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Measuring Stress in Later Adulthood: Examining the Psychometric Properties of the Revised Stress Assessment Inventory for Older Adults

Rhiannon Y. Ueberholz, Lauren Hytman, Carmen Dang and Alexandra J. Fiocco *

Toronto Metropolitan University, Department of Psychology, Toronto, Ontario Canada.; Rhiannon.ueberholz@torontomu.ca, lauren.hytman@torontomu.ca, c1dang@torontomu.ca, afiocco@torontomu.ca

* Correspondence: afiocco@torontomu.ca; Tel.: +1 416-979-5000 ext. 553008

Abstract: Background: Research suggests that cognitive and behavioural factors, including lifestyle behaviours, contribute to the mitigation of perceived stress and stress-related health outcomes in later life. Given that stress management and lifestyle behaviour interventions for older adults are an important target for healthcare efforts, there is a need to comprehensively measure stress and coping resources in later adulthood. Additionally, researchers need a relatively short, standardized assessment tool that can robustly measure stress and coping for longitudinal and intervention-based studies to reduce burden on participants and for cross-comparison across research. Methods: The Stress Assessment Inventory (SAI), a valid and reliable 123-item measure designed to assess occupational stress and coping resources in younger adults was examined in 294 independent older adults. Results: A shortened and revised SAI is proposed for older adults, with good internal consistency and strong criterion validity. The revised SAI for older adults was found to have a 4-factor model that captures Adaptive Cognitive Resources, Maladaptive Behavioural and Cognitive Habits, Social Support and Adaptive Health Habits. Conclusion: The current study supports the use of the inventory in community-dwelling older adult populations as a comprehensive tool to assess stress and coping for use by researchers and healthcare professionals.

Keywords: stress measurement; healthy aging; older adults; stress-related illness

1. Introduction

The global rise in the aging population [1] underscores the need for policymakers to focus on how to support the physical and psychological well-being of older adults. Researchers have found that chronic stress accelerates the aging process and increases the risk for poor health outcomes later in life, including cardiovascular disease [2], stroke [3], depression [4], and neurodegenerative diseases [5]. The association between stress and increased health risks in later adulthood is partly due to the wear and tear of interconnected biological systems that stem from the activation of stress-sensitive systems over the lifespan [6]. Relatedly, Lazarus and Folkman's [7] Transactional Model of Stress (TMS) posits that stress is experienced when one appraises a threat or challenge to exceed their internal or external coping resources, highlighting individual differences in the experience of stress, cognitive and behavioural coping strategies, and subsequent health outcomes.

The extant literature has identified factors that contribute to the mitigation of perceived stress and stress-related health outcomes in later life, including physical activity [8,9], sufficient sleep [10], coping strategies such as positive reappraisal [11], and traits of resilience including cognitive hardiness [12,13]. These behavioural and cognitive factors are critical targets in psychosocial interventions for older adults [14–16] and may be important pathways for change in the experience of stress and stress-related outcomes [17].

Current validated self-report instruments to measure stress in older adults primarily focus on one aspect of stress, for example, one's thoughts and feelings about a stressful situation (i.e., the

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Perceived Stress Scale). As such, multiple questionnaires must be administered to measure behavioural and cognitive factors associated with stress in older adults. This approach, for example, measuring sleep and coping using the 19-item Pittsburgh Sleep Quality Index (PSQI) with the 60-item Coping Orientations to Problems Experienced Scale (COPE), may be burdensome and time-consuming for respondents. Moreover, many of the existing measures that assess stress-mitigating or aggravating factors, such as lifestyle risk factors, have not been validated in older adults, posing a challenge to reliable measurement in this population [18].

Evaluating various constructs that protect or pose a risk to one's health can be resolved by developing inventories that briefly measure multiple facets of health and behaviour. Widespread use of these inventories in Canada has been highly impactful in identifying and addressing the risk of illnesses such as Diabetes [19,20]. Emotional stress is a major contributing factor to the largest leading causes of death, including coronary heart disease and respiratory disease [21]. Furthermore, factors such as diet, sleep and social support are crucial to managing stress and maintaining physical health [17]. Given the pervasiveness of stress and the need for stress management, an inventory to measure stress and factors that perpetuate or mitigate stress could be used to assess individual risk of developing a stress-related illness. This would be particularly important for older adults who are already at higher risk of health complications [22–25].

