated and

refined by a panel of experts in stress, health, and geropsychology to enhance relevance and clarity. The final older adulthood-specific items were then integrated with items from the Adult STRAIN, which assess stress experiences relevant to earlier stages of life, and evaluated via the present validation study.

In its validated form, the Older Adult STRAIN capitalizes on the Adult STRAIN's architecture and use of intelligent logic to survey a broad range of acute life events and chronic difficulties that can impact mental and physical health. Similar to the Adult STRAIN, each of the stressors queried is accompanied by follow-up probes designed to develop a high-resolution panorama of stress experiences over the lifespan. Further, data derived through the Older Adult STRAIN may be aggregated or disaggregated according to stressor type (i.e., acute, chronic), timing (i.e., early adversity, adult stress, recent stress), primary life domain (death, education, financial, housing, legal/crime, life-threatening situations, marital/partner, other relationships, possessions, reproduction, treatment/health, work), and/or core psychosocial characteristic (entrapment, humiliation, interpersonal loss, physical danger, role change/disruption) to accommodate specific research and/or clinical objectives.

However, with the addition of 18 older adulthood-specific stressors and the adaptation of 6 existing Adult STRAIN items to be more relevant to older adulthood, the Older Adult STRAIN is uniquely positioned to target the construct of cumulative life stress from the perspective of older adulthood. Aspects of older adult stress that have as yet gone uncaptured in content, impact, or both, are more accurately accounted for in the Older Adult STRAIN and, as such, made available to inform and enhance the development of healthcare policies and infrastructures that support health in aging. That said, beyond the preliminary ambit of the present validation

study as discussed below, more research is needed to explore the incremental validity of the Older Adult STRAIN in relation to the Adult STRAIN as well as to other investigator-based interview measures. Moreover, in the spirit of assessment being an ongoing endeavor, continued work will be needed to update the Older Adult STRAIN as generational and cohort experiences continue to impact stress and resilience trajectories.

Usability and Acceptability. The study's first aim was to develop the Older Adult STRAIN as described above (See Appendix E for final measure) and then, through the present validation study, to examine the measure's usability and acceptability. Indices of usability and acceptability included objective measures regarding time to complete, discontinuations, failed attention checks, and over all completion rates as well as subjective, self-reported ratings of usability and acceptability.

Regarding objective usability and acceptability, 126 older adult participants (*Mean age* = 73.36, *SD* = 6.58) completed the Older Adult STRAIN in approximately 33 minutes with no discontinuations or failed attention checks, resulting in a 100% completion rate. While this average time to complete is 15 minutes longer than the average reported in the Adult STRAIN validation study (i.e., 18 minutes), that study also reported a lower completion rate (90.8%) as well as higher attrition due to failed attention checks (35%) (Slavich & Shields, 2018). Several additional factors may also contribute to this difference in timing, notably that the Adult STRAIN includes 18 fewer questions, and its validating study had a lower number of older adult respondents (*n* = 12, 5% of the study sample), who may, as a cohort, demonstrate different test-taking behaviors. In comparison to gold standard investigator-based interviews, such as the

LEDS (Brown & Harris, 1978) and LSI (Hammen et al., 1987), which are reported to take 45-120 minutes and designed to cover a shorter span of time (i.e., past 6 months or year), the Older Adult STRAIN represents a time- and resource-efficient option for measuring cumulative life stress from the perspective of older adulthood.

Participants' subjective experience of the Older Adult STRAIN was queried via an embedded, post-measure survey of usability and acceptability. Participants were asked to indicate their level of agreement with statements regarding the measure's usability and acceptability. On average, participants agreed that the Older Adult STRAIN was "easy to use" and "met [their] approval" as an inventory of older adulthood stress.

Finally, based on findings in the Adult STRAIN validation study, completing the Older Adult STRAIN was not expected to associate with changes in negative affect (data for positive affect was not reported). However, analyses of pre- and post-measure affect in the present study indicated small but significant decreases in both negative and positive affect upon measure completion. While this finding is not implausible, as robust research characterizes positive and negative affect as relatively independent dimensions of affective structure (Fredrickson & Losada, 2005; Watson et al., 1988), present study data cannot account for these shifts in affect. Considering the negative affect items of the PANAS-SF, it is possible that upon completing the Older Adult STRAIN respondents experienced reductions in distress, nervousness, or jitters. Alternatively, considering the positive affect items, they may have felt less excited, enthusiastic, or alert after sitting at a computer and reviewing stress experiences for a period of time. These differences in pre-and post-measure affect may also reflect regression to the mean, whereby

participants who endorsed more extreme values at the first administration tended to endorse values closer to the mean at the second. Finally, another possible explanation for the different findings may be that in the Adult STRAIN validation study, responses to the ten items on each affect scale were averaged rather than summed as recommended by the PANAS-SF guidance. This shift in scoring practices could have resulted in a more restricted range of change scores given the larger sample size in that study. Further research is needed to replicate findings and clarify the factors that influenced the positive and negative mood shifts here indicated.

Concurrent Validity – Stress. The study's second aim was to examine the concurrent validities of the Older Adult STRAIN with regards to several existing measures of past and present stress. Findings indicated that the Older Adult STRAIN demonstrated good concurrent validity with three measures of stress, including the Elder Life Stress Inventory (ELSI), the hassles portion of the Hassles and Uplifts Scale (HUS), and the Perceived Stress Scale (PSS). Notably, the Older Adult STRAIN associated more strongly with the HUS and the PSS, two measures of stress severity or impacts over the last month, than the ELSI, a more similarly structured measure of stress exposures or counts over the last year.

