A cross-sectional cluster analysis of the combined association of physical activity and sleep with sociodemographic and health characteristics in mid-aged and older adults

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A cross-sectional cluster analysis of the combined association of physical activity and sleep with sociodemographic and health characteristics in mid-aged and older adults

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Abstract

Objectives: This study aimed to identify how different patterns of physical activity, sleep duration and sleep quality cluster together, and to examine how the identified clusters differ in terms of socio-demographic and health characteristics.

Study design and outcome measures: Participants were adults from Brisbane, Australia, aged 42-72 years who reported their physical activity, sleep duration, sleep quality, socio-demographic and health characteristics in 2011 (n=5854). Two-step Cluster Analyses were used to identify clusters. Cluster differences in socio-demographic and health characteristics were examined using chi square tests ($p<0.05$).

Results: Four clusters were identified: 'Poor Sleepers' (31.2%), 'Moderate Sleepers' (30.7%), 'Mixed Sleepers/Highly Active' (20.5%), and 'Excellent Sleepers/Mixed Activity' (17.6%). The 'Poor Sleepers' cluster had the highest proportion of participants with less-than-recommended sleep duration and poor sleep quality, had the poorest health characteristics and a high proportion of participants with low physical activity.

Conclusion: Physical activity, sleep duration and sleep quality cluster together in distinct patterns and clusters of poor behaviours are associated with poor health status. Multiple health behaviour change interventions which target both physical activity and sleep should be prioritised to improve health outcomes in mid-aged adults.

Keywords: sleep quality; sleep duration; physical activity; exercise; mental health

1. Introduction

Insufficient physical activity and poor sleep significantly increase the risk of poor physical and mental health and all-cause mortality [1, 2]. Insufficient physical activity is defined as <150 minutes of moderate-to-vigorous intensity activity per week [3], and poor sleep includes sleeping too few hours (<7 hours/night), too many hours (>8 or >9 hours /night depending on age) and/or reporting poor quality sleep [2, 4, 5]. Internationally, the prevalence of insufficient physical activity amongst adults is 23·8% (range 4·1–65·0) [6], and the prevalence of sleeping too few hours, too many hours or reporting poor sleep ranges from 15-30%, 8-17%, and 30%-50% respectively [7-9]. Additionally, it is typically observed that insufficient physical activity increases, and sleep duration and quality decline, as age increases [6, 10].

Although both physical activity and sleep each individually affect health, their combined effects on health have received little attention [11] . Studies frequently indicate there is a positive association between physical activity and sleep quality [12], however, this does not provide insight into the way these behaviours co-occur. For example, active people may report short sleep duration, but the quality of sleep may be better than for less active people who report sleeping for longer, but with poor sleep quality. Given the impact physical activity and sleep have on health and their potential synergistic effects [12, 13], exploring how different patterns of physical activity and sleep co-occur may assist in identifying target populations for multi-behaviour interventions. Wennman et al.[14] identified four distinct profiles that varied in the volume of physical activity, sleep duration and satisfaction with the duration of sleep. However, that study did not specifically assess sleep quality, which has been shown to interact with sleep duration to influence health status [15], nor did it examine differences in health status between identified profiles.

The aims of this study therefore, were to identify: (1) how different patterns of physical activity, sleep duration and sleep quality cluster together; and, (2) how the identified clusters differ by sociodemographic and health characteristics.

2. Methods

2.1. Design and participants

This study used cross-sectional data from the HABITAT Study, a longitudinal, multi-level study examining lifestyle, health and well-being in mid-aged adults in Brisbane, Australia. A full description of the methods is provided elsewhere [16]. In 2007, 17,000 individuals (using electoral roll data, 85 individuals were randomly chosen from each of 200 Census Collection Districts stratified by socio-economic status) aged between 40 and 65 years, were invited to participate in a mail survey biennially. Data from the 2011 survey were used in the current study, as this survey included questions about physical activity, sleep duration and sleep quality. In 2011, the mail survey was sent to 9716 people, 6900 (71%) responded, and 5854 (85%) had complete data for the physical activity and sleep questions which were included in the current analysis. The study was approved by The University of Queensland ethics committee (QUT ID3967H).