One inventory that may be of value is the Stress Assessment Inventory (SAI), originally developed as a comprehensive measure of cognitive and behavioural factors that moderate the relationship between stress and stress-related illness among employees within organizational health promotion programs [26]. The SAI measures perceived stress and uniquely measures cognitive (e.g., appraisal and resilience), behavioural (e.g., diet, exercise), and environmental (e.g., social support) stress factors. The SAI was made commercially available by Western Psychological Services (WPS) as the "Stress Profile" [27] and as the "StressScan", available through Envisia Learning [28]. The instrument was validated 30 years ago and continues to be used to assess organizational stress and stress-related outcomes in younger to middle-aged adults [26]. Its widespread use has served to assess the relationship between stress and stress management for professional well-being (Fowler, 2006), psychological predictors of health [29–31], and factors that help individuals cope with stressors [32]. However, previous studies using the SAI (i.e., [29–31,33]) have largely focused on younger to middle aged-adults (20 to 64 years old) and primarily in organizational contexts to help employees manage work-life balance, to avoid burnout [28].

As a comprehensive measure of stress and stress management, the SAI can be a useful tool to index risk in older adult populations, particularly as the risk of developing chronic illness exacerbated by stress increases with age [34,35]. However, no research has validated the SAI within this population. Furthermore, there are discrepancies between the initial published inventory and subsequent inventory versions [26]. Namely, subscales were renamed, and items were dropped without adequate documentation of these changes. Lastly, the SAI is four times the recommended length of questionnaires to avoid respondent fatigue and lower response rate, making its use burdensome for research participants [36]. Given the potential applicability within older adult populations and current methodological shortcomings, the objective of the current study was to assess the validity of the SAI in community-dwelling older adults and provide modifications to better adapt the SAI for older adults.

2. Materials and Methods

2.1. Participants

Participants included 294 physically and cognitively healthy older men and women aged 60 to 95 living in the Greater Toronto Area of Ontario, Canada. Please see Table 1 for further details on the sample. Based on sample size criteria for conducting a factor analysis, the sample size for the present analysis is considered "fair" to "good" [37].

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Table 1. Participant Characteristics and scale scores.

Study Variable	Study 1 (*N* = 201) *M (SD) or %(n)*	Study 2 (*N* = 93) *M(SD) or % (n)*	Total (*N* = 294) *M (SD) or %(n)*
Demographics			
Age	68.65 (6.95)	68.93 (4.65)	68.73 (6.32)
Sex (% female)	63% (127)	74% (69)	67% (196)
Years of Education	16.61 (3.26)	16.19 (3.39)	16.48 (3.30)
Retired (% retired)	61% (122)	n/a	
Ethnicity (% white)	88% (177)	89%(83)	88% (260)
Stress Assessment Inventory			
SAI Stress Scale	13.86 (3.82)	15.15 (3.57)	14.27 (3.79)
SAI Global Health Scale			
SAI Exercise Subscale	11.38 (8.52)	11.09 (3.07)	11.29 (3.05)
SAI Sleep Subscale	18.08 (3.04)	17.90 (3.02)	18.03 (3.00)
SAI Eating Subscale	19.20 (3.18)	19.68 (3.44)	19.35 (3.27)
SAI Prevention Subscale	45.83 (4.14)	45.64 (3.73)	45.77 (4.01)
SAI Social Support Scale	66.39 (12.67)	57.53 (13.13)	63.57 (13.44)
SAI Type A Behaviour Scale	26.73 (5.71)	25.70 (5.53)	26.40 (5.66)
SAI Cognitive Hardiness Scale	108.12 (13.55)	107.26 (9.91)	107.85 (13.26)
SAI Coping Scale			
SAI Positive ReappraisalSubscale	17.67 (3.20)	17.32 (2.93)	17.56 (3.12)
SAI Negative Reappraisal Subscale	11.71 (3.50)	12.31 (3.37)	11.90 (3.46)
SAI Threat Minimization Subscale	16.45 (3.24)	16.01 (2.92)	16.31 (3.15)
SAI Problem-focused Coping Subscale	13.99 (2.60)	14.84 (3.01)	14.26 (2.76)
SAI Psychological Well-Being Scale	45.53 (8.56)	44.78 (8.76)	45.29 (8.61)
Criterion Validity Dependent Variables			
Quality of Life Scale	88.07 (12.73)	86.66 (12.48)	87.61 (12.64)
Perceived Stress Scale	12.05 (6.46)	13.85 (6.80)	12.62 (6.61)

Note: Stress Assessment Inventory (SAI) means and standard deviations are based on the original responses, prior to item reduction. Retirement data not collected for Study 2.

