Predictors of Mental Health in Post-Menopausal Women: Results from the Australian Healthy Aging of Women Study

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**Objective:** To examine the extent to which socio-demographics, modifiable lifestyle, and physical health status influence the mental health of post-menopausal Australian women.

**Methods:** Cross-sectional data on health status, chronic disease and modifiable lifestyle factors were collected from a random cross-section of 340 women aged 60-70 years, residing in Queensland, Australia. Structural equation modelling (SEM) was used to measure the effect of a range of socio-demographic characteristics, modifiable lifestyle factors, and health markers (self-reported physical health, history of chronic illness) on the latent construct of mental health status. Mental health was evaluated using the Medical Outcomes Study Short Form 12 (SF-12®) which examined and Center for Epidemiologic Studies Depression Scale (CES-D).

**Results:** The model was a good fit for the data ($\chi^2 = 4.582$, df=3, p=0.205) suggesting that mental health is negatively correlated with sleep disturbance ($\beta = -0.612$, p <0.001), and a history of depression ($\beta = -0.141$, p = 0.024). While mental health was associated with poor sleep, it was not correlated with most lifestyle factors (BMI, alcohol consumption, or cigarette smoking) or socio-demographics like age, income or employment category and they were removed from the final model.

**Conclusion:** Research suggests that it is important to engage in a range of health promoting behaviours to preserve good health. We found that predictors of current mental health status included sleep disturbance, and past mental health problems, while socio-demographics and modifiable lifestyle had little impact. It may be however, that these factors influenced other variables associated with the mental health of post-menopausal women, and these relationships warrant further investigation.

**Key words:** Mental health; Depressive symptoms; Sleep; Modifiable lifestyle factors; Women
1. Introduction

Decrements in mental health are associated with a wide variety of factors. Indeed, reduced mental health has been associated with adversity and social disadvantage [1, 2], female gender [2], limited social support [3, 4], aging [5], and adverse life experiences [6-8], although, the exact mechanisms behind these changes may be difficult to determine. When considering the women’s mental health, it is likely that women experience multiple and repeated ‘risk’ factors for reduced mental health like higher rates of poverty, sexual discrimination and more negative life events [2].

First, socio-demographic factors and life experiences have been linked to diminished mental health. For example, low income and corresponding poverty [9, 10], increased levels of stress, negative early life experiences [9, 10], social isolation [4], unemployment [11], decreased availability of food sources and corresponding nutritional deficits, and lack of transportation [12] have all been correlated with diminutions in mental health status.

Reductions in mental health have also been attributed to modifiable lifestyle factors including sleep disturbance [13, 14], cigarette smoking [15], physical inactivity [16], and being overweight or obese [17]. Other studies however, have failed to find relationships between mental health and lifestyle behaviours, body weight, or health service utilisation [15]. Further, in an American study, Stunkard, Faith, and Allison (2003) reported that because of the increasingly prevalence of both obesity and depression, some co-occurrence is expected [18]. They suggest the relationship between obesity and depression is complex and is best understood within a 'moderator–mediator' framework which explores the influence of moderating (subgroups) and mediating (pathways) factors on the relationship between these conditions [18].
Reduced mental health is also often associated with reductions in perceived physical health status [19] and having one or more chronic illnesses [20]. Indeed, authors have suggested that chronic illness and functional disability are linked with mental decline [20, 21], although chronic illness is more likely to occur in the presence of physical inactivity, smoking, poor diet, and sleep disturbance [13, 14, 20, 21].

Clearly, a wealth of literature has explored determinants of mental health. Current evidence suggests that poor mental health in women may be influenced by a variety of factors including socio-demographic characteristics, lifestyle, stressful life experiences, poor sleep quality, and socio-economic disadvantage. However, the extent to which these variables influence mental health may be difficult to determine and, at times, is contradictory. Furthermore, as women age they are likely to face a variety of pressures from work commitments [22], family commitments like caring for husbands, parents and grandchildren [23] and responsibility for running a household [23]. At the same time women may also be adjusting to changes in their own health and functioning [24]. The purpose of this study was to examine the relative influence of socio-demographic characteristics, modifiable lifestyle factors, and self-reported health status on the mental health status (depressive symptoms and compromised function related to mental health) in post-menopausal women from Queensland, Australia.