Several factors may help to account for these findings. On one hand, the stronger association between the measure of cumulative life stress (Older Adult STRAIN) and those of daily hassles (HUS) and present perceived stress (PSS) align with stress sensitization theories, which posit that individuals become more reactive to stress as they age and accumulate stressful experiences (Mroczek & Almeida, 2004; Almeida et al., 2011). Therefore, participants who endorsed exposure to a greater number of stressors over the course of their lives would also tend to

endorse greater present stress due to having developed a heightened sensitivity to adverse experiences as they aged. These findings also align with stress proliferation theories, in that stressors encountered in one stage or domain of life (e.g., early childhood, marriage, health) can interact with and compound stressors in others (Pearlin, 2010). Consistent with this perspective, participants who endorsed greater cumulative life stressor counts would also tend to endorse greater daily hassles and or present perceived stress due to the multiplicative effects of prior and existing stress experiences.

Findings may also reflect respondent characteristics, such as personality and social desirability, that were not assessed in the present study. For instance, individuals' stress endorsements, past and present, may be collectively influenced by neuroticism or, alternatively, the desire to present themselves in a favorable light. While the Adult STRAIN validating study found no relations between cumulative life stress, personality, and social desirability, the validating studies in Brazilian Portuguese and German reported small but significant associations for one (Sturmbauer et al., 2019 (personality)) or both (Cazassa et al., 2020). Neither personality nor social desirability was reported in the Adolescent STRAIN (Slavich et al., 2019). It is possible that either or both factors could contribute to over- or under-reporting based on various aspects of sociocultural identity, including age and cohort effects.

Additionally, self-report instruments, like the Older Adult STRAIN, the HUS, and the PSS, are often associated with biases of mood and memory (Harkness & Monroe, 2016). Respondents' reports of past stress experiences may be filtered through their current mood and, thereby, made more or less distressing depending upon prevailing affect. Consistent with this critique, data

from the present study demonstrated significant associations between cumulative life stress endorsement and affect. Respondents who endorsed greater positive affect tended to endorse fewer lifetime stressors as well as lower present perceived stress and daily hassles. Conversely, respondents who endorsed greater negative affect tended to endorse greater lifetime stressors as well as higher present perceived stress and daily hassles. These associations suggest that present affect significantly impacted respondents' reports of both past and present stress, which could help to explain the relative stronger correlations between the Older Adult STRAIN, the PSS, and the HUS. The older adult research also posits the impact of a "positivity effect" on memory, such that with advancing age, adults increasingly attend to and remember positive information more than negative information (Carstensen & DeLiema, 2018). As factors that may influence the content and valence of episodic memories queried in a lifespan measure like the Older Adult STRAIN, memory and related biases are valuable potential confounds. Further research is needed to ascertain their unique effects as well as how they interact with other respondent characteristics, such as personality and social desirability, to impact older adults' endorsements of cumulative life stress.

Regarding the relation between the Older Adult STRAIN and the ELSI, both longer term inventories of stress (lifetime, past year, respectively), their relatively weaker association suggests the incremental value of the Older Adult STRAIN in being able to capture experiences that are neither linear nor monotonic along a broader timespan within the developmental stage of older adulthood. In the present study, the Older Adult STRAIN demonstrated more robust associations than the ELSI across all mental and physical health indices assessed, notably including the more objective measures related to doctor-diagnoses, with which the ELSI yielded

no significant relations. A number of factors may account for this difference. First, the Older Adult STRAIN covers a broader period of time. When using the ELSI or similar inventories that are designed to query recent rather than cumulative experience, the time period assessed may not be representative of actual stress experience. A respondent may report relatively lower stress experiences in the limited time frame assessed after having navigated several highly impactful stressors in the period just prior. In such a case, stress exposures that may be salient to health outcomes and related care go unaccounted. Second, the Older Adult STRAIN assesses multiple experiences over time. In cases where a stressor occurred more than once, it accounts for accretive effects. Finally, by querying a greater array of stressors, the Older Adult STRAIN renders a higher resolution picture of the respondent's stress experience across domains and developmental stages. An acute stressor occurring at one time may evolve into a chronic stressor at another. Moreover, certain kinds of stress, such as trauma and grief, may not resolve in straightforward or predictable fashion; adaption may occur variably with significant relapses over the course of years. In each of these cases, the respondent's scores on a more limited inventory would not accurately reflect their broader stress experience, nor would they be as reliable a predictor in forecasting stress-related health outcomes. So, although the Older Adult STRAIN demonstrated concurrent validity with the ELSI, it also demonstrated an enhanced ability to render a comprehensive picture of cumulative life stress in older adulthood.

Comparative analyses of each stress scale's association with the measured outcomes indicated that while the Older Adult STRAIN demonstrated the strongest association with the more objective physical health variables (i.e., doctor-diagnosed general health and auto-immune conditions), the PSS and HUS evidenced stronger correlations with the mental health variables

and poor sleep quality. These findings may reflect methodological parities between measures that were designed to assess stress severity or impact ratings as opposed to event counts. For instance, the PSS, the HUS, and the measures used to assess depression, anxiety, quality of life, and sleep (GSD-SF, GAS-10, OPQoL-Brief, PSQI, respectively), all queried the respondent's present subjective experience; whereas, the doctor-diagnoses inventories queried whether an event objectively occurred over the entire lifespan. The Older Adult STRAIN assessed both objective (stressors counts) and subjective (stressor severity) experiences. However, its subjective items substantially refer to past rather than present experiences. Acknowledging the possibility that the objective querying aspect of the Older Adult STRAIN and the doctor-diagnoses inventories contributed to their stronger association, a parallel analysis of the Older Adult STRAIN reported as total stress severity rather that total event count was conducted. Findings yielded a similar pattern of results, with the PSS and HUS demonstrating more robust associations with the mental health and sleep variables than the Older Adult STRAIN. Taken together, these findings suggest that the proximity to stressful events (i.e., reporting on experiences in the past month versus in a lifetime) may have pervasive impacts on mood, quality of life, sleep, and interactions there between, highlighting that proximal stress may be an important variable to control for in subsequent research.

