Psychosocial and Physiological Predictors of Somatisation in a Population-Representative Sample of Australian Women: A Longitudinal Study

This thesis is submitted in partial fulfilment of the Honours degree of Bachelor of Psychological Science (Honours)

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Abstract

Somatic symptoms are chronic physical complaints, such as headaches and joint pain. Patients presenting with them have repeat appointments, but usually remain undiagnosed. Women have been found to have a higher burden of somatic symptoms. To remedy a lack of longitudinal research on a comprehensive set of psychosocial and physiological predictors of somatic symptoms in women, we used data from two waves (Wave 5 and 6) of the Australian Longitudinal Study on Women's Health. The waves were three years apart (conducted in 2017 and 2019), and were completed by 8,261 women, who were representative of the Australian general population. Participants answered questions about eight relevant physiological factors and seven relevant psychosocial factors. Linear regression with somatic symptom burden as the outcome was conducted to (a) compare the standardised coefficients across all predictors, and (b) the amount of variance contributed by psychosocial predictors combined and physiological predictors combined. Missing data on predictors was multiply imputed. The five strongest predictors were distress (strength of depression and anxiety symptoms), the presence of at least one physiological condition, stress, being overweight, and having a sexual condition. Together, all the predictors accounted for 32.8% of variance, and, alone, psychosocial predictors accounted for more variance than physiological predictors: 29.7% vs. 11.5%. The results suggest that supports should be strengthened for health professionals to consider and investigate the psychosocial circumstances of patients presenting with common physical complaints.

Key Words: somatic symptoms, somatisation, psychological wellbeing, physical wellbeing, longitudinal analysis, women's health.

Declaration

This thesis contains no material which has been accepted for the award of any other degree of diploma in any University, and, to the best of my knowledge, this thesis contains no material previously published except where due reference is made. I give permission for the digital version of this thesis to be made available on the web, via the University of Adelaide's digital thesis repository, the Library Search and through web search engines, unless permission has been granted by the school to restrict access for a period of time.

September 26, 2022

Contribution Statement

This thesis was based on an existing dataset from the Australian Longitudinal Study on Women's Health. I completed the required paperwork to be added to the already approved project A695 on the relative contributions of psychosocial and physiological factors to somatic symptoms. I led the process of determining the variables to be included in this study based on a literature search and exploration of the data dictionary. Based on the variables chosen, my supervisor provided an initial R Markdown template for cleaning the data, which I extended and applied to incorporate all selected predictors. My supervisor next wrote the R script for running a regression with multiply imputed data and I interpreted the results and worked with my supervisor in developing supporting appendices. I was responsible for completing all analysis interpretation as well as the thesis write-up.

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September 26, 2022

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Physical complaints that cannot be attributed to a biological cause are referred to as ‘somatic symptoms or ‘somatisation’. A medical examination ruling out organic causes is required to take place before symptoms are classified as somatic. Additionally, the term ‘somatisation’ is used when physical complaints or impairments are in excess of what would be expected from a diagnosis (Kellner, 1990; Zijlema et al., 2013). When first defined, somatisation was described as being linked to ‘hysteria’ (now termed ‘anxiety’) and ‘hypochondriasis’ (now termed ‘health anxiety’). However, under the modern definition, experiencing somatisation does not preclude having an existing illness. It is now recognised that somatisation can exist in conjunction with a physical illness, as the presentation of an illness, an amplification of an illness, or as a factor enabled by an illness (American Psychiatric Association, 2013; Lipowski, 1988, van der Feltz-Cornelis & van Houdenhove, 2014).

Patients with somatic symptoms exert increased pressure on the healthcare system. Estimates of the rates of general practitioner visits of people with somatic symptoms vary, but, at the low end, somatic symptoms are estimated to account for around 20% of primary care visits (Peveler et al., 1997; Tylee & Gandhi, 2005). Additionally, roughly 50% of general practitioner visits are associated with headaches and fatigue, which are frequently not associated with specific medical conditions (Katon et al., 2001). One theory is that due to the stigma around mental health, presenting to the general practitioner, especially during initial visits, with a psychological issue is more uncomfortable, encouraging patients to normalize their symptoms (Tylee & Gandhi, 2005). Cross-cultural differences in the frequency of doctor visits have been found, likely reflecting cultural differences in definitions of somatisation and the structure of

healthcare systems (Simon et al., 1999). The complex nature of somatic symptoms make them difficult to rigorously measure in comparison to well established physiological conditions (Verhaak et al., 1998).

As general practitioners are trained to primarily attribute presenting symptoms to physical disease, futile and exhaustive diagnostic searches are often undertaken to determine the cause of symptoms (Kroenke, 2005; Reid et al., 2001). It has been estimated that somatic symptoms account for around 50% of visits to referral clinics and hospital settings (Nimnuan et al., 2001). As suggested by Kroenke (2005), the approach to treating somatic symptoms is often seen to be more in line with treating a chronic physiological disease rather than an acute one. Both, general practitioners and patients visiting with somatic symptoms tend to look for the more direct approach of finding the problem and fixing it regardless of the underlying nature often causing the patient to be returned to the general practitioner to begin the investigation again . The diagnostic search process creates extensive expense and complexities for the patient as well as the healthcare system, often resulting in a conclusion of a lack of physical disease (Haller et al., 2015; Kleinstäuber et al., 2011; Peveler et al., 1997; Smits et al., 2009). Furthermore, some patients do not request a medical intervention but receive one anyway amplifying an already long and tiresome process (Ring et al., 2004). Overall, the need for further research on somatisation is underscored by its consistently observed negative association with patient quality of life (Kohlmann et al., 2013; Lieb et al., 2007; olde Hartman et al., 2009; Reid et al., 2001).

Bodies of research and multiple theories have emerged around psychosocial factors and the burden of bodily symptoms. Drawing on findings regarding the emotional predictors of pain detection and the finding that no pathology is discovered in the majority of general practitioner visits for common symptoms, numerous authors propose that somatisation is driven by a

biopsychosocial process – one involving interplay between biological, psychological and social factors (Gatchel, 2004; Gatchel et al., 2007; Katon et al., 2001; Mangelsdorff, 1989; Tylee & Gandhi, 2005). Moreover, biological mechanisms have been suggested for how high levels of depression and anxiety can increase pain (Kroenke, 2005; Lerman et al., 2015). Consistent with this proposal, emotional difficulty and psychiatric disorders are often found to be comorbid with chronic pain (Gatchel et al., 2007). Though somatisation frequently accompanies depression and anxiety, a third or more patients with somatic symptoms suffer from somatisation independently of depression and anxiety (Ormel et al., 1994). In reviewing over 80 papers to look at the relationship between depression and somatic symptoms, patients presenting with general aches and pains were found to be 20% less likely to seek mental health support even though made up approximately 20% more of the visits to their general practitioner (Tylee & Gandhi, 2005). Possible psychosocial precursors of somatisation among these patients include stress (Cariello et al., 2020) and other psychiatric illnesses (Kroenke et al., 1997).

The relationship between various psychosocial factors and somatic symptoms has been demonstrated in many cross-sectional studies. High levels of anxiety and depression have been found to be associated with higher levels of somatisation (Dehoust, 2014; Henningsen, 2003; Wilpart et al., 2017) and to co-occur with various forms of somatoform disorders (e.g., somatisation disorder and pain disorder; Lieb, 2007). Additionally, anxiety and depression have been shown to act as intermediaries in the indirect effect of emotion regulation on somatisation (Schwartz, 2017). Currie and Wang (2004) observed a positive association between major depression and pain. Patients with existing physiological conditions, such as cancer who also had diagnosis of depression or pain reported similar levels of somatic symptom burden regardless of the phase their cancer was in (Kroenke et al., 2010). Ormel et al. (1994) surveyed and medically

evaluated patients at primary care clinics across 14 countries assessing the presence physiological conditions, psychosocial conditions, and disability (i.e., disruption to the participants ability to perform usual activities). Psychosocial factors were shown to have a stronger association with disability than were physiological factors. Furthermore, Ormel et al. (1993) found similar results among participants from the Netherlands. Of course, cross-sectional studies cannot establish cause and effect, and, thus, are unable to rule out the possibility that physical symptoms give rise to increased psychological distress over time.

A need for further longitudinal studies

A number of longitudinal studies capable of demonstrating temporal relationships consistent with causality have been conducted but have yielded inconsistent results. Lerman et al. (2015) found that, while anxiety and depression predicted pain approximately one year later, the reverse relationship did not hold. Depression has also been observed to predict somatic symptoms among sufferers of back pain six and 12 months later (Carroll et al., 2004), as well as among elderly individuals three years later (Jarvik et al., 2005). Anxiety has been found to predict somatic symptom burden in adolescents 11 years later (Bonvanie et al., 2017). However, in line with these findings, Burton et al. (2009) utilised self-reported twice daily diary entries over 12 weeks, mood and concern about a specific symptom were found to have a stronger predictive relationship with somatic symptoms as compared to anxiety or stress. Burton et al. (2009), suggests that these outcomes may give support to the idea that patients experiencing somatic symptoms may not experience a significant association between emotional states and their symptoms. However, in people aged over 55 during a 12 year-period, a predictive relationship from pain to depression was observed, although the reverse relationship did not hold (Hilderink et al., 2012). In a study with young German women, the tendency to catastrophise

physical symptoms has also been shown to predict future somatic symptoms between two assessments 17 months apart (Woud et al., 2015). Studies utilizing daily diaries over a 12-week period have similarly produced inconclusive results. Experiencing stressful situations resulted in a decrease in reported symptoms, suggesting that stressful situations led participants to pay less attention to bodily discomfort (Burton et al., 2009; van Gils et al., 2014). However, acute periods of stress similar to what is experienced during an exam period have shown associations with increases in somatisation (Zunhammer et al, 2013).