2. Materials and Methods

2.1. Sample

In 2001, women aged 50 to 60 were selected at random from the Queensland electoral roll (and followed up in 2006 and 2011). Recruitment strategies and response rates are detailed in several earlier papers [25-27]. This paper presents cross-sectional data from the
343 women, currently aged 60-70 years, who are continuing to participate in the Australian Healthy Aging of Women (HOW) study in 2011.

Multiple retention strategies have been used to retain women in the study although around 224 women (40%) dropped out between 2006 and 2011. More specifically, 8 women died during the intervening period, 53 women withdrew their consent, and 168 women were lost to follow-up. To assess attrition, responders and non-responders were compared across a number of socio-demographic characteristics (age, identifying as Aboriginal or Torres Strait Islander, country of birth, highest educational attainment, employment status and income). Employment status was the only characteristic that distinguished the two groups; non-responders were more likely to report being permanently ill or unable to work (8%) and less likely to be retired (19%) than women who continued to participate in the 2011 survey (2% and 29% respectively; $\chi^2 = 15.3$, df = 5, $p = 0.009$).

2.2. Measures

Quantitative data were collected using a structured self-completed questionnaire. The survey instrument included items on socio-demographics, modifiable lifestyle factors, chronic illness and health-related quality of life (using the SF-12).

2.2.1. Mental Health

In order to assess the various aspects of mental health in post-menopausal people, two outcome measures were used: the Mental Component Summary Score (MCS) from the Medical Outcomes Study Short Form 12 (SF-12®) [28] and the Center for Epidemiologic Studies Depression Scale (CES-D) [29], both of which have been used in a variety of population in a variety of locales. The SF-12 has demonstrated good reliability and validity in previous research [28, 30], and is scored using standard scoring procedure [31], with 100
being the best possible score (indicating better self-reported health status) and zero being the worst possible score (indicating poor self-reported health status).

The CES-D is a 20-item instrument that measures depressed mood or affect [29] and includes one item about sleep. The CES-D has been shown to be reliable and valid for use in the general population [29], clinical populations [32] and in older people. Items are summing with higher scores indicating more depressive symptoms, scores of between 16 and 26 suggest mild depression and scores of ≥ 27 suggest major depression [33].

The CES-D and MCS were moderately correlated (r = 0.521, p < 0.001) suggesting that although related, the instruments be measuring different aspects of mental health. This is supported by Prince (1998) who reported that the SF12 is a global measure of functional outcomes related to mental health, while the CES-D provides an estimate of frequency of symptoms associated with recent depressed mood [34]. Further, as aging is frequently associated with decrements in physical health [19], increased rates of chronic illness [20], functional decline and worse mental health [20, 21], it was theorized that the inclusion of both measures would provide a more comprehensive exploration of mental health status.

Past history of depression and/or anxiety may be a significant predictor of current mental health status. As a potentially important covariate, this variable was included by summing the number of women who reported previous diagnosed with an anxiety disorder and/or depression (scores 0-2).

2.2.2. Physical health and chronic illness

Physical health was measured using the SF-12® Physical Health Component Summary Score (PCS) and was summed using the standard scoring procedure [31]. Chronic illness in women was measured by summing the number of chronic conditions per person. Women were asked to self-report whether they had ever been diagnosed with any of the following
conditions: ischemic heart disease; stroke; breast cancer; non-insulin dependent diabetes mellitus [35].

2.2.3. Modifiable lifestyle factors

The modifiable lifestyle factors evaluated in this study included BMI [36], physical activity, dietary intake, alcohol intake, caffeine consumption, smoking status [27] and sleep [37]. BMI was calculated and grouped according to the WHO International Classification of adult weight [36] with scores <18.5 being underweight, scores between 18.5 - 24.9 being normal weight range, scores between 25.0 – 29.9 being overweight and scores ≥ 30 being obese. Alcohol and tobacco use were measured using standard questions about the amount and frequency of current patterns of consumption [38] while physical activity was evaluated by asking women about the frequency of exercise in the past month [27].