Concurrent Validity – Mental and Physical Health. The third aim of the study sought to examine the concurrent validities of the Older Adult STRAIN with regards to several common measures of mental and physical health. Results indicated that the Older Adult STRAIN demonstrated good concurrent validity with measures of mental health (i.e., anxiety, depression) and physical health (i.e., poor sleep quality, doctor-diagnosed general health and auto-immune

conditions). As expected, results aligned with the literature proposing a positive association between cumulative life stress and anxiety and depressive symptoms (Cohen et al., 2019; Inoue et al., 2022; Kendler et al., 2003). Additional analyses of the discriminant validity of the Older Adult STRAIN with regard to an older adult-specific measure of quality of life also yielded the expected relationship, with quality of life being significantly, negatively associated with cumulative life stress. Regarding physical health, findings were also consistent with predictions in indicating a positive association between cumulative life stress and both poor sleep quality and doctor-diagnosed general health and auto-immune conditions. Taken together, these findings support the concurrent validity of the Older Adult STRAIN, as an aggregated measure of cumulative life stress, in relation to several key measures of mental and physical health in older adulthood.

Analyses of covariates and potential confounds also indicated significant associations between aggregated cumulative life stress counts and age, gender, and personal income. Respondents who were older tended to endorse lower lifetime stressor counts. These results align with SST and SAVI perspectives, which associate aging with reduced exposure to stressors due in large part to situational selection and enhanced emotion regulation skills (Carstensen et al., 1999; Charles, 2010). They are also consistent with studies finding that older age is associated with less reported lifetime stress (Almeida, 2005; Charles et al., 2010; but see Neupert & Bellingtier, 2019 for counterpoint). In contrast, respondents who identified as a gender minority (e.g., non-binary, female) or endorsed a lower income tended to report higher lifetime stressor counts. These results are consistent with existing research finding that minoritized gender status and lower socioeconomic status are associated with greater lifetime stress (Brewin et al. 2000; Cardona et

al., 2022). Neither race, nor education, nor relationship status indicated significant relations. The finding regarding race runs contrary to research evidencing significant and compelling differences in cumulative life stress impacts related to racial identity and experience (Geronimus et al., 2006; Langellier et al., 2021; Moore et al., 2021). However, it is not surprising given the limited racial/ethnic diversity of the present sample. Further research in more diverse samples is needed to help clarify race-related differences in cumulative life stress so that under-represented identities may also participate in and fully benefit from the therapeutic and healthcare innovations developed upon such data.

Turning to more granular analyses of the associations between cumulative life stress and mental and physical health, disaggregated results demonstrated significant differences in the strength of the association between stress and each mental or physical health outcome based upon the context and characteristics of the stressor (e.g., developmental stage of exposure, type of stressor, primary life domain, psychosocial quality). For instance, regarding mental health, while aggregated data reflected a strong association between geriatric anxiety and cumulative life stress in general (see Figure 1b above), a more refined investigation suggests that certain stress factors are more powerful drivers of this relationship than others. Regarding stressor type, anxiety corresponded more strongly with chronic stressors than with acute life events. Regarding timing, anxiety was more strongly related to experiences occurring in adulthood than in childhood. Regarding life domains, stressors related to housing and health demonstrated greater correspondence with anxiety than those related to death or possessions. Finally, regarding psychosocial stressors, role changes or disruptions were more anxiogenic than interpersonal loss. Each of these dimensions provides insight into the drivers of anxiety for this particular sample of

older adults. Collectively, they also point to potential approaches for addressing anxiety, such as programs that build resources for managing chronic difficulties or assist in navigating healthcare networks. By identifying factors that drive the relationship between cumulative life stress and anxiety, the Older Adult STRAIN can not only categorize groups by experience but also help to clarify the most valuable interventional targets.

Study results reveal a similar pattern of associations between depressive symptoms and various aspects of cumulative life stress, highlighting the compounding impacts of certain types of stressors (see Figure 1a). For instance, stressors related to housing, marriage/partnership, and work served as significant drivers for both depression and anxiety. Comparative analyses also suggest the potentially variable impacts of other stressors, such as those related to finances or life-threatening situations. For example, while stressors related to death were unrelated to anxiety, they were significantly, inversely associated with depression, such that individuals endorsing more experiences related to death tended to report lower levels of depressive symptoms. This intriguing finding aligns with the literature positing age-related adaption to stressful events. Several theories, including Socioemotional Selectivity Theory (SST), Coping, Appraisal, and Resilience in Aging (CARA) perspectives, and inoculation-based theories, align in positing that aging adults' abilities to cope with adversity improve as they accumulate knowledge and experiences to inform effective stress-management strategies (Aldwin & Igarashi, 2016; Carstensen et al., 1999; Schiebe & Carstensen, 2010). According to these approaches, experiences of death can provide individuals the opportunity to build resilience for coping with subsequent losses. A related interpretation is that older adults are better positioned to

manage certain experiences, like the deaths of loved ones, based on the belief that they are expected or appropriate to a particular stage of life (Haigh et al., 2018).