2.2. Measures

Data were collected from two studies that examined cognitive functioning and well-being in older adults living independently in the community: 201 participants from the Study 1 (see [38]) and 93 participants from Study 2 (see [39]). Both samples were recruited through community flyers and the Toronto Metropolitan Senior Participant Pool. All participants completed the SAI, the Perceived

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Stress Scale (PSS) and the Quality of Life Scale (QOLS). The PSS and QOLS were selected in the current study to assess validity of the SAI in older adults due to their measurement of similar constructs and well-established use for psychological research in older adults (e.g., [40,41]. The Psychological Well-being Scale of the SAI was also used to assess validity, as it was originally designed for validity testing. Both studies were approved by the Research Ethics Board at Toronto Metropolitan University (REB#2014-164, REB#2012-192).

2.2.1. The Stress Assessment Inventory (Nowack, 1990)

The Stress Assessment Inventory (SAI) measures cognitive and behavioural moderators of the stress-illness relationship, specifically, physical and mental challenges that may arise from and perpetuate chronic activation of the stress response [26]. It is comprised of 123 items; five of those items are a "reliability check" to assess response bias, and the remainder of items are organised into seven scales:

The 6-item Stress Scale measures the occurrence of hassles from six distinct sources (health, work, personal finances, family, social obligations, and environmental concerns) over the last three months. Responses are given on a 5-point Likert scale from 1 = Never to 5 = Always, with higher scores indicating greater stress.

The 25-item Global Health Habits Practices Scale measures engagement in healthy lifestyle habits over the last three months. It has four subscales: Exercise, Sleep/Relaxation, Preventative Health Practices, and Nutrition/Eating. Each item is rated on a 5-point Likert scale from 1 = Never to 5 = Always, with higher scores indicating greater engagement in protective health practices.

The 15-item Social Support Network Scale comprises three items related to satisfaction with five distinct social support networks: immediate boss or supervisor; other people at work; spouse, lover or significant other; family members/relatives; and friends. Satisfaction is rated on a 6-point Likert scale from 1= Not at All Satisfied to 5=Extremely Satisfied, or 6 = Not Applicable.

The 10-item Type A Behaviour Scale measures the frequency of being hard-driven, impatient, and competitive in response to daily life challenges. Each item is rated on a 5-point Likert scale from 1=None of the Time to 5=All of the Time, with higher scores indicating greater propensity towards Type A behaviours.

The 30-item Cognitive Hardiness Scale measures one's propensity to commit to one's work, self, and hobbies, perceived sense of control over significant life outcomes, and viewing life's changes as challenges rather than threats [12]. Items are rated on a 5-point Likert scale from 1 = Strongly Agree to 5 = Strongly Disagree, with higher scores indicating greater cognitive hardiness.

The 20-item Coping Style Scale assesses the use of emotion-focused and problem-focused coping strategies. It is comprised of four subscales: Positive Appraisal, Negative Appraisal, Problem-focused Coping, and Threat Minimization. Respondents indicate the degree to which they engage the strategy on a 5-point Likert scale from 1 = Never to 5 = Always, the higher scores indicating greater use of the strategy.

The 12-item Psychological Well-being Scale is intended as the inventory's outcome measure, predicted by the other scales and subscales of the SAI for validity testing (Nowack, 1990). The degree to which psychological well-being is experienced is rated on a 5-point Likert scale from 1 = Never to 5 = Always, with higher scores indicating greater psychological well-being.

In a sample of younger and middle-aged adults [26], the underlying structure of the inventory was proposed to contain three factors: Component 1— Global Health Practices, Eating/Nutrition, Preventative Hygiene, Sleep/Relaxation, and Exercise; Component 2—Positive Appraisal, Threat Minimization, Problem-Focused Coping, Cognitive Hardiness, and Social Support; and Component 3—Intrusive Negative Thoughts, Type A Behaviour, and Stress [26]. Internal consistency of the SAI scales was mostly good (α = .82 – .83), except the Stress Scale was acceptable (α = .67) and the Psychological Wellbeing Scale was excellent (α = .93). The subscales had acceptable internal consistency (α = .69 – .79).

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2.2.2. The Perceived Stress Scale (PSS; [42])

The 10-item Perceived Stress Scale (PSS) measures one's perception of stress during the last month. Respondents rate items on a five-point Likert scale from 0 = Never to 4 = Very Often, with higher scores indicating greater perceived stress. The PSS is widely used in older adult samples and has demonstrated good internal consistency (α = .81 – .82; [43]).