Sleep disturbance was measured using the 21-item General Sleep Disturbance Scale (GSDS) which assesses subjective sleep over the past 7 days [37]. A total score and seven subscales (sleep onset; sleep maintenance; quality of sleep; quantity of sleep; early waking; daytime sleepiness, and self-medication to assist sleeping) are all calculated [37]. The instrument has demonstrated good internal consistency in a variety of population groups including new mothers (Cronbach alpha = 0.88) [39]. The total GSDS is scored by summing items, with higher scores indicating more frequent sleep disturbance (scores range from 0-147).

2.3 Conceptual model

In order to predict the factors correlated with reduced mental health, specifically related to increased depressive symptoms and compromised function related to mental health, the following theoretical model was developed (see Figure 1). This model hypothesizes that mental health is influenced by (1) socio-demographic characteristics; (2) modifiable lifestyle
factors; and (3) objective and subjective health markers. Building on this model, we hypothesized that mental health was negatively impacted by an array of social disadvantage [9, 10, 17], modifiable lifestyle factors like sleep disturbance [13, 14], smoking [15], sedentary lifestyle [16], being overweight or obese [17], and self-reported poor physical health [19, 20]. We also theorized that many predictors were correlated with one another. For example, increased sleep disturbance may be associated with marital status (single and divorced women report more sleep disturbance), BMI may increase with age, and smoking, and poor diet are likely to be associated with physical health self-reports.

[Insert figure 1 about here]

2.4 Data analysis

Analyses were performed using SPSS (Statistical Package for the Social Sciences) version 19 and AMOS (Analysis of Moment Structures) version 19[40]. Descriptive data are presented at counts and percentages or and mean (SD). Pearson’s correlation coefficients were used to calculate linear relationships between normally distributed continuous variables. The level for significance was set at \( \alpha = .05 \). Bivariate associations were analysed using independent sample t-tests, Analysis of Variance (ANOVA) and Pearson’s correlations and significance was set at \( \alpha = .05 \).

Multivariable analysis used structural equation modelling (SEM). This analysis was chosen over general linear modelling (GLM) because as an extension of regression analysis procedures, it was able to simultaneously explore the impact of independent variables on the mental health construct (comprising two outcome measures) and also examine potential interactions between multiple predictor variables.

Prior to multivariable analysis, data were examined for missing values. When >10% of data were missing, cases were excluded (n=46). Screening of the remaining 343 surveys
showed that only a small amount of data (<1%) were missing at random and these values were replaced with mean substitution [41]. Strength of associations between variables was assessed using standardized betas, which provided a basis for comparing relationships regardless of the measurement scales.

The conceptual model (see Figure 1) was used to guide preliminary bivariate analysis and determine the variables to be considered in the multivariable analysis. Several models were estimated from primary bivariate analysis and, to determine the adequacy of the models, multiple goodness-of-fit indices were examined. The criteria for good fit included: (1) a non-significant $\chi^2$ test; (2) chi square/degree of freedom ratio (CMIN/DF) <3; (3) root mean square error of approximation (RMSEA) <0.06; (4) comparative fit index (CFI) >0.95, and; Tucker-Lewis index (TLI) >0.95. The significance level for the SEM was set at $p = \leq .05$.

3. Results

3.1. Sample description

The average age of women in this study was 64.8 years (SD = 2.8). Almost three-quarters (73.2%, n = 248) were married, 23.0% (n = 78) were separated or divorced, and most (86.8%, n = 295) reported being Australian born. Over half (55%, n = 186) were retired, 25.1% were in paid employment (n = 85), 16.6% worked at home (n = 56), and 3.3% (n = 11) of women were unemployed or on a disability support pension.

Most participants reported at least one modifiable lifestyle factor. More specifically, 25% (n = 85) reported no exercise in the past month, 8%, (n = 27) were current smokers, 14.7% (n = 50) drank alcohol daily or almost daily, and 91.8% (n = 312) drank 4 or more caffeinated drinks per day. Moreover, 26.5% were overweight (n = 90), and 41.3% were
obese (n = 140). Over one-quarter (27%, n = 80) of the sample was above the threshold (GSDS ≥43) for self-reported poor sleep during the past week [37].