Similarly, Selection, Optimization, and Compensation (SOC) and Strength and Vulnerability Integration (SAVI) perspectives assert that through the aging process, older adults become increasing adept at discerning strengths and weakness, whether they be related to physical health, mental health, or social support, and optimizing their areas of strength to compensate for those of relative weakness (Baltes & Baltes, 1990; Urry & Gross, 2010). Seen in the context of these approaches, experiencing the death of loved ones can compel individuals to take stock of the resources they have available (e.g., psychological, interpersonal, financial, physical) and to allocate them in a manner that supports health and wellness even as they navigate loss. Considered in the context of these various theoretical perspectives, the present association between greater death experiences and lower depressive symptoms provides an example of a compelling interaction of stress exposures and adaptive resilience factors that invites further investigation.

Finally, the data for quality of life also reflect differential impacts based upon stressor characteristics, demonstrating, by contrast, substantial overlap with the findings related to depression and anxiety. For instance, similar to depression and anxiety, poorer quality of life was more strongly associated with chronic difficulties than acute life events, a finding that aligns with allostatic load theories positing the accretive impacts of chronic wear and tear on biobehavioral stress responses and related health outcomes (Guidi et al., 2021; McEwen, 2012; Parker et al., 2021). Additionally, lower quality of life also associated more strongly with adult

and recent life stress than with early life stress, highlighting the utility of precision tools for articulating unique and additive stressors associated with aging not only to better understand the vulnerabilities and strengths with which older adults pursue health but also to clarify and foster trajectories of resilience with regards to prior adverse experiences.

Taken together, these findings align with a *stress characteristics* perspective on life stress which emphasizes the variability in stress-by-response interactions as an alternative to earlier theories positing uniform or similar biobehavioral responses across disparate stress experiences (Cohen et al., 2019; Goodman et al., 2017; Kemeny, 2003; Weiner, 1992). They also advance existing research by 1) providing evidence that the associations between stressors and outcomes differ by type, timing, life domain, and core psychosocial characteristics and 2) setting the stage for building a deeper understanding of how these relations may shift in older adulthood, thereby impacting health trajectories and related care. From a research perspective, the data derived from the Older Adult STRAIN offer a panoramic model of a population's stress profile that can enable efficient identification of target groups, risk and resilience trajectories, and comparative outcomes. Additionally, from a clinical perspective, the Older Adult STRAIN enables user-friendly, high-resolution assessment that can inform the development of precision interventions at both individual and community levels.

Limitations and Future Directions

Several limitations of this study should be noted to situate the results and highlight pathways forward. First, this study used a cross sectional design to evaluate the validity of a novel measure of cumulative life stress with regard to concurrent measures of stress as well as mental and

physical health. Results are correlational and not intended to reflect predictive validity. Additional work using longitudinal designs is needed to enable more sophisticated testing and predictive modeling regarding the relationship between cumulative life stress and various mental, physical, and social health outcomes.

Second, while the study sample approximated the racial/ethnic composition of the state of Maine, it was not particularly diverse nor was it fully representational in terms of gender, socioeconomic status, or ability. This limitation narrows the generalizability of the proposed measure and study findings to aspects of identity and experience represented in the development and evaluation processes (Gurven, 2018). It also restricts inquiries into differential risk and resilience profiles related to underrepresented intersectionalities that could inform more targeted and effective clinical care (Henrich et al., 2010). For instance, the present sample of 126 respondents included only two individuals who identified as gender non-binary and five who identified as black, indigenous, or a person of color, even fewer who identified as both. Most respondents were college educated and living well above the current poverty line. Additionally, the study was held online and included a virtual interview which required both access to technology and computer literacy, resources that are not equally distributed across sociodemographic groups. While this design made the study more available to individuals who may not have been able to attend study sessions in person, particularly considering that the study took place during the Covid-19 pandemic, it was also vulnerable to self-selection biases of individuals who preferred and had access to digital media. Relatedly, power analysis indicated that we needed a sample of 11 participants to detect a large effect size and at least 67 to detect a smaller effect size. While a few item level endorsements fell beneath this minimum threshold

(e.g., financial exploitation, jail time), study analyses were completed using data aggregated into core characteristics and domains that exceeded this minimum threshold. That said, in all cases, results need to be interpreted considering the limitations of the sample represented. Aging research and healthcare more broadly will benefit from studies that engage larger and more representative samples, both within the general aging population as well as within clinical subgroups (e.g., depression, chronic pain, cognitive decline, optimal aging) (National Academies of Sciences, Engineering, and Medicine. 2022).

Third, study measures were primarily self-report and, as such, likely reflect biases of mood, memory, and proximal stress. They may also reflect common method variance, or overlapping variability that is attributable to factors related to the common assessment methods used (e.g., social desirability, affect) rather than reflect true relationships among the variables assessed. Additionally, self-report findings may have been influenced by cohort effects or age-related differences in perceptions of stress such that older adults may have tended to downplay stressors or to interpret them as less threatening. For instance, comparisons of the Adolescent STRAIN, Adult STRAIN, and Older Adult STRAIN validation studies suggests several interesting patterns. First, younger adults tended to endorse significantly higher stress counts and severity impacts than adults ($t(280) = 3.77$, $p < .000$; $t(280) = 3.81$, $p < .000$, respectively). Second, while there was no statistically significant difference in the number of stressors endorsed between older adults and younger adults, older adults' impact severity ratings were significantly lower than those of the younger adults ($t(255) = .59$, $p > .05$; $t(255) = 3.08$, $p = .004$, respectively). Conversely, while older adults, on average endorsed significantly more stressors than adults, there was no statistically significant difference in their impact severity ratings ($t(170) = 3.76$, p

<.000; t(170) = .65, *p* >.05, respectively), suggesting that as adults aged, stressors were associated with lower adverse impacts. While these comparisons are based upon studies with different samples and, to a degree, measures, they suggest the influence of age-related differences in how stress is perceived and, in doing so, pose an intriguing question for future research. Finally, the present study lacked an objective measure of analyses. Although the MoCA was used to help describe the study sample, as a cognitive screener, it is not adequate to the task of serving as a proxy for executive function. Subsequent work would benefit from the inclusion of more comprehensive neuropsychological assessment as well as biobehavioral markers and objective clinical outcomes that are not as vulnerable to self-report biases.