2.2. Physical activity and sleep behaviour

Physical activity was measured using the Active Australia Questionnaire (AAQ) which has acceptable test-re-test reliability and validity [17] and assesses time spent in walking, moderate and vigorous intensity activity during the previous 7 days. Consistent with recommended scoring protocols, total weekly physical activity time was calculated as the sum of walking, moderate and vigorous intensity activity (excluding gardening), with vigorous intensity activity weighted by two and the total physical activity time truncated to 1680 minutes [18]. Physical activity was categorised as; inactive (<60 minutes/week), insufficiently active (60-149 minutes/week), meeting activity recommendations (150-300 minutes/week) and exceeding activity recommendations (>300 minutes/week) [3].
Sleep duration was measured by asking how many hours and minutes participants slept (including at night, naps and any other time during the day) on each of a usual weekday and weekend day. Weighted-average sleep duration was calculated as the sum of weekday (x5) and weekend (x2) sleep durations, divided by seven. Sleep duration was subsequently classified as; less than sleep recommendations, meeting sleep recommendations or exceeding sleep recommendations. This

classification used age-appropriate guidelines for adults aged 18-64 years (recommended sleep duration 7-9 hours/day) and adults aged ≥65 years (recommended sleep duration 7-8 hours/day) [4]. Sleep quality was measured by asking the participant to rate sleep quality over the last week using response options of excellent, very good, good, fair or poor. These five options were collapsed into three categories; excellent/very good, good, or fair/poor.

2.3. Sociodemographic and health characteristics

Participants were asked to report their date of birth, gender, height, weight, gross annual household income, education, employment status, occupation, general health, presence of chronic diseases and psychosocial distress. Age in 2011, was calculated from date of birth, and subsequently categorised as ≤54, 55-64, or ≥65 years. Body mass index (BMI) was calculated and categorised as <25, 25-30, or >30 kg/m^2. Gross household income (AUD) was collapsed from 13 into five categories; unknown, <$36,400, $36,400-$72,799, $72,800-$129,999, ≥$130,000. Education was collapsed from 10 into three categories; school-only, vocational (trade, business or apprenticeship)/diploma (associate or undergraduate) or bachelor degree or higher.

Two items were used to create five categories of employment. The first item assessed employment status using 10 response options; full-time, part-time, casual, retired, work without pay, home duties, unemployed, permanently unable to work, student or other. The second item asked for current occupational title. Participants who reported being retired were classified as 'retired' whilst those who reported being either in work without pay, home duties, unemployed, permanently unable to work, student or other, were classified as 'not in the workforce'. Participants who reported being in full-time, part-time or casual employment and who provided an occupational title were classified into the three categories; managers and professionals, white collar or blue collar, using standard classifications [19].

Self-rated health was collapsed from five into three categories; excellent/very good, good or fair/poor. Participants reported if a doctor or nurse had told them they had any of the following chronic conditions; arthritis, asthma, cancer, chronic bronchitis, diabetes, heart disease, hypertension, circulatory conditions (non-heart related), osteoporosis, hypercholesterolaemia, injury and depression. Participants were then categorised as having 0, 1-2 or ≥3 conditions. Psychological distress was assessed using the Kessler 6, a validated six item screening questionnaire [20]. Respondents were categorised as; no distress (0 -7) or distressed (8-24) [20].