Self-reported physical health scores (PCS) averaged 47.0 (SD = 9.9). Women also indicated whether they had been diagnosed with any of a number of chronic illnesses that significantly contribute to Australian women’s burden of disease. Overall, 11% reported two or more chronic illnesses (n = 36), 21% reported one chronic illness (n = 72) and 68% denied a history of chronic illness (n = 232).

Self-reported mental health function on the SF12 mental health summary score (MCS12) averaged 54.3 (SD = 7.9) and the average CES-D score for this sample was 14.1 (SD = 5.8). Further examination of the CES-D showed that 3% of the sample (n=10) reported depressive symptoms consistent with major depression (CES-D ≥27), 27% reported mild depressive symptoms (n = 82, CES-D 16 - 26) and 70% reported few depressive symptoms (n = 217, CES-D <16).

3.2. Bivariate correlations

Mental health was compared across socio-demographic characteristics, modifiable lifestyle factors, and health variables. Bivariate analysis showed no differences in depressive symptoms and compromised function related to mental health by country of birth (CES-D, t(338) = -1.690, p = 0.097; MCS, t(338) = 1.897, p = 0.059), or marital status (CES-D, F(3,337) = 2.002, p = 0.137; MCS, F(3,337) = 0.282, p = 0.755). Further, employment categories did not impact depressive symptoms (CES-D, F(3,334) = 1.819, p = 0.143). In contrast, women who were unemployed or on a disability support pension reported lower MCS scores (M = 45.9, SD = 10.9) than women who were employed (M = 54.6, SD = 6.6),
worked at home (M = 52.3, SD = 10.2), or retired (M = 55.3, SD = 7.2) (F(3,334) = 6.381, p <0.001).

The correlation matrix between observed continuous variables is shown in Table 1. Many of the personal background and modifiable lifestyle factors were not significantly correlated with mental health. Women with higher CES-D scores and lower MCS scores did however, reported more sleep disturbance, more chronic illness, lower PCS12 scores, and less physical activity. Furthermore, women with higher CES-D scores also had a lower MCS scores.

[Insert table 1 about here]

3.3. Structural equation model

Bivariate analysis the conceptual model (Figure 1) was used to develop a testable model of the relative impact of socio-demographic characteristics, modifiable lifestyle factors, physical health and chronic illness on mental health in post-menopausal women. The initial model (Model I) included significant MCS or CES-D pathways determined by the bivariate analysis (employment status, exercise, sleep disturbance, chronic illness, past diagnosis with anxiety and/or depression, and physical health) and also significant correlations between exogenous variables. As shown in Table 2, the significant chi-squared test, along with other fit indices, suggested the model was a poor fit for the data (χ² (10) = 60.168, p <0.001). In Model II, non-significant pathways (employment status) and correlations (chronic illness and history of depression, chronic illness and sleep disturbance; history of depression and PCS) were removed but again the model represented a poor fit for the data (see Table 3).

The final model (Model III) shown in Figure 2 was a good fit for the data (χ² (3) = 4.582, p = 0.205, CMIN/DF = 1.527, CFI = 0.991, TLI = 0.957, RMSEA = 0.039, 90% CI = 0.000-0.105) and explained 45% of the variance in the mental health construct. The final model comprised 3 observed exogenous variables and one latent construct, mental health,
which comprised two measures, the MCS and the CES-D. To enable identification, one restriction was placed on the model, the variance between the mental health latent construct and MCS score was fixed to one.