Research on physiological predictors of somatic symptoms is largely underrepresented. Furthermore, finding studies exploring the influence of both psychosocial and physiological factors and their interactions with somatic symptoms is not found (Kliem et al., 2014). Some longitudinal studies even exclude participants with health conditions further hindering the role physiological factors influence (i.e. cancer or major heart disease; Burton et al., 2009). When, in the rare case, physiological influences are considered, it is often to only to a limited extent such as back pain (Jarvik et al., 2005), chronic pain (Lerman et al., 2015), or pain in the elderly (Hilderink et al., 2012).

A systematic review on somatisation disorder, somatic symptoms, hypochondriasis, and related predictive factors concluded that existing research is limited with high heterogeneity (olde Hartman et al., 2009). Numerous reviews have called for further longitudinal research (Lieb et al., 2007; Weich & Araya, 2004). In particular, there is scope to address the temporal relationship between psychosocial factors and somatic symptoms across longer periods spanning multiple years. There is also scope to explore population-representative samples rather than specific populations, such as the elderly and adolescents (Jasper et al., 2012; Kliem et al., 2014;

Thomas & Locke, 2010). Furthermore, opportunity also exists for longitudinal studies to explore a comprehensive range of predictors – both psychosocial and physiological.

A need for focusing on women

For numerous reasons, there are likely to be benefits to exploring the predictors of somatic symptoms among women in particular. Firstly, women have been shown to have a higher burden of somatic symptoms in daily life (Ballering et al., 2020; Barsky et al., 2001), as well as in communities under stress after surviving disasters (van den Berg et al., 2009). Secondly, women have been shown to be more likely to experience abuse (ALSWH, 2019), a possible psychosocial precursor of somatic symptoms (Afari et al., 2014; Eslami et al., 2019). Women who have experienced abuse in childhood or are victims of crime in adulthood are known to experience poorer health outcomes, more frequent healthcare visits, and higher medical costs (Koss et al., 1991; Walker, Gelfand et al., 1999; Walker, Unutzer et al., 1999) and women report having more adverse experiences in childhood (Petruccelli et al., 2019). Finally, an association between depressive symptoms and menstrual symptoms in adolescent girls reaching the point of puberty has been observed (Beal et al., 2014), suggesting that the association between psychosocial variables and somatic symptoms develops early.

The present study

In this longitudinal study, we aim to compare the relative contributions to physiological and psychosocial factors to somatic symptoms over a three-year period in a population-representative sample of Australian women aged 22 to 27. On average, women of this age are less likely to suffer from physical ailments associated with natural aging. We will be using data from the Australian Longitudinal Study on Women's Health (ALSWH) – a study established to

explore psychological, physical, social, and environmental factors impacting Australian women throughout their lives (Brown et al., 1996; Dobson et al., 2015).

A common and well-validated measure of somatisation is the Patient Health Questionnaire-15 (PHQ-15), in which respondents are asked about the degree to which they are bothered by the 15 bodily symptoms shown in Table 1 (Kroenke et al., 2002; Witthöft et al., 2013; Zijlema et al., 2013). While not designed as a measure of whether reported symptoms are medically unexplained, the PHQ-15 has been found to be appropriate to use as a screener for symptoms that often remain medically unexplained (Han et al., 2011; Jasper et al., 2012; Kroenke & Mangelsdorff, 1989). In a systematic review of 99 articles on 40 questionnaires to assess common somatic symptoms, the PHQ-15 and the Symptom Checklist-90 somatization scale (SCL-90 SOM) were shown to be the best fit for use in large-scale studies like the ALSWH. Both the PHQ and SCL-90 SOM were shown to have test-retest reliability, validity, measure severity of symptoms and have questions pertaining to both general and somatic symptoms (Zijlema et al., 2013). The ALSWH includes questions about 11 of the 15 symptoms included in the PHQ-15, and for this study it was decided that summing across those 11 is sufficient, given that somatic symptoms as measured by the PHQ-15 and other instruments tend not to group into distinct clusters, factors, or dimensions (Eliasen et al, 2017; Kilem et al., 2014l; Kroenke et al., 2002; Lacourt et al., 2013; Rosmalen et al., 2011). The ALSWH did not address questions concerning: stomach pain, dizziness, chest pain, and fainting spells from the PHQ-15. We nevertheless test the dimensionality of the 11 symptoms in the ALSWH survey in a supplementary analysis in Appendix A. The PHQ-15 has been found to capture relevant symptoms, to be suitable for use in large-scale studies, has demonstrated to be time-efficient, has strong psychometric properties, and is available in multiple languages (e.g. Kocalevent et al.,

2013; Zijlema et al., 2013). Furthermore, Kroenke et al. (2002) found the PHQ-15 to have high internal reliability and high correlation with other somatisation scales such as the World Health Organization Schedule for Somatoform Disorders Screener and the somatisation scale from the Hopkins Symptom Checklist. Additionally, the PHQ-15 has been shown to demonstrate external validity in predicting IBS (Witthöft et al., 2013). As information on the PHQ-15 is gained from self-report, it is best to be used as a diagnostic tool to evaluate severity of symptom. Caution should be used in assessing if a condition is medically explained or not based on self-report measures. The PHQ-15 and thus our survey includes questions on back pain, joint pain, menstrual cramps or problems with the menstrual cycle, headaches, racing heart, shortness of breath, pain during sexual intercourse, constipation, nausea or upset stomach, tiredness, and trouble sleeping. The corresponding questions between the PHQ-15 and analog in the ALSWH are shown in Table 1 (ALSWH, 2020g; Kocalevent et al., 2013; Medscape, 2020).

Psychosocial and physiological predictor variables in the current study were assessed in Wave 5 (collected in 2017), while the outcome variable – somatic symptom burden – was assessed in Wave 6 (collected in 2019). These waves are the most recent, but were collected prior to the COVID-19 pandemic, the effects of which could have represented an artefact. Eight physiological variables with possible implications for common bodily symptoms were assessed: presence of a physiological condition (cardiovascular, respiratory, etc.; yes/no), presence of a sexual condition (yes/no), smoking status (yes/no), cannabis (drug) use (yes/no), exercise (inactive/ low vs moderate; inactive/low vs high), weight (overweight; yes/no), alcohol consumption (risky drinker; yes/no), and having given birth (yes/no). Seven relevant psychosocial variables were available: diagnosis with a psychological condition (yes/no), degree of social support, degree of distress, degree of stress, degree of abuse, self-harm (yes/no), and

degree of self-esteem. Thus, the current study incorporated a more comprehensive set of predictors than past longitudinal studies.

Table 1

Analogues of the PHQ-15 in the ALSWH Survey

PHQ-15	Analog in the ALSWH
Question wording: Over the last week, how often have you been bothered by the following? (0) Not at all; (1) Bothered a little; (2) Bothered a lot.	Question wording: In the last 12 months, have you had any of the following? (1) Never, (2) Rarely, (3) Sometimes, (4) Often.
Stomach pain?	-
Back pain?	Back pain?
Pain in your arms, legs or joints (knees, hips, etc.)?	Stiff or painful joints?
Menstrual cramps or other problems with your periods?	Premenstrual tension, irregular periods, heavy periods, severe period pain?
Headaches?	Headaches / migraines?
Dizziness?	-
Feeling your heart pound or race?	Palpitations (feeling that your heart is racing or fluttering in your chest)?
Shortness of breath?	Breathing difficulties?
Pain or problems during sexual intercourse?	Vaginal discharge or irritation?
Constipation, loose bowels or diarrhea?	Constipation?
Nausea, gas or indigestion?	Other bowel problems?
Feeling tired or having low energy?	Severe tiredness?
Trouble sleeping?	Difficulty sleeping?
Chest pain?	-
Fainting spells?	-

Method

Participants

Women from the 1989- 95 cohort of the ALSWH were chosen on account of being the youngest in the study, and, thus, having a lower likelihood of age-related health decline and complications. Wave 5 and Wave 6 (collected in 2017 and 2019, respectively) were selected, as they provide current data, and yet were conducted prior to the complex circumstances surrounding the Covid-19 pandemic. All participants were either Australian or New Zealand citizens or Australian permanent residents (ALSWH, 2020e).

Surveys in the relevant study waves were completed, at least partially, by 8,495 women aged 22 to 27 in Wave 5 and 8,346 women aged 24 to 30 in Wave 6, (ALSWH, 2020a). Of these participants, 10,103 women provided data in Waves 5 or 6 or both. Among those with available data in both waves, 8,261 women completed the somatic symptoms question – the outcome measure – in Wave 6 and had a non-missing value on at least one Wave 5 predictor. These 8,261 women formed the core sample. Any missing data they had on predictor variables in Wave 5 was imputed using Wave 4 responses (van Buuren & Groothuis-Oudshoorn, 2011).

Table 2 presents descriptive statistics for the core sample and shows that the 1,842 women excluded from the study due to missing data in Waves 5 or 6 largely did not differ from the core sample on key demographic characteristics or values of the predictors.

Analyses were also conducted on a subset of the core sample with no missing data on the predictors (N = 5,261). Table 2 presents descriptive statistics for this ‘complete data’ sample also and shows that participants within it did not differ from the remainder of participants who

provided some but not all data in both waves (N = 3,000) who had missing data added through the imputation.