2.4. Data analysis

To identify different patterns of physical activity, sleep duration and sleep quality, Two-Step Cluster Analyses were conducted using log-likelihood distance measure and the continuous measures of total minutes of physical activity, average sleep duration and sleep quality. The first analysis allowed the number of clusters to be automatically determined and produced three clusters. The validity of this solution was assessed by conducting three separate Two-Step Cluster Analyses which specified two, four or five clusters. Cluster solutions were compared using Schwarz's Bayesian Criterion (BIC), the silhouette co-efficient and the interpretability of the clusters [21]. Silhouette coefficients range from -1 to +1, with higher values indicating stronger cluster classification [22]. The silhouette co-efficient for all clusters was 0.5. The automatically determined, three cluster solution had a cluster ratio of 2.06 whilst the two, four and five cluster solutions had cluster ratios of 2.93, 1.78 and 4.84 respectively (lower is better). The four-cluster solution was selected as the interpretability of the solution provided clusters that were more distinct from each other. Chi-square tests were used to determine if there were any between cluster differences in physical activity, sleep duration and sleep quality or sociodemographic and health characteristics.

Chi-square analyses were also used to compare the age (≤54 years, ≥55 years), gender, education and physical activity levels of those who completed 2007 only, and both the 2007 and 2011 surveys. (Sleep duration and sleep quality were not assessed in 2007 and so could not be compared with the

2011 survey). Chi-square analyses were employed to compare age (≤54 years, ≥55 years), gender, education and physical activity level, sleep duration and sleep quality between participants who completed the 2011 survey and were either included or excluded from the current analyses due to missing data. The Two-Step Cluster Analyses were conducted using SPSS v23 and all other analyses were conducted using Stata 12.1. Alpha was set at 0.05 for all chi-square analyses.

3. Results

Of the 11, 035 participants who completed the 2007 baseline survey, 6900 (62.5%) also responded to the 2011 survey. Compared to those who only completed the 2007 survey, those who responded to both surveys (2007 and 2011) were significantly more likely to be, in 2007, aged ≥55 years (67.6%), female (64.0%), and to have met physical activity recommendations (65.1%) than those who did not complete the 2011 survey (59.9%, 60.6% and 59.6%, respectively, $p<0.001$). Additionally, they were more likely to be University-educated (67.2% bachelor degree or higher vs 62.2% diploma/vocational and 59.2% school-only, $p<0.001$). Of the 6900 who completed the 2011 survey, 5854 participants were included in this analysis. There were no significant differences in gender, education, sleep duration or sleep quality between those who were excluded (n=1046) or included (n=5854) in the analysis. However, a greater proportion of participants were excluded due to missing physical activity and sleep data who, in 2011, were aged ≤54 (17.7% vs 12.6%, $p<0.001$) and meeting activity recommendations (13.4% vs 11.2%, $p= 0.007$).

Of the 5854 participants included in the analysis, the mean age was 55.9 years (SD 7.1), approximately 60% were female, 34% had a bachelor degree or higher, and 37% reported school-only education (Table 1). Mean BMI was 27.0 (SD 5.3), approximately 17% of participants reported poor health, 23% reported ≥3 chronic health conditions and approximately 14% reported symptoms of psychological distress. More than 38% reported fair/poor sleep quality and almost 30% of participants reported sleep durations outside recommendations. Approximately 40% of participants reported insufficient physical activity.

3.1. Differences between clusters in sleep quality, sleep duration and physical activity

The characteristics of the four clusters are shown in Table 2. These were descriptively labelled according to their dominant features: 1) *Poor Sleepers, 2) Moderate Sleepers, 3) Mixed Sleepers/Highly Active* and 4) *Excellent Sleepers/Mixed Activity*.

The largest cluster (n=1829, 31.2%), *Poor Sleepers*, was characterised by significantly lower sleep quality and sleep duration than all the other groups ($p<0.001$). Participants in this cluster (99.7%) reported fair/poor sleep quality and 42% reported less than recommended sleep duration. Physical activity in this cluster (48% meeting or exceeding guidelines) was significantly lower than the *Mixed Sleepers/Highly Active* cluster (100% meeting or exceeding guidelines) and the *Excellent Sleepers/Mixed Activity* cluster (55% meeting or exceeding guidelines) ($p<0.001$). The second largest cluster (n=1799, 30.7*%), Moderate Sleepers*, was characterised by the largest proportion of participants reporting both good sleep quality (92.8%) and longer than recommended sleep duration (9.1%). This group had the smallest proportion of participants exceeding physical activity recommendations (17.1%). The third largest cluster (n=1198, 20.5%), *Mixed Sleepers/Highly Active*, had the greatest variability in sleep quality (24.5% fair/poor, 28.2% excellent/very good) and sleep duration (20.5% less than recommended, 4.3% more than recommended) and significantly higher physical activity than all the other groups ($p<0.001$), with 100% exceeding recommendations. The smallest cluster (n=1028, 17.6%), *Excellent Sleepers/Mixed Activity,* was characterised by significantly higher sleep quality than all the other groups ($p<0.001$) with 100% reporting very good/excellent. There was a significantly higher proportion (82.4%) with recommended sleep duration than all the other clusters and 55% of people in this cluster reported meeting or exceeding activity recommendations.