2.2.3. The Quality of Life Scale (QOLS; [44])

The 16-item Quality of Life Scale (QOLS) measures current satisfaction across six domains: material and physical well-being; relationships; social, civic and community activities; personal development and fulfilment; recreation; and independence. Items are rated on a seven-point Likert scale from 1 = Terrible to 7 = Delighted, with higher scores indicating greater satisfaction. The QOLS has been validated in older adults and has good internal consistency (α = .87 – .89; [44]).

2.3. Statistical Analysis

Twenty-four (.06%) data points were missing from the total dataset. Since less than 1% of the data was missing, complete-case analyses were conducted [45,46], resulting in a final sample size of 294. All items from the SAI were first subjected to a theoretically driven item-reduction process to assess their relevancy and applicability to healthy older adults.

Consistent with classical test theory, the SAI was evaluation on its dimensionality, reliability, and validity [47] (Nunnally, 1978). Dimensionality was evaluated using very simple structure (VSS), parallel analysis, and exploratory factor analysis (EFA; [48,49]. First, each scale within the SAI was evaluated on its dimensionality using polychoric correlations as recommended for categorical data [50,51]. Items that performed poorly during the EFA were removed. Then, sum scores were calculated for each unidimensional scale and subscale to evaluate the dimensionality of the overall SAI using Pearson correlations. The Psychological Well-Being Scale was not included in the exploratory factor analysis of the SAI as it is an outcome measure for validity testing. All EFA models were estimated using unweighted least squared [52] and oblimin rotations to improve model fit.

Reliability was assessed by internal consistency measured by McDonald's Omega for all scales within the SAI and for the SAI overall [53]. Validity was assessed using three linear regression models regressing the SAI scales, subscales and covariates (age, sex and education) on PSS, QOLS and Psychological Well-being.

All analyses of dimensionality and reliability were conducted with R version 4.2.1 (R Core Team, [54]) using the Psych package (for VSS, parallel analysis, EFA and McDonald's Omega; [55]) and EFA.dimensions package (for calculating polychoric correlation matrices; [56]). Validity testing was conducted using IBM SPSS 29.0.10. For additional details on model evaluation, model selection, and item retention, please refer to the Supplemental Materials (S1. Supplemental Statistical Analysis).

3. Results

Bartlett's test was statistically significant ($p < .001$), and the KMO value was .82 for the current dataset, exceeding the recommended KMO value of .70 [57], supporting the decision to conduct a factor analysis.

3.1. Theoretically Driven Item-Reduction

Items that queried work-related habits were removed, given the sample's demographic (Mage = 68.73); the average retirement age in Canada is 65 years [58]. Items that noted work and other relevant activity were retained (e.g., Missed a large proportion of, or an entire night of sleep because of work projects, travel schedule, social activities, shift work, family problems, etc.). One item was removed due to potential ambiguity and misinterpretation; specifically, frequency of practicing safe sex over the past three months may prompt a different response depending on whether one considers abstinence or unprotected sex with a long-term partner as always practicing safe sex or never

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practicing safe sex. A total of 27 items (22%) met the criteria for removal. See Supplemental Material for the list of removed items (S2. Theoretically Driven Item Reduction).

3.2. Factor Structure

The best-fitting factor structure of each scale within the SAI is reported below. See Supplemental Material for all factor structure iterations and their corresponding correlation matrix, model fit statistics, factor loadings, and communalities (S3. Factor Structure Iterations).

3.2.1. Stress Scale

A one-factor model was selected, containing five items pertaining to five different daily hassles one can experience (health, personal finances, family, social obligations, and environmental concerns). The one-factor model accounted for 39% of the variance, and the SRMSR = .02.

3.2.2. Global Health Scale

A three 3-factor model was selected, and based on the items within each factor, the proposed subscales within the Global Health Scale and their proportion of variance explained were Exercise (21%; 3 items), Sleep/Rest (13%; 3 items) and Eating/Nutrition (17%; 4 items). The cumulative variance explained by the Global Health Scale was 52%, and the SRMSR = .03. All items within the original Preventative Hygiene and Risk subscale were dropped due to not meeting the item retention criteria.

3.2.3. Social Support Scale

A 3-factor model was selected, as strong factor loadings suggested that each factor comprised social support from a distinct social support resource. Based on the cluster of items within each factor, the proposed subscales within the Social Support Scale and their proportion of variance explained were Social Support from a Partner (28%; 3 items), Social Support from Family (26%; 3 items) and Social Support from Friends (22%; 3 items). The cumulative variance explained by the Social Support Scale was 76%, and the SRMSR = .05.

3.2.4. Type A Behaviour Scale

A 1-factor model was selected for the Type A Scale, with all four items loading onto a single factor. The cumulative variance accounted for by the Type A Behaviour Scale was 30%, and the SRMSR = .05.