Procedure

The ALSWH began in 1996 with three age cohorts surveyed every three years. These were women born between 1921 and 1926, 1946 and 1951, and 1973 and 1978. A new cohort of women born between 1989 and 1995 was first recruited in 2011, and was deemed 'the new young cohort' (ALSWH, 2020f). The sampling procedure for the ALSWH across all four cohorts has been previously described in detail (ALSWH, 2020e; Dobson et al., 2015; Loxton et al., 2015, 2018; Mishra, Hockey et al., 2014; Mishra, Loxton et al., 2014). For the 1989-95 cohort, social media was used extensively in recruiting, and focus groups were conducted with pilot participants to discuss survey style, format, duration, study promotion, privacy, and data linkage (Mishra, Hockey et al., 2014; Mishra, Loxton et al., 2014). In Wave 1, there were 17,070 participants in the 1989-95 cohort, so attrition has been substantial over time, with some 50% of participants returning in Wave 5 (Loxton et al., 2015; Mishra Hockey et al., 2014; Mishra, Loxton et al., 2014).

In Waves 1 to 3, ALSWH participants in the 1989-95 cohort have been shown to have rates of rural dwelling and distributions of relationship status that are similar to those in the 2011 Australian census. These ALSWH participants were, however, found to be more likely to have completed a university degree, even though the census, unlike the ALSWH, included data from university students who are not permanent residents of Australia (ALSWH, 2020f; Mishra, Hockey et al., 2014; Mishra, Loxton et al., 2014).

Table 2

Descriptive Statistics Comparing Demographic Variables of the Core Dataset to Imputed and Removed Participants

Comparisons	1: Complete data vs. partially complete		2: Complete or partially complete vs. missing DV or Wave 6		
	Participants with complete data (no missingness on predictors or DV) (N = 5,261)	Participants with at least some Wave 5 and the DV, but missingness on at least one predictor (N = 3,000)	Participants in the regression with multiple imputation (N = 8,261)	Participants with a missing DV or fully missing Wave 6 (N = 1,842)	Total: 10,103
Demographics					
Living Overseas	No: 5,114 (97%) Yes: 147 (3%)	V = .005 No: 1,413 (97%) Yes: 37 (3%)	No: 6,527 (97%) Yes: 184 (3%)	V = .0 No: 1,736 (97%) Yes: 48 (3%)	No: 8,263 (97%) Yes: 232 (3%)
Education	H. School: 763 (14%) Vocat.: 1,270 (22%) Bachelor: 2,316 (49%) Postgrad: 910 (15%)	* V = .04 H. School: 188 (15%) Vocat.: 291 (22%) Bachelor: 651 (49%) Postgrad: 205 (15%)	H. School: 951 (14%) Vocat.: 1,561 (24%) Bachelor: 2,967 (45%) Postgrad: 1,115 (17%)	*** V = .115 H. School: 326 (19%) Vocat.: 549 (33%) Bachelor: 618 (37%) Postgrad: 192 (11%)	H.School: 1,277 (15%) Vocat.: 2,110 (25%) Bachelor: 3,585 (43%) Postgrad: 1,307 (16%)
Healthcare Card	No: 4,404 (84%) Yes: 857 (21%)	*** V = .054 No: 1,119 (79%) Yes: 303 (21%)	No: 5,523 (83%) Yes: 1,160 (17%)	*** V = .072 No: 1,323 (76%) Yes: 426 (24%)	No: 6,846 (81%) Yes: 1,586 (19%)
Marital Status	Married: 792 (15%) De Facto: 1,735 (33%) Single/ Sep: 2,730 (52%)	*** V = .239 Married: 99 (7%) De Facto: 152(11%) Single/ Sep: 1,083 (81%)	Married: 891 (14%) De Facto: 1,887 (29%) Single/ Sep: 3,813 (58%)	V = .027 Married: 194 (12%) De Facto: 469 (28%) Single/ Sep: 1,017 (61%)	Married: 1,085 (13%) De Facto: 2,356 (28%) Single/ Sep: 4,830 (58%)
Age	24.788 (1.739)	*** d = .242 24.364 (1.767)	24.697 (1.754)	*** d = .099 24.524 (1.739)	24.66 (1.75)
Baseline levels of the physiological predictors					
Physical Condition	No: 3,033 (58%) Yes: 2,228 (42%)	V = .001 No: 831 (58%) Yes: 606 (42%)	No: 3,864 (58%) Yes: 2,834 (42%)	V = .01 No: 999 (56%) Yes: 773 (44%)	No: 4,863 (57%) Yes: 3,607 (43%)
Sexual Condition	No: 3,045 (58%) Yes: 2,216 (42%)	*** V = .077 No: 965 (67%) Yes: 473 (33%)	No: 4,010 (60%) Yes: 2,689 (40%)	* V=.024 No: 1,010 (57%) Yes: 763 (43%)	No: 5,020 (59%) Yes: 3,452 (41%)
Smoker Now or Past	No: 3,972 (75%) Yes: 1,289 (25%)	*** V = .044 No: 1,139 (80%) Yes: 283 (20%)	No: 5,111 (68%) Yes: 1,572 (32%)	*** V = .078 No: 1,191 (76%) Yes: 558 (24%)	No: 6,302 (75%) Yes: 2,130 (25%)
Drug Use Ever	No: 3,683 (70%) Yes: 1,578 (30%)	* V = .029 No: 1,040 (73%) Yes: 380 (27%)	No: 4,723 (71%) Yes: 1,958 (29%)	** V = .03 No: 1,176 (67%) Yes: 572 (33%)	No: 5,899 (70%) Yes: 2,530 (30%)
Exercise	Inactive/ Low: 1,528 (29%) Moderate: 1,160 (22%) High: 2,573 (49%)	V = .018 Inactive/ Low: 410 (31%) Moderate: 280 (21%) High: 631 (48%)	Inactive/ Low: 1,938 (29%) Moderate: 1,440 (22%) High: 3,204 (49%)	V = .019 Inactive/ Low: 529 (31%) Moderate: 343 (20%) High: 823 (49%)	Inactive/ Low: 2,467 (30%) Moderate: 1,783 (22%) High: 4,027 (49%)
Overweight	No: 3,047 (58%) Yes: 2,214 (42%)	V = .012 No: 725 (56%) Yes: 562 (44%)	No: 3,772 (58%) Yes: 2,776 (42%)	* V = .024 No: 893 (55%) Yes: 741 (45%)	No: 4,665 (57%) Yes: 3517 (43%)
Alcohol: Risky Drinker	No: 4,741 (90%) Yes: 520 (10%)	V = .007 No: 2,606 (90%) Yes: 301 (10%)	No: 7,347 (90%) Yes: 821 (10%)	V = .0 No: 0 (0%) Yes: 0 (0%)	No: 7,347 (90%) Yes: 821 (10%)
Given Birth	No: 4,706 (89%) Yes: 555 (11%)	*** V = .083 No: 1,256 (96%) Yes: 59 (4%)	No: 5,962 (91%) Yes: 614 (9%)	*** V = .075 No: 1,474 (85%) Yes: 261 (15%)	No: 7,436 (89%) Yes: 875 (11%)
Baseline levels of the psychosocial predictors					
Social Support	4.003 (0.897)	*** d = .369 3.662 (0.956)	3.934 (0.920)	*** d = .156 3.783 (1.016)	3.904 (0.942)
Distress	20.414 (7.593)	*** d = .014 20.517 (7.560)	20.435 (7.586)	*** d = .174 21.808 (8.186)	20.717 (7.732)
Stress	1.008 (0.556)	* d = .058 0.976 (0.533)	1.001 (0.552)	*** d = .106 1.061 (0.579)	1.013 (0.558)
Psychological Condition	No: 3,436 Yes: 1,825	V = .008 No: 953 Yes: 485	No: 4,389 Yes: 2,310	*** V = .035 No: 1,093 Yes: 687	No: 5,482 (65%) Yes: 2,997 (35%)
Abuse	2.716 (4.253)	d = .066 3.011 (4.689)	2.739 (4.489)	*** d = .134 3.347 (4.745)	2.863 (4.392)
Self-Harm	No: 2,970 Yes: 2,291	*** V = .042 No: 791 Yes: 490	No: 3,761 Yes: 2,781	V = .003 No: 958 Yes: 721	No: 4,719 (57%) Yes: 3,502 (43%)
Self-Esteem	2.716 (4.253)	d = .066 3.011 (4.689)	2.739 (4.289)	*** d = .134 3.347 (4.745)	19.099 (6.528)
Value of the outcome at Wave 6					
	1.228 (.523)	** d = .066 1.262 (.522)	1.227 (.519)	d = .045 1.203 (.534)	1.236 (.525)

Note. p-value significance is indicated by *** p ≤.001, ** p ≤.01, * p ≤.05.

More problematically, even though the ALSWH includes participants identifying as Aboriginal and Torres Strait Islander, its authors have recommended that it not be used as an independent source for data on Indigenous health due to issues with research methods and recruitment (ALSWH, 2020c).

Ethics approval for the ALSWH was granted by the University of Newcastle (H-2012-0256 and H-2011-0154), the University of Queensland (2012000950 and 2011000809), the Australian Department of Health (project: 15/2012), and the Australian Department of Human Services (2012/CO10726). The Department of Human Services provided permission for the ALSWH to access participants' linked data on the use of health and pharmaceutical services with participants' consent (Mishra, Loxton et al., 2014). The present study does not report on any linked data. Data for the present study was shared by the investigators of the ALSWH following a project approval process (approval number: A695).

Measures and Materials

Participants completed online self-report surveys at two timepoints (3 years apart). Variables relevant for the present study are described below, along with their classifications as physiological and psychosocial. The full text of the surveys is available online (ALSWH, 2020g), along with the full coding of the variables (ALSWH, 2020i).