3.2. Sociodemographic differences between clusters

There were differences among clusters by gender, socioeconomic status, and employment ($p<0.001$); but not age ($p = 0.159$) (Table 3). The *Mixed Sleepers/Highly Active* cluster included the

highest proportion of men (50.6%), high income (28% ≥$130,000), and the lowest proportion with school-only education (30.0%).

3.3. Health differences between clusters

There were differences among clusters by BMI, general health, number of chronic health conditions and psychological distress (p<0.001) (Table 4). The *Poor Sleepers* cluster was characterised by consistently poor health characteristics including the highest proportion of people with a BMI >30 (28.8%) and reporting fair/poor self-rated health (28.4%), ≥3 chronic health conditions (30.5%) and psychological distress (24.2%).

4. Discussion

This study identified four population clusters which differed in their patterns of physical activity and sleep (quality and duration), and by sociodemographic and health characteristics. The clusters which demonstrated a poorer profile of both physical activity and sleep behaviours also reported poorer health status. This information, together with the knowledge that both physical activity and sleep individually exert strong influences on health and well-being, [1, 9, 23], and may have positive synergistic effects upon each other [12], highlights the importance of examining their joint influences.

The two clusters with the highest proportion of participants were the *Poor Sleepers* (31.2%) and *Moderate Sleepers* (30.7%) groups, which were also the clusters with poorer sleep, physical activity and health profiles. These clusters had the lowest proportions of participants reporting excellent/very good sleep quality, recommended sleep durations, and recommended physical activity levels; and the highest proportions of participants with BMI >30.0, fair/poor self-rated health, ≥3 chronic diseases and psychological distress. This reflects the high prevalence of insufficient physical activity [6], sleep durations outside the recommended times and poor quality sleep [24] amongst the Australian population. These results extend research that indicates unhealthy

lifestyle behaviours tend to co-occur [13], as, to our knowledge, this is the first study to specifically examine how this combination of behaviours cluster together.

Consistent with observations that higher physical activity is associated with improved sleep quality [12], the *Mixed Sleepers/Highly Active* group all exceeded the recommendations for activity and 28.2% reported excellent/very good sleep quality and 75% reported sleep durations within recommended durations. However, this group also included 24.5% who reported fair/poor sleep quality and 20.5% who reported less than recommended sleep duration. This may reflect the variability of sleep duration and sleep quality between individuals [4] or may be related to individuals restricting sleep to participate in activity [25].

Engaging in multiple unhealthy behaviours increases the risk of poor health [11, 23] but little is known about the joint impact of physical activity and sleep on health. This study offers a unique insight into the potential combined influence of these behaviours. Given the well-established health benefits associated with physical activity [1], it may have been anticipated that the *Mixed Sleepers/Highly Active* cluster (of which 100% exceeded activity recommendations) would have the most favourable health profile. However, the *Excellent Sleepers/Mixed Activity* cluster had a moderately better health profile in each health category. The BMI in this cluster was similar to that of the *Mixed Sleepers/Highly Active* cluster which had the best BMI profile, which may be related to individuals engaging in a greater number, or more balanced spread, of behaviours. The less favourable health profile of the *Mixed Sleepers/Highly Active* cluster relative to the *Excellent Sleepers/Mixed Activity* cluster may be related to the higher proportion of men in the *Mixed Sleepers/Highly Active* cluster, who typically have higher morbidity [26]. The two clusters with the worst health profiles, *Poor Sleepers* and *Moderate Sleepers,* had similar proportions of total participants in each activity category. However, the *Poor Sleepers* cluster had a significantly higher proportion reporting fair/poor sleep quality and sleep durations less than recommended. This combination of poor sleep quality and duration was associated with significantly worse general