3.2.5. Cognitive Hardiness Scale

A 3-factor model was selected. Based on the cluster of items within each factor, the subscales within the Cognitive Hardiness Scale, comprising of the three components of hardiness, and their proportion of variance explained were Control (19%; 6 items), Challenge (15%; 4 items) and Commitment (11%; 4 items). The cumulative variance explained by the overall scale was 45%, and the SRMSR = .04.

3.2.6. Coping Scale

A 3-factor model was selected. Based on the cluster of items within each factor, the proposed subscales and their proportion of variance explained were Negative Appraisal (20%; 5 items), Positive Appraisal (16%; 4 items), and Problem-Focused Coping (15%; 5 items). The scale's cumulative variance was 52%, and the SRMSR = .03.

3.2.7. Psychological Well-Being Scale

A one-factor model best fits the Psychological Well-being Scale. Nine items were retained, with a cumulative variance of 75% and SRMSR of .03.

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3.2.8. Exploratory Factor Analysis of the Revised Subscales

The factor analysis of each scale within the SAI reduced the original inventory from 123 items to 65 items, comprising seven scales and 12 subscales. Based on the analyses, the following new scales and subscales are proposed:

1. The Stress Scale,
2. The Global Health Scale (Subscales: i. Eating/Nutrition, ii. Sleep/Rest, and iii. Exercise),
3. The Social Support Scale (Subscales: i. Partner, ii. Friends, and iii. Family),
4. The Type A Behaviour Scale,
5. The Cognitive Hardiness Scale (Subscales: i. Control, ii. Challenge, and iii. Commitment),
6. The Coping Scale (Subscales: i. Positive Appraisal, ii. Negative Appraisal, and iii. Problem-Focused Coping),
7. The Psychological Well-Being Scale.

A 4-factor model was selected for the overall inventory based on its interpretability, strength of factor loadings and communalities. The final model had an SRMSR of .03 and accounted for 43% of the cumulative variance with factors 1 to 4 accounting for 17%, 10%, 9% and 7% of the variance, respectively. Please see Supplemental Table 8 for factor loadings and communalities. For a detailed summary of model fit statistics for all evaluated scales and the overall SAI, please see Supplemental Tables (S4. Supplemental Tables).

Factor 1 captures Adaptive Cognitive Resources given that its primary factor loadings consist of three subscales from the Cognitive Hardiness: a) Control, Challenge and Commitment, b) the Positive-Appraisal Subscale, and c) the Problem-focused Coping Subscale. Factor 2 represents Maladaptive Behavioural and Cognitive Habits, with primary loadings on the Stress Scale, the Sleep Subscale (inverse relationship), the Negative Appraisal Subscale, and the Type A Behaviour Scale. Factor 3 was labelled Social Support, as all three subscales within the Social Support Scale (i.e., Support from a Partner, Support from Friends, and Support from Family) loaded onto this factor. Factor 4 was labelled Adaptive Health Habits (7%), consisting of the Eating/Nutrition Subscale and the Exercise Subscale.

3.3. Internal Consistency

Scales within the SAI ranged from poor (ω = .63 - .67; Type A Behaviour Scale, Sleep subscale and Eating Subscale) to excellent reliability (ω = .95; Psychological Well-being scale). The overall inventory also had good reliability (ω = .85). See Supplemental Materials for McDonald's Omega values for each scale and subscale.

3.4. Criterion Validity

3.4.1. Perceived Stress Scale

The adjusted regression model (controlling for age, sex, and education) was statistically significant, with SAI explaining approximately 46% of the variance in PSS scores ($F(17, 271) = 15.12$, $p < .001$ adj. $R^2 = .46$). Stress, sleep, social support from a spouse, and the control subscale of the cognitive hardiness scale were significantly associated with predictors of PSS scores with small effect sizes ranging from β = -.11 to -.24. See Table 2 for more details.

Table 2. Regression Models Assessing Criterion Valitity of SAI Scales and Subscales.