Outcome Variable: Somatic Symptom Burden (Wave 6)

Somatic symptoms were measured in all waves other than Wave 4, including the wave of interest – Wave 6 – using a question about common symptoms. The question was, 'In the last 12 months, have you had any of the following': (a) headaches/migraines, (b) severe tiredness, (c) stiff or painful joints, (d) back pain, (e) difficulty sleeping, (f) palpitations, (g) constipation, (h) other bowel problems, (i) premenstrual tension, (j) irregular periods, (k) heavy periods, (l) severe

period pain, (m) breathing difficulties, (n) vaginal discharge, (o) skin problems, (p) allergies, hay fever, sinusitis, (q) problems with one or both feet, (r) urine that burns or stings, (s) leaking urine, (t) hemorrhoids (piles), (u) depression, (v) episodes of intense anxiety (e.g., panic attacks), (w) other mental health problems?' The response options were (1) never, (2) rarely, (3) sometimes, or (4) often (ALSWH, 2020g; ALSWH, 2020i). As shown in Table 1 in the Introduction, of these items, 14 (*a* to *n*) map onto 11 items in the PHQ-15, a valid, reliable, and widely used measure of the severity of somatic symptoms (Han et al., 2011; Kroenke & Mangelsdorff, 1989; Kroenke, 2007; Kroenke et al., 2002; Zijlema et al., 2013). Four items (*i* to *l*) were averaged to provide a single indicator of menstrual pain analogous to one of the items in the PHQ-15. This indicator of menstrual pain was averaged together with the other ten relevant items of the ALSWH survey question to provide a single index of somatic symptoms. A latent profile analysis of the 11 symptom burden items reported in Appendix A showed that existing categories of somatic symptoms are defined by the number of symptoms experienced, rather than the type of symptoms (fatigue, joint, etc.). This finding is consistent with past similar analyses (Kliem et al., 2014; Liu et al., 1997; Rosmalen et al., 2011), and indicates that a total somatic symptom score is a meaningful quantity. Notably, however, gastrointestinal symptoms emerged as a somewhat distinct symptom type that were high in a subgroup (i.e., class) of participants who were relatively low on all other symptoms, and low in a class of participants who were relatively high on other symptoms.

Physiological: Physiological Condition (Wave 5)

Participants were labelled as having (1), as opposed to not having (0), a physiological condition if they indicated that they been 'diagnosed with or treated' for any of the following in the last 12 months: asthma, endometriosis, type 1 diabetes, type 2 diabetes, polycystic ovary

syndrome, a thyroid condition, low iron, or other major physical illness (ALSWH, 2020g; ALSWH, 2020i). Participants who selected only a final response option – 'none of these conditions'– were labelled as not having a physiological condition.

Physiological: Sexual Condition (Wave 5)

Participants were labelled as having (1), as opposed to not having (0), a sexual condition if they indicated that they been 'diagnosed with or treated' for any of the following in the last 12 months: urinary tract infection, thrush or yeast infection, other sexual conditions, chlamydia, gonorrhea, genital herpes, or genital warts (HPV; ALSWH, 2020g; ALSWH, 2020i). Participants who selected only a final response option – 'none of these conditions'– were labelled as not having a sexual condition.

Physiological: Smoking Status (Wave 5)

Smoking status was measured through adapting a variable created by the ALSWH through grouping responses to three questions: '(1) How often do you currently smoke cigarettes or any tobacco products, on a scale from daily to not at all, (2) If you smoke daily, on average how many cigarettes do you smoke EACH DAY, and (3) In your lifetime, would you have smoked at least 100 cigarettes (or equivalent) – yes or no? '. The final categories of smoking status in ALSWH study were (1) never smoked, (2) ex-smoker, (3) smoker < 10 cigarettes per day, (4) smoker 10-19 cigarettes per day, (5) smoker > = 20 cigarettes per day (ALSWH, 2020g; ALSWH, 2020i; Australian institute of Health and Welfare, 2000; Russell & Hall, 2012). In the present study, all participants reporting ever smoking (categories 2-5) were grouped together, as 68% of participants reported never smoking. Thus, in the present study, smoking was a binary variable indicating whether a participant was a current or past smoker: (0) no, and (1) yes.

Physiological: Drug (Cannabis) Use (Wave 5)

Drug use was measured through cannabis use in Wave 5 of the ALSWH. Participants were asked the same question twice, once for recreational use and one for medical use: In the last 12 months, how often did you use marijuana/ cannabis? Options ranged from (1) every day to (6) never (ALSWH, 2020g; ALSWH, 2020i). For the current study, only recreational use was of interest as other medications were not able to be considered. If the participant reported any recreational use in the last 12 months, they were considered to be positive for drug use. As 71% of participants reported never using marijuana/ cannabis recreationally, all participants reporting use ever were grouped together, resulting in two categories: (0) no, and (1) yes.

Physiological: Exercise (Wave 5)

Exercise was measured using standards defined by the Australian Health Survey (ALSWH, 2020c; Australian Bureau of Statistics, 2013; Brown et al., 2012). Under these standards, individuals are categorised as (1) inactive, (2) low, (3) moderate, or (4) high based on their responses to eight questions. Specifically, participants were asked to: 'Please state how many times you did each type of activity in the *last week* - only count activities that lasted for 10 minutes or more': (1) walking briskly, (2) moderate leisure activity, (3) vigorous leisure activity, (4) vigorous household or garden chores. Following this, participants were asked to: 'Please state how much time you spent altogether doing each type of activity *last week* - Add up all the times you spent in each activity to get a total time for each (ALSWH, 2020g; ALSWH, 2020i). This was measured in both hours and minutes (indicating portions an hour), from this the ALSWH created a unique code to assign participants into exercise status groups. In the current study, participants were grouped into one of three categories: low/ inactive, moderate, or high. A dummy-coded version of this variable was created with low/inactive as the reference category.

Physiological: Weight (Wave 5)

In the current study, weight refers to whether a participant is overweight according to the World Health Organization's guidelines for Body Mass Index (BMI; World Health Organization, 2010). According to these guidelines, individuals can be underweight, healthy, overweight, or obese. Participants were asked 'How much do you weigh without clothes or shoes? If you are pregnant now, write in the weight you were in the month prior to pregnancy.' The response option was a blank box labelled 'kgs' (ALSWH, 2020g; ALSWH, 2020i). In the current study, weight was operationalised as a binary variable – (0) underweight or healthy, and (1) overweight or obese. While a simplification, the binary operationalisation is valid in light of the finding that excess weight increases risk of multiple diseases (Australian Institute of Health and Welfare, 2020; Must et al., 1999).

Physiological: Risky Drinker (Wave 5)

Risky drinking status was measured through adapting a variable created by the ALSWH through grouping four questions: '(1) How often do you usually drink alcohol, (2) On a day when you drink alcohol, how many standard drinks do you usually have, (3) How often do you have five or more standard drinks of alcohol on one occasion, (4) How many times would you have had five or more standard drinks of alcohol on one occasion in the last 12 months (ALSWH, 2020g; ALSWH, 2020i)?' The final categories of risky drinking status in ALSWH study were: (1) low long-term risk, but drinks at a short-term risk less than weekly, (2) non-drinker, (3) low long-term risk but drinks at a short-term risk weekly or more, and (4) risky/high drinker, these are in line with Australian government guidelines and classifications (NHMRC, n.d.). In the present study, to create more evenly distributed categories, the (1) and (2) categories were combined, (low long-term risk/ non-drinker), and the (3) and (4) categories were combined,

(low long-term risk but short-term risk weekly or more and risky drinker) resulting in a binary operationalisation of risky drinking: (1) yes, as opposed to not being a classified as a risky drinker (0).

Physiological: Given Birth

Having given birth was assessed through one question in the current study. Participants were asked to answer (1) yes or (0) no to: 'Have you ever given birth (ALSWH, 2020g; ALSWH, 2020i)?' Participants were labelled as having ever given birth (1), as opposed to not having given birth (0).

Psychosocial: Social Support (Wave 5)

Social support was operationalised as the combined score on the Medical Outcomes Study Social Support Scale 6 (MOS-6; Holden et al., 2014; Sherbourne & Stewart, 1991). The MOS-6 measures functional support in a series of 6 questions. They initially came from the Medical Outcome Study with 19 questions on emotional/ informal support, tangible support, affectionate support and positive social interactions. The MOS-6 was designed by the ALSWH as an abbreviated version including two items from the emotional/informational support subscale, two items from the tangible support subscale, one from positive special interactions subscale and one from affectionate support subscale. It was designed to be used in various epidemiological studies and has been shown to have strong reliability and measure global functional social support with the mid-age and young ALSWH cohorts (Holden et al., 2014; Priede et al., 2018; Russell & Smith, 2002). Responses are provided on a scale from (1) none of the time to (5) all of the time, and questions consist of items such as: 'How often is each of the following kind of support available to you if you need it? i.e. Someone to take you to the doctor

if you need it?' The combined score is pre-calculated in the ALSWH database, as calculation involves a series of steps (ALSWH, 2020g; ALSWH, 2020i, Russell & Smith, 2002).

Psychosocial: General Distress (Wave 5)

General distress was measured using the Kessler Psychological Distress Scale (K10) which assesses symptoms of anxiety and depression (Brooks et al., 2006; Clarke et al., 2008; Kessler et al., 2011). Strong association has been demonstrated between a high score on the K10 and a diagnosis of anxiety (Andrews & Slade 2001; Clarke et al., 2008). The K10 has been used in many large-scale and national Australian studies (Australian Bureau of Statistics, 2018; Clarke et al., 2008; Coombs, 2005), and is comprised of 10 items responded to on a scale from (1) none of the time to (5) all of the time, and then averaged. An example of an item is, 'In the past four weeks, about how often did you feel restless or fidgety?' All items pertain to the preceding four weeks (ALSWH, 2020g; ALSWH, 2020i).