health, number of chronic health conditions and particularly psychological distress, than all other clusters. This is consistent with previous studies which have observed that shorter sleep durations are associated with both poorer psychological and physical health [27] and that physical activity is associated with improved physical and mental health outcomes [28]. Consequently, individuals may benefit most by engaging in both behaviours in the most optimal way, rather than maximising one behaviour at the expense of the other, and reinforces the need to simultaneously target multiple health behaviours.

The prevalence of unhealthy lifestyle behaviours is known to differ by demographic characteristics [11]. This study found few sociodemographic differences between clusters. Globally, male gender is associated with higher physical activity [29], which is consistent with this study which observed a higher proportion of men in the *Mixed Sleepers/Highly Active* cluster. Globally, there is inconsistent evidence regarding the association between education and income with physical activity [29], however the findings of this study with a higher proportion of high income earners and a lower proportion of school-only education level in the *Mixed Sleepers/Highly Active* cluster, is consistent with Australian data that higher socioeconomic status is associated with higher activity [30]. This study aimed to explore differences in sociodemographic characteristics between clusters to identify population groups that may most benefit from combined physical activity and sleep interventions. Few differences by sociodemographic characteristics were observed which, combined with the relatively high prevalence of poor physical activity and sleep behaviours in all clusters, suggests that interventions targeting these behaviours may not need to be directed towards any particular sociodemographic group.

Limitations of the current study include the cross-sectional nature of the data. In the current study, health status differed by distinct patterns of physical activity and sleep. This has important implications for the inclusion of both of these behaviours in interventions, particularly given the bi-directional relationship between physical activity and sleep [11]. Although self-reported behaviour is

vulnerable to social desirability and recall bias and objective measures can capture some components of sleep quality, such as sleep onset latency and sleep efficiency, perceived sleep quality can only be measured subjectively and still offers valuable insight into the overall experience and the restorative effect of sleep [10]. Additionally, the data did not allow for analysis of differences between groups by ethnicity, however future studies should include ethnicity to further elucidate sociodemographic differences [6].

In conclusion, this study identified distinct clusters of physical activity and sleep behaviour and the clusters that had the most favourable engagement in both physical activity and sleep were associated with the most favourable health characteristics. Of concern, however, was the cluster which included high proportions of both poor physical activity and sleep behaviours and which was associated with poor general health, multiple chronic health conditions and psychological distress. This highlights the importance of behaviour change interventions targeting both physical activity and sleep, for improved health outcomes in mid-to-older aged adults.

Contributors

ATR, MJD, WJB, RCP and NWB conceptualised the study.

ATR conducted the analyses and wrote the first draft of the manuscript.

ATR, MJD, WJB, RCP and NWB contributed to data interpretation and reviewed, edited and approved the final manuscript.

Conflicts of Interest Statement: none

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Table 1.
Self-reported socio-demographic, behavioural and health characteristics of participants included in analyses (n=5854; from the HABITAT study, Brisbane, Australia, 2011).