Fourth, several variables had missing data points and, where appropriate, pairwise deletion was used to maximize power. While missing variables analyses and visual inspection of the data set did not indicate any pattern of missingness, in cases where statistics were computed based on a different subset of cases, resulting patterns may not accurately reflect the data had it been complete.

Fifth, the original Adult STRAIN scale developers characterized individual items as being primarily associated with one core characteristic (e.g., entrapment, interpersonal loss, role change/disruption) and one primary life domain (e.g., housing, marital relationships, treatment/health) based upon an extensive review of the stress and health literatures. However, in some cases, choosing one primary association can prove challenging and other sources may suggest meaningful relations with additional or alternative core characteristics or primary life domains. For instance, it is possible that the stressor of losing the ability to complete one's

finances or make legal decisions could be conceptualized as being associated with the core characteristics of entrapment or humiliation, rather than with role change/disruption as it is operationalized in the present study. Further research incorporating factor analysis would be valuable to confirm and clarify item-by-characteristic and item-by-domain associations as well as the ways in which these associations may relate to various sample characteristics (e.g., age, race, gender, socioeconomic status).

Finally, this study demonstrates limited evidence of reliability, due in part to the study design and in part to the characteristics of the Older Adult STRAIN as a global stressful life events measure. Regarding the first, further research in a larger, more representative sample size is needed to examine the factor structure of the Older Adult STRAIN. Although the items of the original Adult STRAIN, which provided a foundation for the development of the Older Adult STRAIN, were rationally categorized into primary life domains and core psychosocial characteristics based on both deductive and inductive research methods (Slavich & Shields, 2018), no exploratory factor analysis has been completed to evaluate the proposed model's fit. Additionally, while test-retest reliability of the Older Adult STRAIN summary scores is of limited use (i.e., shifts in stressor endorsement over time may be masked in the aggregate), an item level analysis would be useful to demonstrate reliability in the form of temporal stability. Regarding the second, a longstanding body of psychometric research holds that internal consistency is not an appropriate index of reliability for global stress exposure measures, like the Older Adult STRAIN, which query exposures to disparate events that may or may not co-occur, let alone co-vary (Burton et al., 2004; Gray et al., 2004). One would not expect the experience of losing a parent in childhood to associate with having something stolen in midlife or being in a

car accident in later life. As no latent construct is presumed to drive the relationship between items, several aspects of internal reliability (e.g., Cronbach's alpha coefficient, inter-item correlation, item-total correlation, interscale correlation) that are conventionally reported in the scale development literature for measures where an underlying construct is presumed, would not accurately reflect the Older Adult STRAIN's utility as a multi-faceted measure of cumulative life stress (Cleary, 1981). That said, further research integrating exploratory and confirmatory factor analyses would be valuable in clarifying item relevance and clarity and facilitating ongoing measure refinement.

Conclusion

In conclusion, findings demonstrate that the Older Adult STRAIN is an efficient, user-friendly measure for assessing cumulative life stress exposures and experiences from the perspective of older adulthood. In the present study, the measure's online, automated interview system demonstrated good concurrent validity with past and present measures of stress as well as strong and differentiated associations with measures of mental and physical health, including anxiety, depression, quality of life, sleep quality, and doctor diagnosed general health and auto-immune conditions. Given the breadth and depth of the data made efficiently available through its use, the Older Adult STRAIN stands to benefit clients/patients, clinical researchers, and healthcare stakeholders alike by clarifying risk and resilience trajectories across older adulthood and enabling much needed innovation in the development of precision, age-informed care.

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APPENDICES

Appendix A
Study Recruitment Flyer

Appendix B
Focus Group Agenda

Welcome and Roadmap

1. **Introductions & warm-up** (10-15 mins)

2. **Define session goal** (2 mins)
   To identify elements of stress and resilience unique to older adulthood (e.g., retirement, caregiving or partnering, mental and physical health changes, social connectivity)

3. **Open discussion older adulthood stress factors** (15 mins)
   a. Type – not encountered until older adulthood
   b. Frequency – occurring more often in older adulthood
   c. Intensity – occurring with greater intensity in older adulthood

4. **Review STRAIN** (10-15 mins)
   a. Content
      1. 55 acute life events and chronic difficulties
      2. count versus severity

   b. Structure
      1. 5 Core Characteristics

Entrapment	Interpersonal Loss	Role Change/Disruption
Humiliation	Physical Danger	

      2. 12 Domains

Death	Legal/Crime	Possessions
Education	Life-Threatening Situations	Reproduction
Financial	Marital/Partners	Treatment/Health
Housing	Other Relationship	Work

5. **Focused Discussion | Q & A** (20-25 mins)
   a. Stress & Resilience
      Psychological
      Physical
      Social

6. **Wrap up** (5 mins)

Thank you for your thoughts and suggestions!
Follow-up comments are welcome at mainemoodlab@gmail.com.

Appendix C
Demographics Questionnaire

To start with, we would like to get some background information from you.

1. **What is your race? (Please check one)**

   - ○ **Native American or Alaska Native**
     A person having origins in any of the original peoples of North, Central, or South American

   - ○ **Asian**
     A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

   - ○ **Black or African American**
     A person having origins in any of the black racial groups of Africa.