Psychosocial: Stress (Wave 5)

Stress was operationalised using an average stress score comprised of 11 questions responded to on a scale from (1) n/a, to (2) not at all stressed, to (6) extremely stressed. An example items was: 'In the last 12 months, how stressed were you over: your own health, your study, your relationships with friends (ALSWH, 2020g; ALSWH, 2020i).' The overall combined mean stress score on this measure has been shown to have internal reliability, as well as external validity reflected in correlations with indices of mental and physical health (Bell et al., 2001). All items pertain to the preceding 12 months.

Psychosocial: Psychological Condition (Wave 5)

Participants were labelled as having (1), as opposed to not having (0), a psychosocial condition if they indicated that they been 'diagnosed with or treated' for any of the following in

the last 12 months: depression, anxiety disorder, post-traumatic stress disorder, anorexia, bulimia, other eating disorder, bipolar disorder, borderline personality disorder, or other major mental illness. (ALSWH, 2020g; ALSWH, 2020i). Answering yes resulted in a yes as the combined score. Participants who selected only a final response option – 'none of these conditions'– were labelled as not having a psychological condition.

Psychosocial: Abuse (Wave 5)

Abuse in the past 12 months was measured using the Composite Abuse Scale (CASC), which was developed as an indicator of involvement in a psychologically or physically abusive relationship (Hegarty et al., 1999; Hegarty & Valpied 2007). The CASC enquires about 21 forms of physical and psychological abuse from a partner, and participants indicate, for each form, whether they experienced it (1) never, (2) in the last 12 months only, (3) more than 12 months ago, or (4) in the last 12 months and more than 12 months ago (ALSWH, 2020g; ALSWH, 2020i). Participants were invited to skip this scale altogether if feeling uncomfortable, so, if a participant responded to only one item with an answer other than 'never', we considered that participant a responder, and recoded the participant's empty responses as 'never'. Next, to obtain an index of abuse over the past 12 months, a count of items to which the participant responded '2' or '4' was computed. A factor analysis was conducted to check that all items (responded to 1-4) loaded on a single factor (see Appendix B; Table B.1 and Figure B.1). The one-factor solution was adequate, meaning that a count of items was valid.

Psychosocial: Self-Harm (Wave 5)

Self-harm was operationalised through a single question, 'Have you deliberately hurt yourself or done anything that you knew might have harmed or killed you?' Response options were: (1) yes, in the last 12 months, (2) yes, more than 12 months ago, (3) never (ALSWH,

2020g; ALSWH, 2020i). Participants answering ‘yes in the last 12 months’ were considered to experience self-harm.

We considered including suicidal thoughts (‘Have you been feeling that life isn’t worth living? Yes/no’) as a predictor, but there was significant overlap between this measure and self-harm in the Wave 5 data, so only self-harm was retained as a predictor. This decision was supported from previous research also showing a strong overlap in the two measures. Previous findings suggest the majority of self-harm does not come from a desire to die, however regardless of motivation, it results in an increased risk of suicidal thoughts, specifically when the action is repeated (Kidger et al., 2012; Paul et al., 2014).

Psychosocial: Self-Esteem (Wave 5)

Self-Esteem was measured using the summed score from the Rosenberg Self-Esteem Scale. The scale consists of 10 questions with an associated response scale from (1) strongly agree to (4) strongly disagree. An example of an item is, ‘I am able to do things as well as most other people’ (ALSWH, 2020g; ALSWH, 2020i). The scale has been shown to have strong construct validity and is widely used to measure self-esteem (Gray-Little et al., 1997; Robins et al., 2001).

Demographics

Demographic characteristics of the sample were considered (see Table 2) and used in multiple imputation (see Analysis below). The measures of considered demographic characteristics are described in Table 3 (ALSWH, 2020g; ALSWH, 2020i).

Table 3

Measures Used for Assessing Sample Demographic Characteristics

Demographic	Question wording and response options	Categories/ response options in current study
Education	What is the highest level of education you have completed? (1) Year 10 or below (2) Year 11 or equivalent (3) Year 12 or equivalent	(1) High school completed
	(4) Certificate I/II (5) Certificate III/ IV (6) Advanced diploma/ diploma,	(2) Vocational
	(7) Bachelor degree	(3) Bachelor degree
	(8) Graduate diploma/ graduate certificate (9) Postgraduate degree	(4) Postgraudate
Healthcare card	Do you have a Health Care Card? This is a card that entitles you to discounts and assistance with medical expenses. This is not the same as a Medicare card. Yes, no	(0) no, (1) yes
Marital status	(1) Married	(1) Married
	(2) De Facto	(2) De Facto
	(3) Separated (4) Divorced (5) Widowed (6) Never married	(3) Single/ Seperated
Age	What is your date of birth?: Free fill date.	21, 22, 23,24,25,26,27,28,29

Analysis

The analysis was carried out in two steps – both involving linear regression. In the first step (assessing relative individual contributions to predictors), the outcome variable – somatic symptom burden – was regressed onto the full set of predictors: psychosocial and physiological. In the second step (assessing combined contributions to psychosocial and physiological predictors), the impact of removing all physiological predictors was assessed by calculating the

R^2 with only the psychosocial predictors in the model. R^2 was then calculated with only the physiological predictors, and the set of variables associated with the largest reduction in R^2 compared to the full model was deemed a stronger predictor of somatic symptoms. In all regressions, missing data on the predictors was imputed in 20 datasets based on the other predictors in Wave 5, the same predictors in Wave 4, and demographics in Wave 5. Notably, not all demographic variables and predictors were available in Wave 4. The Wave 4 variables used are listed in Appendix D.

In all regressions, scores on the outcome variable, continuous predictors, and predictors consisting of counts (abuse) were standardised (transformed into *z*-scores). The relative contributions to different individual predictors in the full model – with all other predictors controlled for – could, therefore, be compared.

Results

Participants

Descriptive statistics for the participants with and without missing data are shown in Table 2. The table additionally shows the results of demographic comparisons between (1) participants with complete data (n = 5,261) and those with partially complete data (that is, missing data on at least one predictor in Wave 5 (n = 3,000), and (2) participants with complete or partially complete data (N = 8,261) and those missing somatic symptom information or all variables in Wave 6. With large sample sizes, group comparisons often yield statistically significant results. Thus, in interpreting these comparisons, the focus should be on effect sizes rather than statistical significance. Since the comparisons involved chi-square analyses and *t*-tests, the relevant effect size metrics are Cramer's V and Cohen's d. According to convention, a Cramer's V of .10 or less indicates a small effect, a Cramer's V of .30 indicates a medium effect,

and a Cramer's *V* greater than or equal to .50 indicates a large effect (Kim, 2017). For Cohen's *d*, the cut-offs for small, medium, and large effects are .20, .50, and .80, respectively (Cohen, 1977; Cohen, 2013; Lakens, 2013). In Table 2, all differences between groups have effect sizes below the cut-off for small, except in two cases for Cramers' V and two cases for Cohen's *d*. Firstly, participants with partially complete data were younger than those with complete data (*d = .242).* Secondly, participants with partially complete data reported lower levels of Social Support than those with complete data (*d* = .369). Furthermore, participants missing the outcome variable or Wave 6 information were less likely to have a bachelor or postgraduate degree than those with complete or partially complete data (*V* = .115). Lastly, participants with partially complete data were less likely to be married than those with complete data (*V* = .239).

Relative Individual Contributions of Psychosocial and Physiological Factors

As described in the Statistical Analysis section in the Method, in the first step of analysis – a multiple regression model with multiple imputation and all psychosocial and physiological predictors included- the relative contributions to all predictor variables – to somatic symptoms – were explored. The coefficients are presented in Table 4, and can be compared across predictors, since continuous predictors and the outcome variable – somatic symptoms – were converted to *z*-scores. The five strongest statistically significant predictors were, in order of size: the K10 Distress Scale *z*-score (*B* = 0.251), whether a physiological condition was reported (*B* = 0.229), stress z-score (*B* = 0.204), whether one is overweight (*B* = 0.134), and whether one has a sexual condition (*B* = 0.134). Appendix C (Table C.1) presents the results of the same linear regression without imputation, and this analysis produced similar results, except in that self-harm emerged as a stronger predictor (*B* = 0.137, as compared to *B* = 0.130 in Table 4). A number of assumption checks were conducted with the non-imputed data, and their results are also reported

in Appendix C. First, normality of residuals was confirmed through visual inspection of a histogram of residuals (Appendix C: Figure C.1). Secondly, it was confirmed that there were no Cook's distances greater than 1, implying lack of influential points within the regression.

Combined Contributions of Psychosocial and Physiological Factors

In the second step, the physiological predictors shown in Table 4 were removed from the regression, and the R^2 was recorded. The R^2 represents the proportion of variance in somatic symptoms accounted for by psychosocial factors alone, and, as can be seen in Table 5, at .297, it is not substantially different to the R^2 for the full model (.328). Nevertheless, the R^2 change from full to psychosocial-only was statistically significant. In the third step, psychosocial predictors were removed from the full model to obtain R^2 representing the contribution to physiological factors. This R^2 (.115) is smaller than the R^2 representing the contribution to psychosocial factors. Similar results were found in a series of regressions using non-imputed data shown in Appendix C (Table C.2). It follows that psychosocial factors account for more variance in future somatic symptom burden.