	10-item Perceived Stress Scale			
Item	**B**	**95% CI**	**SE B**	**β**
Age	-.031	[-.124 , .062]	.047	-.030
Sex	-.508	[-1.685, .670]	.598	-.038
Education	-.136	[-.320, .048]	.093	-.068

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Stress	**.363*** **	[.154, .572]	.106	.191
Exercise	.091	[-.115, .296]	.104	.041
Sleep	**-.502** **	[-.843, -.160]	.174	-.156
Eating	-.151	[-.396, .093]	.124	. -.061
Social Support - Partner	**-.189***	[-.362, -.017)]	.088	-.107
Social Support - Family	.058	[-.138, .255]	.100	.029
Social Support - Friends	.167	[-.099, .433]	.135	.068
Type A Behaviour	.225	[-.024, .475]	.127	.091
Cognitive Hardiness – Control	**-.399*** **	[-.603, -.195)]	.104	-.244
Cognitive Hardiness - Challenge	-.188	[-.466, .089]	.141	-.076
Cognitive Hardiness - Commitment	-.099	[-.382 -.185]	.144	-.038
Negative Appraisal	.134	[-.085, -.353]	.111	.070
Positive Appraisal	-.275	[-.556, .006]	.143	-.110
Problem-focused Coping	-.046	[-.331, .239]	.145	-.017

Quality of Life Scale

	B	**95% CI**	**SE B**	**β**
Age	**.169***	[.018, .320]	.076	.084
Sex	1.345	[-.576, 3.266	.976	.055
Education	**.362***	[.063, .662]	.153	.092
Stress	**-.686*** **	[-1.026, -.345]	173	-.187
Exercise	**.366***	[.028, .703]	.172	.088
Sleep	.385	[-.174, .944]	.284	.064
Eating	.094	[-.308, .496]	.204	.022
Social Support - Partner	-.086	[-.367, .195]	.143	-.024
Social Support - Family	-.078	[-.401, .244]	.164	-.022
Social Support - Friend	**.868*** **	[.429, 1.30]	.224	.186
Type A Behaviour	.193	[-.214, .601]	.207	.042
Cognitive Hardiness - Control	**.697*** **	[.365, 1.029]	.169	.222
Cognitive Hardiness -Challenge	**.527***	[.068, .985]	.233	.111
Cognitive Hardiness-Commitment	**.912*** **	[.448, 1.377]	.237	.181
Negative Appraisal	-.212	[-.568, .143]	.180	-.059
Positive Appraisal	**.701***	[.243, 1.159]	.232	.145
Problem-focused Coping	-.197	[-.653, .271]	.235	-.039

Psychological Well-Being

	B	**95% CI**	**SE B**	**β**
Age	**.083***	[000, .166]	.042	.073
Sex	.767	[-.291, 1.825]	.537	.053
Education	.080	[-.085, .245]	.084	.036
Stress	**-.231***	[-.419, -.043]	.096	-.111
Exercise	.106	[-.079, .291]	.094	.044

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Sleep	.037	[-.270, .344]	.156	.011
Eating	.116	[-.103, .336]	.112	.043
Social Support - Partner	-.044	[-.200, .111]	.079	-.023
Social Support - Family	-.016	[-.193, -.160)]	.090	-.007
Social Support - Friend	.165	[-.074, .404]	.121	.061
Type A Behaviour	-.043	[-.267, .182]	.114	-.016
Cognitive Hardiness - Control	**.491*** **	[.307, .674]	.093	.273
Cognitive Hardiness -Challenge	**.433*** **	[.184, .683]	.127	.159
Cognitive Hardiness-Commitment	**.551*** **	[.296, .806]	.130	.194
Negative Appraisal	-.029	[-.226, .167]	.100	-.014
Positive Appraisal	**.614*** **	[.362, .867]	.128	.224
Problem-focused Coping	.136	[-.120, .392]	.130	.047

Note: B = unstandardized regression coefficient; SE B = standardized error; β = standardized coefficient. *p < .05. **p< .01. ***p<.001.

3.4.2. Quality of Life Scale

The adjusted regression model was statistically significant, with SAI explaining 61% of the variance in QOLS scores ($F(17, 282) = 32.86$, $p < .001$, adj. $R^2 = .61$). Age, stress, education, exercise, social support from friends, all three components of cognitive hardiness (control, challenge, and commitment), and positive appraisal were significantly associated with QOLS scores, with small effect sizes ranging from β = .084 - .22. See Table 2 for regression coefficients and standard errors.

3.4.3. Psychological Well-Being

The adjusted regression model was statistically significant, with SAI explaining approximately 63% of the variance in Psychological Well-being Scale scores ($F(17, 271) = 30.32$, $p < .001$, adj. $R^2 = .63$). Age, stress, all three components of cognitive hardiness (control, challenge, and commitment), and positive appraisal were significantly associated with Psychological Well-being Scale scores, with small to medium effect sizes ranging from β = .07 - .27. See Table 2 for regression coefficients and standard errors.