   - ○ **Native Hawaiian or Other Pacific Islander**
     A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

   - ○ **White**
     A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

   - ○ **Multiple races**

   - ○ **None of the above**

2. **Do you consider yourself to be Hispanic or Latino (see definition below)?** ○ **Yes** ○ **No**

   Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture of origin, regardless of race.

3. **Do you consider yourself to be Franco-American?** ○ **Yes** ○ **No**

4. **How many years of school did you complete?**
   - ○ 8 years or less
   - ○ 10 years
   - ○ 12 years
   - ○ 14 years
   - ○ 16 years
   - ○ More than 16 years
   - ○ Other, please specify_____

5. **With regard to your current or most recent job activity:**
   a. **What kind of work do (did) you do? (Job Title) _____**
   (For example: registered nurse, personnel manager, supervisor of order department, gasoline engine assembler, grinder operator.)

   b. **How much did you earn, before taxes and other deductions, during the past 12 months?**
      - Less than $5,000
      - $5,000 through $11,999
      - $12,000 through $15,999
      - $16,000 through $24,999
      - $25,000 through $34,999
      - $35,000 through $49,999
      - $50,000 through $74,999
      - $75,000 through $99,999
      - $100,000 and greater

6. **Which of these categories best describes your total combined family income for the past 12 months? This includes income (before taxes) from all sources, wages, rent from properties, social security, disability and/or veteran's benefits, unemployment benefits, workman's compensation, help from relatives (including child payments and alimony), and so on.**
   - Less than $5,000
   - $5,000 through $11,999
   - $12,000 through $15,999
   - $16,000 through $24,999
   - $25,000 through $34,999
   - $35,000 through $49,999
   - $50,000 through $74,999
   - $75,000 through $99,999
   - $100,000 and greater

Appendix D
Positive and Negative Affect Scale - Short Form (PANAS-SF)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way at this time for each descriptor. Please use the following scale to record your answers.

1	2	3	4	5
Very Slightly	**A Little**	**Moderately**	**Quite of Bit**	**Extremely**

_____ interested

_____ distressed

_____ excited

_____ upset

_____ strong

_____ guilty

_____ scared

_____ hostile

_____ enthusiastic

_____ proud

_____ irritable

_____ alert

_____ ashamed

_____ inspired

_____ nervous

_____ determined

_____ attentive

_____ jittery

_____ active

_____ afraid

Appendix E
Older Adult STRAIN Assessment Experience Survey

Please consider your experience taking the last survey about older adulthood stress and indicate your level of agreement with the following two statements.

1. **The cumulative life stress measure was easy to use.**

O Completely disagree	O Disagree	O Neither agree nor disagree	O Agree	O Completely agree
0	1	2	3	4

2. **The cumulative life stress measure meets my approval as an inventory of older adulthood stress.**

O Completely disagree	O Disagree	O Neither agree nor disagree	O Agree	O Completely agree
0	1	2	3	4

Appendix F
Elders Life Stress Inventory (ELSI)

Please indicate whether you experienced each of the following events in the **LAST YEAR.** For any event endorsed as "Yes," please then rate the impact of that experience according to the following scale:

0 = Not at all 1 = A little 2 = Somewhat 3 = Very much 4 = Extremely

Financial/work events			
Money problems	○ No	○ Yes	0 1 2 3 4
Retirement	○ No	○ Yes	0 1 2 3 4
Decrease in hours worked	○ No	○ Yes	0 1 2 3 4
Increase in hours worked	○ No	○ Yes	0 1 2 3 4
Change to worse job	○ No	○ Yes	0 1 2 3 4
Spouse retired	○ No	○ Yes	0 1 2 3 4
Health events			
Deterioration of memory	○ No	○ Yes	0 1 2 3 4
Sick or injured	○ No	○ Yes	0 1 2 3 4
Health problem of family member	○ No	○ Yes	0 1 2 3 4
Institutionalization of spouse	○ No	○ Yes	0 1 2 3 4
Institutionalization of parent	○ No	○ Yes	0 1 2 3 4
Relationship events			
Marriage in the past year	○ No	○ Yes	0 1 2 3 4
Divorce	○ No	○ Yes	0 1 2 3 4
Marital separation	○ No	○ Yes	0 1 2 3 4
Troubles with boss or coworkers	○ No	○ Yes	0 1 2 3 4
Worsening relationship with child	○ No	○ Yes	0 1 2 3 4
Worsening relationship with wife	○ No	○ Yes	0 1 2 3 4
Childs divorce	○ No	○ Yes	0 1 2 3 4
Loss events			
Death of spouse	○ No	○ Yes	0 1 2 3 4
Death of son or daughter	○ No	○ Yes	0 1 2 3 4
Death of parent	○ No	○ Yes	0 1 2 3 4
Death of other family member	○ No	○ Yes	0 1 2 3 4
Death of a friend	○ No	○ Yes	0 1 2 3 4
Loss of a close friend	○ No	○ Yes	0 1 2 3 4

Living situation related events

Move to worse residence	○ No	○ Yes	0 1 2 3 4
Deterioration in living conditions	○ No	○ Yes	0 1 2 3 4
Burglarized/robbed	○ No	○ Yes	0 1 2 3 4
Loss of prized possessions	○ No	○ Yes	0 1 2 3 4
Decrease in enjoyed activities	○ No	○ Yes	0 1 2 3 4
Assuming responsibility for parent	○ No	○ Yes	0 1 2 3 4

Appendix G
Perceived Stress Scale - Ten Item (PSS-10)

Instructions: The questions in this scale ask you about your feelings and thoughts during the last month. In each case, please indicate with a check how often you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

2. In the last month, how often have you felt that you were unable to control the important things in your life?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

3. In the last month, how often have you felt nervous and "stressed"?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

5. In the last month, how often have you felt that things were going your way?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

7. In the last month, how often have you been able to control irritations in your life?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

8. In the last month, how often have you felt that you were on top of things?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

9. In the last month, how often have you been angered because of things that were outside of your control?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

o Never	o Almost Never	o Sometimes	o Fairly Often	o Very Often
0	1	2	3	4

Appendix H
Hassles and Uplifts Scale (HUS)

HASSLES are irritants—things that annoy or bother you; they can make you upset or angry. Some hassles occur on a fairly regular basis and others are relatively rare. Some have only a slight effect, others have a strong effect. This questionnaire lists things that can be hassles.