Table 4

Coefficients and Associated Confidence Intervals in the Linear Regression of Symptom z-Score on Eight Physiological and Seven Psychosocial Predictors with 20 Imputed Datasets

Predictor	Unstandardised coeff. (B)	Std. error of coeff.	p-value	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Phys.: Physiological Condition: Yes (1) vs. No (0)	0.229	0.022	<.001***	0.185	0.273
Phys.: Sexual Condition: Yes (1) vs. No (0)	0.134	0.022	<.001***	0.090	0.177
Phys.: Current or Past Smoker: Yes (1) vs. No (0)	0.112	0.028	<.001***	0.057	0.167
Phys.: Current or Past Drug Use: Yes (1) vs. No (0)	-0.007	0.025	0.789	-0.057	0.043
Phys.: Exercise: Moderate (1) vs. Low/Inactive (0)	-0.054	0.022	.013**	-0.097	-0.12
Phys.: Exercise: High (1) vs. Low/Inactive (0)	-0.062	0.018	<.001***	-0.098	-0.026
Phys.: Overweight: Yes (1) vs. No (0)	0.134	0.023	<.001***	0.090	0.178
Phys.: Risky Drinker: Yes (1) vs. No (0)	-0.009	0.038	0.818	-0.082	0.065
Phys.: Given Birth: Yes (1) vs. No (0)	0.099	0.037	.008**	0.026	0.171
Psych.: Social Support *z*-score	0.023	0.013	0.067	-0.002	0.048
Psych.: General Distress *z*-score	0.251	0.018	<.001***	0.216	0.286
Psych.: Stress	0.204	0.014	<.001***	0.176	0.231
Psych.: Psychological Condition: Yes (1) vs. No (0)	0.045	0.026	0.084	-0.006	0.097
Psych.: Abuse *z*-score	0.097	0.012	<.001***	0.073	0.122
Psych.: Self-Harm: Yes (1) vs. No (0)	0.13	0.025	<.001***	0.080	0.180
Psych.: Self-Esteem *z*-score	-0.003	0.016	0.831	-0.035	0.028

Note. p-value significance is indicated by *** p ≤.001, ** p ≤.01, * p ≤.05.
Phys. = physiological; Psych. = psychosocial

Table 5

R^2 and Significance of R^2 Change When Fitting the Full Model in Table 4, and When Fitting Models with Physiological and Psychosocial Predictors Only

Model	R^2	**Sig. of R^2 change**
Full	.328	-
Physiological only	.115	$p < .001$***
Psychosocial only	.297	$p < .001$***

Discussion

This study assessed the relative longitudinal contributions to physiological and psychosocial factors to somatic symptoms in longitudinal data from a population-representative sample of Australian women. We found that psychosocial predictors accounted for more variance than physiological predictors to future somatic symptoms. The strongest individual predictors were distress (strength of depression and anxiety symptoms), the presence of at least one physiological condition, stress, being overweight, and having a sexual condition.

The strong contribution of the psychosocial predictors is in line with previous research showing anxiety and depression to be associated with higher levels of somatisation (Ormel et al., 1993; Ormel et al., 1994). The current study adds support for further investigation of assessing both psychological and physiological contributors, expanding the research for further exploration on contributors to somatic symptom burden (Kliem et al., 2014; Lieb et al., 2007; Weich & Araya, 2004). Previous research has demonstrated a connection between mental health diagnosis and somatic symptoms, however, the relationship has also been shown to impact in both

directions causing an inability to establish causal direction (Lieb et al., 2007). With psychosocial factors appearing to have a stronger impact on somatic symptoms than previous medical symptoms general practitioners should take the opportunity to look at screening psychosocial factors and addressing these issues along with or prior to necessary medical testing depending on the case. Providing alternative treatments when a medical condition is not found could help to reduce the number of doctor visits, time, and expense.

Independent contributors to somatic symptom burden were shown to be in line with previous findings as the strongest association was demonstrated between distress and somatic symptom burden. In this study distress was measured in terms of strength of depression and anxiety symptoms, through the K10. Depression and anxiety have been shown to correlate with somatic symptoms in numerous studies (Bonvanie et al., 2017; Carroll et al., 2004; Dehoust, 2014; Henningsen, 2003; Jarvik et al., 2005; Lerman et al., 2015; Wilpart et al., 2017). In a study looking at over 10,000 consecutively visiting patients at participating general practitioner offices in Australia the majority of patients with scores showing high anxiety and depression on the K10 also had somatisation (Clarke et al., 2008). Additionally, using an Australian population-based sample Andrews and Slade (2001) show increasing K10 scores to indicate higher probability of meeting criteria for a diagnosis of an anxiety disorder or affective disorder prevalence in either the DSM-5 or the ICD-10. Furthermore, this finding does fall in line with past research showing high levels of anxiety and depression increasing the levels of somatisation (Bonvanie et al., 2017; Clarke et al., 2008; Dehoust, 2014; Henningsen, 2003; Wilpart et al., 2017). In the current study 17% of participants scored 30 or higher on the K10, according to post-hoc calculations not presented in the results, an established threshold for a high likelihood of the participant experiencing depression or anxiety (Andrews & Slade, 2001; Australian Bureau of Statistics,

2012; Clarke et al., 2008). As previously suggested patients may be more likely to present to their general practitioner with complaints of somatic symptoms rather than psychological complaints. Thus, it could be possible that depression and anxiety are remaining undiagnosed while focusing on trying to treat the somatic symptoms (Clarke et al., 2008). Although in this study diagnosis of anxiety or depression was taken into account distress as measured by the K10 made the biggest difference. It is unclear in this study if the participants scoring 30 or above are missing diagnosis in some cases, and there may be merit in trying to further untangle between clinical/ diagnosed anxiety and depression and K10 scores before assessing the contribution of these variables to somatic symptoms.

Furthermore, stress was found to be the third largest contributor overall and the second strongest psychosocial predictor in the current study. Previous research is somewhat conflicted around stress and the impact on awareness on the somatic symptom burden suggesting stress may be a precursor (Cariello et al., 2020), increase somatic symptom burden (Zunhammer et al, 2013), or play the role as a distractor resulting in reduced attention to somatic symptom burden (Burton et al., 2009; van Gils et al., 2014). Further investigation utilizing longitudinal design over a longer period of time may provide further insight into these variances.

Physiological factors were the second, fourth and fifth highest individual contributing factors in the current study in order: reporting a physiological condition diagnosis, classification of being overweight/ obese, and reporting a sexual condition diagnosis. Studies investigating the contribution from multiple physiological variables have been historically underrepresented (Burton et al., 2009; Kliem et al., 2014). There is space for future research as little previous research exists around physiological contributions to somatic symptoms, especially in comparison of psychosocial variables.

Strengths of the Current study

This study benefitted from having a longitudinal design using a large population representative sample (Jasper et al., 2012; Thomas & Locke, 2010). As a rule of thumb 50 + 8 x the number of predictors is a suggested sample size to obtain adequate power (Green, 1991; Tabachnick & Fidell; 2007; Wilson Van Voorhis & Morgan; 2007). In this study these calculations would mean a minimum of 170 participants, which we were well in abundance of. Through researching multiple predictors, the current study had the benefit of exploring potentially unknown risk factors on somatic symptoms allowing for additional insight into future investigation (Kliem et al., 2014).

Limitations of Current Study

Though this study was able to map onto 11 of the PHQ-15, questions having the complete PHQ-15 would have allowed for a more complete analysis. Thus, the full set of PHQ-15 items may be of interest to add in future waves.

Additionally, the number of questions contributing to the physiological and psychosocial variables differs greatly. Participants answered 35 items which contributed to the eight physiological variables and 82 items which contributed to the seven psychosocial variables. Though many of the psychosocial variables were in the form of established measures as seen in the Methods, this disparity of overall questions contributing to the variables may have provided greater support toward the psychosocial predictors accounting for a higher portion of variance. An extra precision of measurement afforded by more items around physiological variables would allow for a more balanced comparison. Additionally, an increase in linked data, like medication, scans, physical assessments on physical aspects would contribute to the strength of physiological predictors would provide further physiological insight. Balancing of contributing items and

analysing linked data would be suggested in future research to ensure the predictors were not impacted due to the imbalance of information.

An additional limitation of this study is the reliance on self-report measures due to the potential for response bias. Previously, over and under reporting has been shown in self-report data with physical activity (Prince et al., 2008). However, shorter recall periods are shown to be more reliable as well as reports from individuals who are healthier, younger and more educated (Short et al., 2009). Measures differ in degree of strength and limitations which can impact accuracy of information suggesting strength in implementing mixed measures information collecting to strengthen reliability and validity (Del Boca & Darkes, 2003).

Future Research

Multiple opportunities exist for further research utilizing existing data in the ALSWH as well as additional data. The latent profile analysis (LPA) shown in Appendix A (Figure A.1) offers some evidence against summing across all somatic symptoms, as notably, gastrointestinal symptoms emerged as a somewhat distinct symptom type that were high in a subgroup (i.e., class) of participants who were relatively low on all other symptoms, and low in a class of participants who were relatively high on other symptoms. In line with previous cross-sectional research, an association was shown between gastrointestinal symptom severity, levels of anxiety, depression, and somatic symptoms, suggesting further investigation utilizing longitudinal data to show direction (Wilpart et al., 2017). Gastrointestinal disease and somatic headaches have also been reported in individuals who had experienced low levels of adverse experiences in childhood (Petruccelli et al., 2019). As suggested by previous research and as shown through the LPA, having an overall symptom burden score may be slightly problematic, separating the somatic

symptom burden may also give further insight to which predictors impact specific somatic symptoms.