4. Discussion

Driven by the need for a brief, comprehensive assessment tool of stress and coping strategies for older adults, this study evaluated the utility of Nowack's [26] SAI, which was primarily validated and developed for younger and middle-aged employees within organizational health promotion programs. Following a theoretically driven item-reduction process and assessment of the dimensionality, internal consistency, and criterion validity of the SAI, the current study suggests that the Revised SAI can be a valuable, comprehensive assessment of stress and coping for community-dwelling older adults.

4.1. Guidance for Use and Value of the Revised SAI

The value of the Revised SAI lies in its capacity to robustly examine chronic stress and stress management in older adults in a relatively brief format that is estimated to take respondents 25 minutes to complete. Close to half of the SAI items were dropped while retaining validity and internal consistency. The current validation of the Revised SAI demonstrated a factor structure that distinctly captures stress and factors associated with stress: social support; protective cognitive coping; protective behavioural habits; and daily hassles with maladaptive cognitive and behavioural habits.

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The Revised SAI, in its current form, may be used in cross-sectional, longitudinal, and intervention research in older adults to measure chronic and life stress comprehensively. The Revised SAI is particularly beneficial for longitudinal and intervention-based studies as its balance of thoroughness and brevity allows researchers to track stress over time with minimal respondent burden efficiently. Often, recommendations for measuring chronic stress involve using multiple methods, including self-report and stress physiology (e.g., heart rate variability, allostatic load; [35,59]. However, the time constraints of administering multiple tests in a single study may limit the number of measurements a researcher can administer. Using the Revised SAI as a comprehensive and relatively brief measure of stress in older adults may permit time for more robust measurements, such as physiological testing, in a single study. This contrasts with the need for multiple questionnaires to capture constructs in the Revised SAI. Additionally, using a standard inventory, rather than varying selections of multiple scales, will allow for comparability across numerous studies for systematic review. Moreover, the comprehensive nature of the Revised SAI, compared to specific self-report measures of stress such as the PSS, can provide valuable insight into how different aspects of self-reported stress and stress management relate to physiological measures of stress. To exemplify, using the SAI can be applied to examine how different factors such as social support, stress and behaviour can be modelled to predict stress biomarkers [60].

4.2. Modifications and Limitations of the Revised SAI

Theoretically driven item reduction and EFA of the original scales and subscales resulted in notable scale modifications. First, the original 123-item scale was reduced to 65 items. All items within the Preventative Hygiene subscale were removed due to poor performance, suggesting a lack of applicability or sensitivity in the current sample. The health of older adults has improved in recent decades, evidenced by a longer life expectancy, and in part attributed to decreased smoking rates and attention to blood pressure, implying an overall improvement in personal health literacy and self-care [61–63]. The preventative hygiene items of the SAI may not be appropriate or sensitive enough to assess risk in older adult populations and a focus on mitigating physical health stressors, including hearing healthcare, frequency of vaccinations, or hazard-proofing one's home if there is a risk of falls may be of greater relevance [64,65].

The Threat Minimization subscale was removed due to poor performance, likely due to the disconnect between included items and the psychological construct. Literature suggests that avoidance, or threat minimization, is a maladaptive strategy for younger and older adults [66]. Interestingly, in Nowack's [26] study, the Threat Minimization subscale clustered with other adaptive coping mechanisms, which contradicts the current literature [67]. This suggests that the scale may not have accurately captured the construct.

Scales and subscales of the revised SAI demonstrated acceptable internal consistency, except for the Type A Behaviour Scale, the Exercise Subscale, and the Sleep/Rest. Poor internal consistency of the Type A Behaviour Scale may be attributed to removing over half of the items due to explicit mention of work, and low correlations between the remaining items. Reliability of the Type A Behaviour Scale may be strengthened with items that accurately and cohesively capture this personality construct, beyond employment. Furthermore, Type A is not a singular construct. Indeed, research suggests that it is the toxic core of Type A, namely the aggression-hostility component, that is associated with poor physical and psychological well-being [68,69]. Similarly, poor internal consistency of the Sleep/Rest Subscale and the Exercise Subscale of the Global Health Scale may be accounted for by the few number of items within the subscales [70]. As such, it is recommended that these scales be interpreted with caution.