Please indicate how much of a hassle the item was over the PAST MONTH by circling the appropriate number according to the following scale.

0 = None or not applicable
1 = Somewhat
2 = Quite a bit
3 = A great deal

1.	Your child(ren)	0 1 2 3
2.	Your parents or parents-in-law	0 1 2 3
3.	Other relative(s)	0 1 2 3
4.	Your spouse	0 1 2 3
5.	Time spent with family	0 1 2 3
6.	Health or well-being of a family member	0 1 2 3
7.	Sex	0 1 2 3
8.	Intimacy	0 1 2 3
9.	Family-related obligations	0 1 2 3
10.	Your friend(s)	0 1 2 3
11.	Fellow workers	0 1 2 3
12.	Clients, customers, patients, etc.	0 1 2 3
13.	Your supervisor or employer	0 1 2 3
14.	The nature of your work	0 1 2 3
15.	Your workload	0 1 2 3
16.	Your job security	0 1 2 3
17.	Meeting deadlines or goals on the job	0 1 2 3
18.	Enough money for necessities (e.g., food, clothing, housing, healthcare, taxes, insurance)	0 1 2 3
19.	Enough money for education	0 1 2 3
20.	Enough money for emergencies	0 1 2 3
21.	Enough money for extras (e.g., entertainment, recreation, vacations)	0 1 2 3
22.	Financial care for someone who doesn't live with you	0 1 2 3
23.	Investments	0 1 2 3

24.	Your smoking	0 1 2 3
25.	Your drinking	0 1 2 3
26.	Mood-altering drugs	0 1 2 3
27.	Your physical appearance	0 1 2 3
28.	Contraception	0 1 2 3
29.	Exercise(s)	0 1 2 3
30.	Your medical care	0 1 2 3
31.	Your health	0 1 2 3
32.	Your physical abilities	0 1 2 3
33.	The weather	0 1 2 3
34.	News events	0 1 2 3
35.	Your environment (e.g., quality of air, noise level, greenery)	0 1 2 3
36.	Political or social issues	0 1 2 3
37.	Your neighborhood (e.g., neighbors, setting)	0 1 2 3
38.	Conserving (gas, electricity, water, gasoline, etc.)	0 1 2 3
39.	Pets	0 1 2 3
40.	Cooking	0 1 2 3
41.	Housework	0 1 2 3
42.	Home repairs	0 1 2 3
43.	Yardwork	0 1 2 3
44.	Car maintenance	0 1 2 3
45.	Taking care of paperwork (e.g.,, paying bills, filling out forms)	0 1 2 3
46.	Home entertainment (e.g.,, TV, music, reading)	0 1 2 3
47.	Amount of free time	0 1 2 3
48.	Recreation and entertainment outside the home (e.g., movies, sports, eating out, walking)	0 1 2 3
49.	Eating (at home)	0 1 2 3
50.	Church or community organizations	0 1 2 3
51.	Legal matters	0 1 2 3
52.	Being organized	0 1 2 3
53.	Social commitments	0 1 2 3

Appendix I
Geriatric Anxiety Scale - 10 (GAS-10)

Below is a list of common symptoms of anxiety or stress. Please read each item in the list carefully. Indicate how often you have experienced each symptom during the PAST WEEK, INCLUDING TODAY by checking under the corresponding answer.

	Not at all (0)	Sometimes (1)	Most of the time (2)	All of the time (3)
1. I was irritable.				
2. I felt detached or isolated from others.				
3. I felt like I was in a daze.				
4. I had a hard time sitting still.				
5. I could not control my worry.				
6. I felt restless, keyed up, or on edge.				
7. I felt tired.				
8. My muscles were tense.				
9. I felt like I had no control over my life.				
10. I felt like something terrible was going to happen to me.				

Appendix J
Geriatric Depression Scale-Short Form (GDS-SF)

Circle the answer that best describes how you felt over the past week.

1. Are you basically satisfied with your life?	**yes**	**no**
2. Have you dropped many of your activities and interests?	**yes**	**no**
3. Do you feel that your life is empty?	**yes**	**no**
4. Do you often get bored?	**yes**	**no**
5. Are you in good spirits most of the time?	**yes**	**no**
6. Are you afraid that something bad is going to happen to you?	**yes**	**no**
7. Do you feel happy most of the time?	**yes**	**no**
8. Do you often feel helpless?	**yes**	**no**
9. Do you prefer to stay at home, rather than going out and doing things?	**yes**	**no**
10. Do you feel that you have more problems with memory than most?	**yes**	**no**
11. Do you think it is wonderful to be alive now?	**yes**	**no**
12. Do you feel worthless the way you are now?	**yes**	**no**
13. Do you feel full of energy?	**yes**	**no**
14. Do you feel that your situation is hopeless?	**yes**	**no**
15. Do you think that most people are better off than you are?	**yes**	**no**

Appendix K
Older Peoples' Quality of Life Questionnaire - Brief (OPQoL-Brief)

We would like to ask you about your quality of life:

Single item - global QoL:

1 Thinking about both the good and bad things that make up your quality of life, how would you rate the quality of your life as a whole?