As self-report measures were used in this study, further investigation would be made more robust by including formally administered diagnostic testing. Though difficult and potentially costly to obtain, neurobiological assessments of population-based samples to understand depression, anxiety and somatic symptoms co-occurring would provide further insight to the investigation of the connection between individual somatic symptoms and mental disorders (Leib et al., 2007). In line with additional linked data as previously mentioned.

Furthermore, limitations in questions asked in the ALSWH survey do not allow for assessment of somatic symptom causality. Exploring bidirectional relationships between physiological, psychosocial, and somatic symptoms through several waves of questioning in the ALSWH or a similar longitudinal study as well as including various methods of gaining information would help to strengthen the findings. Leib et al. (2007) suggests a bidirectional link between mental disorders and somatic symptoms from findings. Furthermore, having six or more symptoms has been attributed to being an independent predictor of depression and anxiety when looking at over 500 patients reporting to their general practitioner with mainly somatic complaints (Kroenke et al., 1997). The current study did not take into account reporting of somatic symptoms (mapping onto the PHQ-15) in Wave 5 to establish if the somatic symptom burden was reported at the earlier time point as well. Adding further analysis investigating the relationship between psychosocial factors, physiological factors and somatic symptoms over at least six to ten waves would allow for a better picture of potential bidirectionality of the relationship.

The contribution of psychosocial factors in the current study also suggests value in the inclusion of experiences from earlier in life such as trauma and childhood adversity. Though the impact of abuse was considered in the current study, further exploration into childhood experiences should be considered. The questions in the CASC are asked around partner abuse including psychologically and physical abuse. However, previous studies have indicated, women who experienced abuse in childhood later went on to have increased medical costs (Walker, Gelfand et al., 1999; Walker Unutzer et al., 1999). Experiences in childhood and throughout life including sexual abuse, adverse experiences, witnessing domestic violence and household disfunction have all shown to contribute to an increase in future somatic symptom burden (Afari et al., 2014; Anda et al., 2006; Kroska et al., 2018; Paras et al., 2009; Winding & Andersen, 2019). An increase in types of abuse experienced has shown a positive correlation to abuse health outcomes (Walker, Gelfand et al., 1999; Walker Unutzer et al., 1999). Patients presenting with somatic symptoms have been shown to be more likely to have experienced at least one traumatic event at a significantly higher rate than individuals not experiencing somatic symptoms (Aragona et al., 2010). Further consideration of the contribution of various forms of abuse, not just partner could be of interest in future studies lending further insight into the complex dynamic between psychosocial and physiological interactions.

Though there is existing data around experiences in childhood or earlier in life available with the ALSWH, the current study focused more on the last 12 months. Future research could benefit from including data already existing in the ALSWH in the areas of adverse childhood experiences (ACES), and childhood environment (ALSWH, 2020b). The ACES questions use the Adverse Childhood Experiences scale (ACEs) which asks questions regarding experiences and interactions with multiple people in their life including parent or adult, mother, father, an

adult or person 5-years or older than them, or a member of their household. The questions asked in ACEs direct interaction with the participant completing the questionnaire such has: While you were growing up during your first 18 years of life, did an adult or person at least 5 years older ever: 'attempt oral, anal, or vaginal intercourse with you?' – or – while you were growing up during the first 18 years of your life, did you: 'live with anyone who used street drugs (ALSWH, 2020g)?' While the ACEs questions may provide further insight to the prediction of somatic symptoms from previous psychosocial events, a systematic review and meta-analysis looking at ACEs and health outcomes showed ACEs is usually answered retrospectively, years if not decades later. In evaluating previous studies, it was suggested that retrospectively completing the ACEs questions maybe be impacted by how the participant remembers the events as an adult, and that some individuals may not remember the events into adulthood, thus not reporting them (Petuccelli et al, 2019).

Childhood adversity has been shown to be associated with somatisation in adults and attachment insecurity has been shown to mediate the relationship (Maunder et al., 2017). The role attachment plays in somatic symptom burden is something to be considered in line with current investigation, support has shown for various attachment styles throughout life to impact somatic symptom burden (Maunder et al., 2017; McWilliams, 2017; Neumann et al., 2015; Schroeter et al., 2015). Additionally, a systematic review of 27 studies looking at somatic symptoms in children who have a chronically ill family member gives support for a strong correlation between somatization and children with a chronically ill parent. However, mixed results were obtained when it was a sibling who was chronically ill (Elliott et al., 2020). Exploring the relationship of having a chronically ill family member and the impact on somatic symptom is worth exploration, especially in the case of a chronically unwell child's impact on a

parent. Through a meta-analysis and systematic review mothers with children having intellectual disabilities showed significant findings for both anxiety and depression but not somatic symptoms (Rydzewska et al., 2021). Potential exists to either partner with longitudinal studies beginning earlier in life or recruiting younger cohorts to allow for a more complete view of earlier influences.

Furthermore, as this study focused on women, further investigation into experiences unique to women are worthy of investigation. These experiences include pregnancy and pregnancy-related complications. Utilizing existing data in the ALSWH like Reproductive Health (REPH) and Pregnancy, birth, and child (CHLD) data (ALSWH, 2020b; Amiel Castro et al., 2016; Kukulskienė & Žemaitienė, 2022). Though not exclusive to women, the role of domestic responsibility and childrearing on the impact of somatic symptom contribution is worth consideration (Landstedt et al., 2016). As suggested by Ballering et al. (1982), there is a potential association between household responsibilities and increased likelihood of experiencing somatic symptoms. Previous research suggests that women experiencing both a high amount of domestic responsibility and strain from work outside the home experience a likelihood of a double up in the potential to experience somatic symptoms (Krantz & Ostergren, 2001). Suggesting value for further analysis including additional factors inclusive of domestic and other lifestyle factors impact on somatic symptoms. Existing information in the ALSWH in this field includes the home and living arrangements variables (HOME; ALSWH, 2020b). Furthermore, continuing to ensure younger women are recruited and represented in further longitudinal research is important as information gathered from them shows the continued change in reproduction, support, lifestyle, and other trends (Mishra, Loxton et al., 2014).

Though results show stronger prediction for psychosocial contributors to the somatic symptom burden the contribution from physiological is not to be dismissed. A systematic-review and meta-analysis investigating ability of early psychological interventions' ability to prevent and treat somatic symptoms with overall results showing no significant effects were gained on future outcomes (Berezowski et al., 2022). Patients presenting to their general practitioner do so with individual, complex, unique descriptions surrounding what has brought them in for the visit, these stories are influenced every aspect of the person and their life. Due to this dynamic interaction of things affecting the person makes it difficult to determine where causes end and begin (Tylee & Gandhi, 2005). Further research is needed with consideration to suggestions of a biopsychosocial model creating an interplay between the biological (physiological), psychological, and social factors contributing together to impact the burden of somatic symptoms and to support treatment (Gatchel, 2004; Gatchel et al., 2007; Katon et al., 2001; Mangelsdorff, 1989).

Conclusion

The current study significantly adds to the exploration of psychosocial and physiological predictors of future somatic symptom burden. In line with previous research the influence of psychosocial factors on future somatic symptom burden is visible. This and future research have the ability to impact the lives of many individuals and influence efficiency and the strain on the healthcare system. Further insight into causes and contributors to somatic symptoms is provided and can support general practitioner's in more quickly and successfully treating patients reporting with them as well as assessing potential psychosocial causes. A broadening in the understanding of the dynamic contribution of both physiological and psychosocial factors on the somatic symptom burden is presented. There remains significant scope to further explore both

physiological and psychosocial predictors of somatic symptoms as well as their combined interaction with one another.

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Appendix

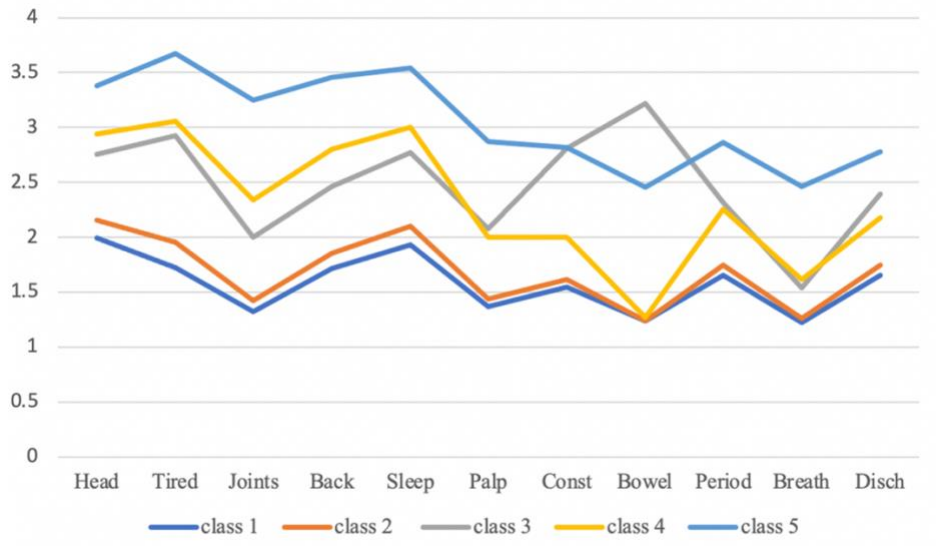
Appendix A: Latent Profile Analysis for the 11 Relevant Somatic Symptom Burden Items

Table A.1: Latent Classes Within Somatic Symptom Burden

Class solutions	AIC	aBIC	BIC
1 class	244,460.62	244,506.80	244,544.93
2 class	231,890.18	231,982.54	232,058.81
3 class	229,112.55	229,251.08	229,365.48
4 class	227,386.34	227,571.05	227,723.58
5 class	226,302.23	226,723.79	226,533.12

Note. AIC = Akaike Information Criterion. aBIC = Sample-size adjusted Bayesian Information Criterion. BIC = Bayesian Information Criterion. Retained five-class solution in bold.