The parameter estimates show that the mental health construct was negatively correlated with by sleep disturbance ($\beta = -0.612, p <0.001$), and indicated that sleep when sleep disturbance increases by 1 standard deviation, mental health scores decrease by an average of 0.61 of a standard deviation. Similarly, past diagnosis of depression or anxiety negatively impacted the mental health construct ($\beta = -0.141, p = 0.024$). Specifically, for every additional diagnosis with either anxiety or depression (SD = 1), current mental scores decreased by 0.141 of a standard deviations. Interestingly, the mental health construct was not influenced by the included socio-demographic characteristics (income, age), many lifestyle factors (BMI, alcohol consumption, tobacco use) or PCS scores or chronic illness. Finally, significant correlations were noted between exogenous variables like sleep disturbance and exercise ($\beta = 0.153, p = 0.003$) and sleep and history of depression/anxiety ($\beta = 0.247, p <0.001$). These results suggest that sleep disturbance is increased among women reporting little or no exercise in the past month, and also among women who have previously been diagnosed with anxiety and/or depression.

[Insert figure 2 about here]

4. Discussion

Poor mental health causes significant morbidity and mortality globally [42]. Evidence suggests that the risk of deterioration in mental health increases with age, and with many countries having aging populations, the proportion of people with diminishments in mental health will undoubtedly rise [43]. This study explored the multiple factors potentially
associated with increased depressive symptoms and compromised function in women as they age. The use of two measures to estimate the mental health construct enabled comprehensive analysis of the construct; MCS assessed how mental health affects overall functioning, while the CES-D examined depressive symptom frequency more specifically related to the past week [34]. By identifying the factors associated with increased depressive symptoms and compromised function related to mental health, health care providers will be better able to meet the mental health care needs of post-menopausal women.

In this paper, we developed and tested a theoretical model of poor mental health status using SEM. Predictors included socio-demographic characteristics, modifiable lifestyle factors, and self-reported markers of health (see Figure 1). The initial model (Model 1) included significant ‘mental health’ pathways determined by the bivariate analysis and also significant correlations between exogenous variables but despite predicting 43% of the variance in mental health in this population; this model was not a good fit for the data. Model II, a trimmed model, excluded non-significant pathways but still inadequately fit the data. The final model (Model III) was a good fit for the data, included three predictors and two additional covariance estimates, and explained 45% of the variance in mental health status.

The SEM model illustrated the importance of sleep in mental health (MCS and CES-D). These results are consistent with previous research in which poor sleep or short sleep duration has been linked to poor general health, increased physical and mental distress, more activity limitations and pain, and increased mental illness [30, 44]. The potential for confounding must be acknowledged, specifically, the links between poor sleeping and depressive illness. For example, people with insomnia experience greater levels of depression and anxiety than people without insomnia [45]. Further, insomnia and increased number of awakenings may be a signs of depression and anxiety [45]. Despite this, the research
highlights the importance of sleep to promoting good mental health and it is likely that an intervention to improve one, will invariably positively impact the other.

The mental health of women in this study was also negatively impacted by previous diagnosis with depression and/or anxiety. This is consistent with literature suggesting that past mental health problems greatly increase the odds of future depressive episodes [46, 47]. Possibly, the stress-responsive system dysfunction persist after remission [46], and that the stress associated with midlife [48, 49], may increase women’s vulnerability to mental health problems in those who are at increased risk. One of the strategies therefore, for the preservation of good mental health in mid-life and older women, may be through the promotion of positive health behaviours and the maintenance of good general physical and mental health earlier in life [19, 20].

Interestingly, the model suggested that most modifiable lifestyle factors seemed to have little effect on the mental health construct. These findings are, to some extent, in contrast with previous research which has suggested that poor mental health is related to unhealthy lifestyle and obesity [50]. However, these variables may have impacted mental health through their relationship with covariates, specifically in relation to sleep disturbance, exercise and past mental health problems. This relationship is mirrored among elderly Japanese men and women; positive correlations were found between lifestyle and sleep and those who report a deterioration in sleep quality also frequently reported a corresponding deterioration in self-reported health status [51]. Moreover, Baldwin and colleagues reported that health-related quality of life was influenced by sleep disturbance, but was moderated by co-morbid health conditions [52]. Since socio-economic disadvantage and chronic health conditions are strongly associated with both unhealthy lifestyle and sleep problems, disrupted sleep and poor
physical health may be a mechanism through which lifestyle is linked to poor mental health [52].