Your quality of life as a whole is:	Very good	Good	Alright	Bad	Very bad
	☐	☐	☐	☐	☐

OPQOL-Brief

2 Please tick one box in each row. Please select the response that best describes you/your views. There are no right or wrong answers.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1 I enjoy my life overall	☐	☐	☐	☐	☐
2 I look forward to things	☐	☐	☐	☐	☐
3 I am healthy enough to get out and about	☐	☐	☐	☐	☐
4 My family, friends or neighbours would help me if needed	☐	☐	☐	☐	☐
5 I have social or leisure activities/ hobbies that I enjoy doing	☐	☐	☐	☐	☐
6 I try to stay involved with things	☐	☐	☐	☐	☐

7 I am healthy enough to have my independence	☐	☐	☐	☐	☐
8 I can please myself what I do	☐	☐	☐	☐	☐
9 I feel safe where I live	☐	☐	☐	☐	☐
10 I get pleasure from my home	☐	☐	☐	☐	☐
11 I take life as it comes and make the best of things	☐	☐	☐	☐	☐
12 I feel lucky compared to most people	☐	☐	☐	☐	☐
13 I have enough money to pay for household bills	☐	☐	☐	☐	☐

Appendix L
Pittsburgh Sleep Quality Inventory (PSQI)

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and night in the past month.

1. During the past month, what time have you usually gone to bed at night?_____
2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?_____
3. During the past month, what time have you usually gotten up in the morning?_____
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours your spent in bed._____

For each of the remaining questions, check the one best response.

5. During the past month, how often have you had trouble sleeping because you…

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
Cannot get to sleep within 30 minutes				
Wake up in the middle of the night or early morning				
Had to get up to use the bathroom				
Cannot breathe comfortably				
Cough or snore loudly				
Feel too cold				
Feel too hot				
Had bad dreams				
Have pain				
Other reasons				

6. During the past month, how would you rate your sleep quality overall?

   o Very good o Fairly good o Fairly bad o Very bad

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

o Not during the past month	o Less than once a week	o Once or twice a week	o Three or more times a week

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

o Not during the past month	o Less than once a week	o Once or twice a week	o Three or more times a week

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

o No problem at all	o Only a very slight problem	o Somewhat of a problem	o A very big problem

Appendix M
Doctor Diagnoses: General Health and Auto-Immune Conditions

(i) Doctor Diagnosed General Health Conditions

Has a medical doctor ever diagnosed you with any of the following conditions: anxiety, arthritis (not rheumatoid or psoriatic), asthma, cancer, chronic obstructive pulmonary disease (COPD), chronic pain, coronary heart disease, dementia, depression, gastroesophageal reflux disease (or chronic heartburn), heart attack, high blood pressure, insomnia, kidney stone(s), metabolic syndrome, migraines, overweight, posttraumatic stress disorder, stomach ulcer(s), or stroke.

(ii) Doctor Diagnosed Auto-Immune Conditions

Has a medical doctor ever diagnosed you with any of the following conditions: Addison's disease, celiac disease, dermatomyositis, Grave's disease, Hashimoto's thyroiditis, inflammatory bowel disease (i.e., Crohn's disease, ulcerative colitis), multiple sclerosis, myasthenia gravis, pernicious anemia, psoriasis (or psoriatic arthritis), rheumatoid arthritis, Sjögren's syndrome, lupus (systemic lupus erythematosus), or other autoimmune disorder to be specified by the participant.

Appendix N
Debriefing Document

Clarifying Adversity and Resilience (CARE) in Aging Study Debriefing Document

Thank you for participation in our study. Your participation is greatly appreciated.

Purpose of the Study The purpose of this study is to explore the relations between cumulative life stress and various health outcomes. Specifically, we are interested in understanding how exposure to and experience of stressful circumstances over the course of one's life may relate to current mental, social, and physical health as well as resilience.

Confidentiality You may decide that you do not want your data used in this research. If you would like your data removed from the study and permanently deleted, please email your request to the graduate researcher Liv Valö at liv.valo@maine.edu. Whether you agree or do not agree to have your data used for this study, you will still receive compensation for your participation.

Final Report If you would like to learn about the results of the study, let the researcher know and we will email you a summary of the results at the end of the study.

Further Reading Slavich, G. M., & Shields, G. S. (2018). Assessing lifetime stress exposure using the Stress and Adversity Inventory for Adults (Adult STRAIN): An overview and initial validation. *Psychosomatic Medicine, 80*(1), 17–27. https://doi.org/10.1097/PSY.0000000000000534

Contact Information If you have any questions or concerns regarding this study, please feel free to contact the Principal Investigator, Liv Valö, at liv.valo@maine.edu or the Faculty Sponsor, Dr. Jeff Hecker, at hecker@maine.edu.

BIOGRAPHY OF THE AUTHOR

Born and raised between the Midwest and Northern Virginia, Liv Valö graduated from Fairfax High School (Fairfax, Virginia, 1995), Roanoke College (Salem, Virginia, 1998, B.A., English), the University of Georgia School of Law (Athens, Georgia, 2003, J.D.), and the University of Maine (Orono, Maine, 2020, M.A., Clinical Psychology). Upon receiving her degree and completing licensure requirements, Liv plans to join the community of clinical psychologists practicing in Maine. Liv is a candidate for the Doctor of Philosophy degree in Clinical Psychology from the University of Maine in May 2024.