Figure A.1: Average Scores on Each Item Within the Five-Class Solution



Appendix B: Factor Analysis of the CASC Abuse Scale

Table B.1

The Extent to Which Each Item in the CASC Loads on a Single Factor

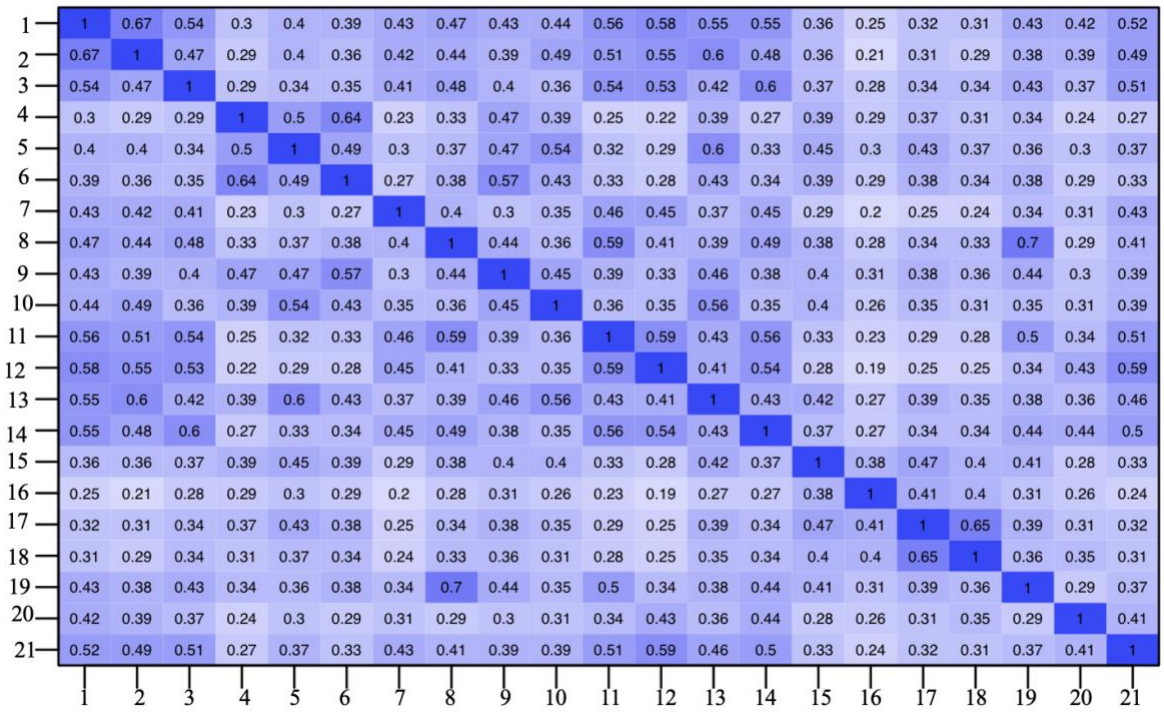
For newly developed scales, the factor loading for every item should exceed 0.5. For an established item, the factor loading for every item should be 0.6 or higher (Awang, 2014). In this factor analysis, there is one loading of 0.4, and the remainder are at 0.5 or higher.

		Wording: My past or current partner…		
			Standardised loading	H^2
1.	CASC132	blamed me for causing their violent behaviour	0.73	0.532
2.	CASC122	pushed, grabbed, shoved, shook or threw me	0.69	0.482
3.	CASC128	tried to turn my family, friends or children against me	0.68	0.461
4.	CASC134	used a knife or gun or other weapon	0.53	0.284
5.	CASC166	beat me up	0.63	0.402
6.	CASC168	threatened to use a knife or gun or other weapon	0.61	0.37
7.	CASC138	forced me to take part in unwanted sexual activity	0.56	0.311
8.	CASC139	followed me or harassed me	0.67	0.448
9.	CASC169	threatened to harm or kill me, my family, children, friends, or pets	0.64	0.415
10.	CASC170	choked me	0.63	0.394
11.	CASC133	harassed me over the telephone, email, Facebook or internet	0.68	0.467
12.	CASC171	told me that I was stupid or crazy, or that I wasn't good enough	0.64	0.413
13.	CASC129	kicked, bit, slapped or hit me with a fist	0.70	0.493
14.	CASC121	tried to keep me from seeing or talking to my family, friends or children	0.69	0.472
15.	CASC172	confined or locked me in a room or other space	0.59	0.347
16.	CASC163	refused to let me work outside the home	0.44	0.193
17.	CASC160	took my wallet and left me stranded	0.57	0.325
18.	CASC174	kept me from my money or credit cards	0.54	0.29
19.	CASC175	followed me or hung around outside my home	0.64	0.408
20.	CASC137	became upset if dinner / housework wasn't done	0.53	0.285
21.	CASC176	told me that I was ugly or that no one would ever want me	0.66	0.437

(ALSWH, 2020g; ALSWH, 2020i)

Figure B.1

Pearson Correlations Between the CASC Items. The numbered items correspond to the items listed in Table B.1.



Appendix C: Linear Regression Using Non-Imputed Data with the Same Predictors as in the Main Analysis and Symptom Z-Score as the Outcome

Table C.1

Coefficients and Associated Confidence Intervals in the Linear Regression of Symptom z-Score on Eight Physiological and Seven Psychosocial Predictors without Data Imputation

Predictor	Unstandardised coeff. (B) Estimate	Std. error of coeff. standard error	p-value	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Phys.: Physiological Condition: Yes (1) vs. No (0)	0.237	0.023	<.001***	0.192	0.283
Phys.: Sexual Condition: Yes (1) vs. No (0)	0.134	0.023	<.001***	0.088	0.179
Phys.: Current or Past Smoker: Yes (1) vs. No (0)	0.117	0.029	<.001***	0.061	0.174
Phys.: Current or Past Drug Use: Yes (1) vs. No (0)	-0.005	0.026	0.851	-0.057	0.047
Phys.: Exercise: Moderate (1) vs. Low/Inactive (0)	-0.079	0.032	.013**	-0.141	-0.017
Phys.: Exercise: High (1) vs. Low/Inactive (0)	-0.085	0.027	.001**	-0.138	-0.033
Phys.: Overweight: Yes (1) vs. No (0)	0.133	0.023	<.001 ***	0.087	0.179
Phys.: Risky Drinker: Yes (1) vs. No (0)	-0.011	0.039	0.772	-0.087	0.064
Phys.: Given Birth: Yes (1) vs. No (0)	0.094	0.038	.014 **	0.019	0.169
Psych.: Social Support *z*-score	0.02	0.013	0.126	-0.006	0.047
Psych.: General Distress *z*-score	0.256	0.019	<.001 ***	0.22	0.293
Psych.: Stress	0.207	0.015	<.001 ***	0.178	0.236
Psych.: Physical Condition: Yes (1) vs. No (0)	0.046	0.027	0.093	-0.008	0.099
Psych.: Abuse *z*-score	0.097	0.013	<.001 ***	0.071	0.122
Psych.: Self-Harm: Yes (1) vs. No (0)	0.137	0.026	<.001 ***	0.085	0.188
Psych.: Self-Esteem *z*-score	-0.004	0.017	0.811	-0.037	0.029

Note. p-value significance is indicated by *** p ≤.001, ** p ≤.01, * p ≤.05.

Phys. = physiological; Psych. = psychosocial

Table C.2

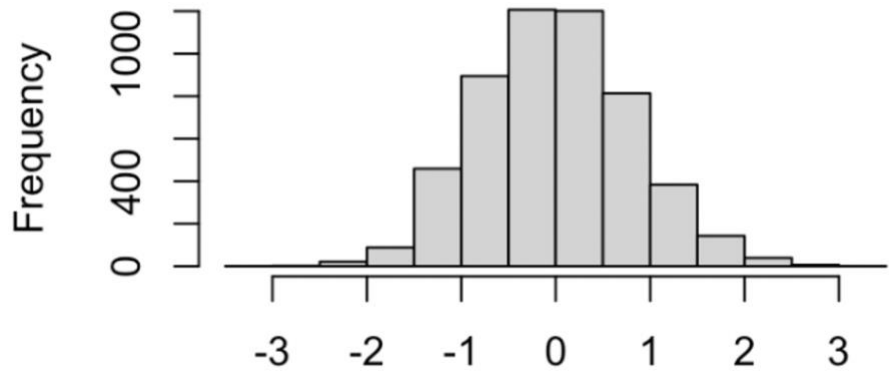
R^2 When Fitting the Full Model in Table C.1, and When Fitting Models with Physiological and Psychosocial Predictors Only

Model	***R*²**
Full	.332
Physiological only	.117
Psychosocial only	.300

*Significance of R2 change could not be calculated because each analysis contained a different number of participants

Figure C.1

Histogram of Residuals for the Regression in Table C.1



Appendix D: Wave 4 Variables Used for Imputation

Variable title in current study	Wave 4 Variable
smoker	smokst
exercise	METMINgrp
BMI/ Weight	BMIGROUP
Risky drinker	alcpatt
Given Birth	no equilivant: REPH132
Distress	k10
Stress	mnstrs
Abuse	CASC136
Abuse	CASC139
Abuse	CASC128
Abuse	CASC129
Abuse	CASC138
Abuse	CASC121
Abuse	CASC122
Abuse	CASC132
Abuse	CASC133
Abuse	CASC134
Abuse	CASC137
Abuse	CASC135

(ALSWH, 2020i)