Several limitations of this study should be acknowledged. First, although data were collected using random sampling, attrition over time may have influenced the representativeness of the sample. There was evidence to suggest, that among study participants, those who were more frail and unwell were more likely to withdraw from the study. Research suggests participants with poorer health have a greater risk of attrition compared with participants in generally good health. Also the data collection methods used (i.e., mail surveys) in this study may have posed a higher risk of attrition. Indeed, mail surveys are considered to be less personal than face-to-face interviews, and therefore participants may be less persuaded to continue in the study [53].

Secondly, the data presented in this paper were cross-sectional and therefore temporal relationships could not be established. For example, results suggest that poor sleepers reported increased depressive symptoms and compromised function related to mental health. However, it is equally plausible that those with reduced increased depressive symptoms and compromised function have more sleeping difficulties. To determine temporality, future research should consider longitudinal study designs to identify which condition occurs first.

Finally, current data did not examine the impact of stress on the health in this cohort. It may be that the stress associated with care giving or dealing with an illness or injury may predict overeating, increased sleep disturbance, and poor health. Indeed, Muennig et al. suggests that stress, anxiety, and depression are linked with increased obesity rates and sedentary lifestyle in women over 45 [24]. Thus, future research should examine the associations between stress, modifiable lifestyle factors, and health in an effort to understand
their potential impact on women at all life stages, and specifically to improve the health of middle-aged women as the age [24].

Despite these limitations, the relatively large sample of women from rural and metropolitan areas of south-east Queensland allowed for analysis of mental health correlates among post-menopausal women. While research suggests that it is important to engage in a range of health promoting behaviours to preserve good health [19, 20], findings from this study did not show that many of these behaviours effected overall mental health. Indeed, the current study found that only frequency of sleep disturbance, physical health, chronic illness and level of physical activity predicted current increased depressive symptoms and compromised function. It is worth noting however, that while one's socio-demographic characteristics and modifiable lifestyle factors seemed to have little impact on mental health, they undoubtedly influenced other factors associated with mental health. Future research should consider the importance of other factors in post-menopausal women’s lives, such as their social environment and support networks of family and friends, as well as life-time stressors that may have a more direct influence on mental health for older women.
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Reference list


### Table 1

**Pearson’s correlations between measured variables**

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<td>0.21**</td>
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<td>7. MCS</td>
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Chronic illness, number of chronic illnesses; Past depression, past history of anxiety and/or depression; Income, gross annual household income; Age, age in years; CES-D, Center for Epidemiologic Studies – Depression; Alcohol, number of alcohol days in the past week; MCS12, Mental Health Component Summary 12 (SF-12); GSDS, General Sleep Disturbance Scale; BMI, Body Mass Index; Smoking, number of cigarettes per day; Exercise, number of exercise days per week in the last month. *p<0.05    **p<0.01
Table 2

**Goodness-of-fit indices for the structural equation models**

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<th>DF</th>
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<th>CFI</th>
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<th>$R^2$</th>
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<td>63.477</td>
<td>11</td>
<td>&lt;0.001</td>
<td>5.771</td>
<td>0.801</td>
<td>0.49</td>
<td>0.117</td>
<td>0.090-0.145</td>
<td>0.415</td>
</tr>
<tr>
<td>III</td>
<td>4.582</td>
<td>3</td>
<td>0.205</td>
<td>1.527</td>
<td>0.991</td>
<td>0.957</td>
<td>0.039</td>
<td>0.000-0.105</td>
<td>0.454</td>
</tr>
</tbody>
</table>

Model I, full model with significant pathways and correlations; Model II, trimmed model; Model III, further trimmed model
Figure 1

_Hypothesized model of factors influencing mental health in post-menopausal Australian women_

- **Personal background**
  - Age
  - Marital status
  - Educational attainment
  - Income
  - Stress and trauma

- **Lifestyle factors**
  - BMI
  - Alcohol consumption
  - Smoking
  - Caffeine intake
  - Diet
  - Sleep disturbance
  - Exercise

- **Health status**
  - Physical health
  - Chronic illness
  - Clinical biomarkers

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**Mental Health**
Figure 2

*Structural equation model for mental health status in post-menopausal Australian women (n = 340)*

*Significant pathways represented by bold font (p<0.05)*