Findings for the overall factor structure of the revised SAI scale and subscales revealed a four-factor solution comprising 1) Adaptive Cognitive Resources, 2) Maladaptive Behavioural and Cognitive Habits, 3) Social Support, and 4) Global Health Practices. This contrasts with the initial three-component solution in younger and middle-aged adults [26]. In the present study, the Social Support Scale loaded independently onto a fourth factor, suggesting that a social support network and adaptive cognitive coping may be two separate constructs among older adults. Prior research

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suggests that receiving social support has greater psychological benefits for younger adults than older adults. Older adults may rely on adaptive cognitive coping resources independent of available social supports, which may explain why both constructs are distinct in this population [71]. Additionally, findings indicate that for older adults, providing social support is more important for well-being than receiving support, as it promotes feelings of independence, usefulness, and autonomy [72]. Unlike the original validation study, the Sleep Subscale did not load onto the Global Health Practices factor and instead loaded negatively onto the Maladaptive Behavioural and Cognitive Habits factor. This may be attributed to the nature of the items inquiring about lack of sleep. The Sleep Subscale can be further improved by adding items that assess sleep and rest more robustly as an overall health practice.

The SAI displayed good criterion validity with validated measures of stress and well-being, as well as the Psychological Well-being Scale of the SAI. Across all outcome measures, the Stress Scale and Cognitive Hardiness-Control were significant predictors in the model. However, subscale items of Eating, Social Support from Family, Negative Appraisal, Type A Behaviour, and Problem-Focused Coping did not significantly contribute to the variance across outcome scores. Although Type A Behaviour may not represent the toxic core and, therefore, may not be an appropriate assessment of the risk profile of Type A, the interpretation of null associations for the remaining items may be attributed to the analytical sample. Interestingly, the Type A subscale of the SAI has been one of the strongest predictors of self-reported health outcomes in younger and middle-aged adults [29]. As such, further research may be needed to explore Type A behaviour as a predictor of health in older adults.

Overall, the analytical sample was relatively healthy, and it is important to recognize that a self-selected bias may have occurred, which may, together, underestimate the magnitude of the associations. Accordingly, replication in a larger, more diverse sample is required.

4.3. Future Directions

Based on the current analyses, further adaptations are recommended to be made to the scale for use in an older adult population. First, it is recommended that the statements be modified to better reflect the lived experience of this large heterogeneous population. For example, “trouble with ageing parents” may be revised to “trouble caring for a loved one”, referring to stress associated with the family caregiver role. While items that referenced work were removed in the current study, items that list work-related contexts (e.g., I feel hurried and pressured for time, i.e., not having enough time to get everything done at work or home) may be modified to be more relevant to older adult respondents. Second, minor revisions to scoring are recommended. For example, when calculating a raw score for the Social Support subscale, a not-applicable (N/A) response earns the highest possible score, indicating the highest level of social support. This may contribute to measurement errors wherein a “not applicable” response is numerically interpreted as having the highest degree of social support.

To date, the findings supporting the ability of the SAI to predict stress-related illness have been mixed [29,31]. To further validate the Revised SAI's ability to predict stress-related illness in older adults, it is recommended that the predictive validity of the SAI for objective health outcomes, such as the number of medical visits or symptoms of illness, be explored. As it is estimated that 75% of doctor’s visits are stress-related [73], this further validation would support the application of the SAI as a screener for stress by physicians that can inform when and which targeted interventions to reduce patient stress are needed.

Considering the study findings and recommendations, study limitations must be addressed. First, while the sample size was adequate for the present analysis, data collection from a larger sample would offer a more accurate representation of the true underlying factor structure [74]. Second, the sample of participants was predominantly white and highly educated, scoring relatively high on the QOLS [44] and low on the PSS [42]. Additional validation should be conducted in a more diverse and representative sample of older adults in North America.

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5. Conclusions

The Revised SAI is a valuable assessment tool for evaluating hassles and strategies used to manage daily stress that may moderate the stress-illness relationship. With recommended modifications and further validation, the Revised SAI may be a valuable assessment tool for stress researchers, specifically for psychosocial intervention-based research and longitudinal research. Given the complex relationship between psychosocial stress, physical health, and cognitive function, comprehensive measures, such as the SAI, that provide a clear pathway for behavioural change are highly valuable. Particularly, given the rapidly ageing population, constructing such measures specific to older adults is crucial for facilitating lifestyle changes that may protect against avoidable age-related decline. Further modifications are recommended, including adding relevant items to scales with low internal consistency and criterion validity, aligning scales and subscales with up-to-date empirical findings and theoretical frameworks relevant to older adults, and addressing measurement issues. Examining the predictive validity of the Revised SAI for stress-related illness would increase the strength of the measurement tool, which could be used by medical professionals screening for and treating stress in older adults.

Supplementary Materials: The following supporting information can be downloaded at: www.mdpi.com/xxx/s1: S1. Supplemental Statistical Analysis; S2. Theoretically-Driven Item Reduction; S3. Factor Structure Iterations; S4. Supplemental Tables.

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