	%
Age (years)	
≤54	43.9
55-64	42.2
≥65	13.9
Gender, male %	42.6
Gross household income (AUD)	
≥$130, 000	21.3
$72,800 - $129,999	24.9
$36,400 - $72,799	24.2
<$36,400	17.2
Unknown[a]	12.4
Education	
Bachelor degree or higher	34.0
Diploma /vocational	29.1
School-only	36.9
Employment	
Managers and professionals	35.3
White collar	15.5
Blue collar	168
Retired	20.0
Not in the workforce	12.4
Sleep quality	
Very good/excellent	23.5
Good	38.3
Fair/poor	38.2
Age appropriate sleep duration	
Less than recommended	24.3
Recommended	70.5
More than recommended	5.2
Physical activity (weighted minutes/week)	
Inactive (<60)	21.2
Insufficiently active (60-149)	19.6
Meeting activity recommendations (150-300)	22.0
Exceeding activity recommendations (>300)	37.3
BMI (kg/m^2)	
<25	38.7
25-30	37.8
>30	23.6
General health	
Excellent/very good	42.7
Good	40.7
Fair/poor	16.6
No. of chronic health conditions	
No chronic conditions	32.0
1-2 chronic conditions	44.7
≥3 chronic conditions	23.3
Psychological distress (Kessler 6)	
No distress (0-7)	86.1
Distress (8-24)	13.9

Notes: [a] Participants reported 'Don't know' or 'Don't want to answer this'

Table 2.
Comparison of sleep quality, sleep duration and physical activity between the four clusters (n=5854; from the HABITAT study, Brisbane, Australia, 2011).

	Poor Sleepers n=1829	Moderate Sleepers n=1799	Mixed Sleepers /Highly Active n=1198	Excellent Sleepers/ Mixed Activity n=1028	
Behaviours	n (%)	n (%)	n (%)	n (%)	p
Sleep quality					
Fair/poor	1824 (99.7%)	121 (6.7%)	293 (24.5%)	0 (0.0%)	
Good	5 (0.3%)	1669 (92.8%)	567 (47.3%)	0 (0.0%)	
Excellent/very good	0 (0.0%)	9 (0.5%)	338 (28.2%)	1028 (100.0%)	<0.001
Sleep duration					
Less than recommended	768 (42.0%)	297 (16.5%)	245 (20.5%)	115 (11.2%)	
Recommended	1038 (56.8%)	1339 (74.4%)	902 (75.3%)	847 (82.4%)	
More than recommended	23 (1.3%)	163 (9.1%)	51 (4.3%)	66 (6.4%)	<0.001
Physical activity (weighted minutes/week)					
Inactive (<60)	509 (27.8%)	503 (28.0%)	0 (0.0%)	227 (22.1%)	
Insufficiently active (60-149)	448 (24.5%)	461 (25.6%)	0 (0.0%)	236 (23.0%)	
Meeting recommendations (150-300)	460 (25.2%)	527 (29.3%)	0 (0.0%)	299 (29.1%)	
Exceeding recommendations (>300)	412 (22.5%)	308 (17.1%)	1198 (100.0%)	266 (25.9%)	<0.001

Table 3.
Comparison of sociodemographic characteristics between the four clusters (n=5854; from the HABITAT study, Brisbane, Australia, 2011).

	Poor Sleepers n=1829	Moderate Sleepers n=1799	Mixed Sleepers/ Highly Active n=1198	Excellent Sleepers/Mixed Activity n=1028	
Demographics	n (%)	n (%)	n (%)	n (%)	p
Age (years)					
≤54	839 (46.0%)	746 (41.5%)	537 (44.9%)	443 (43.1%)	
55-64	752 (41.2%)	779 (43.4%)	497 (41.6%)	439 (42.7%)	
≥65	234 (12.8%)	271 (15.1%)	131 (13.5%)	146 (14.2%)	0.159
Gender					
Male	769 (42.0%)	730 (40.6%)	605 (50.6%)	386 (37.6%)	
Female	1060 (58.0%)	1068 (59.4%)	591 (49.4%)	642 (62.5%)	<0.001
Household income (AUD)					
≥$130,000	335 (18.8%)	327 (18.7%)	327 (28.0%)	227 (22.6%)	
$72,800 - $129,999	474 (26.5%)	435 (24.9%)	270 (23.1%)	244 (24.3%)	
$36,400 - $72,799	431 (24.1%)	445 (25.5%)	264 (22.6%)	243 (24.2%)	
<$36,400	332 (18.6%)	326 (18.7%)	166 (14.2%)	157 (15.6%)	
Unknown [a]	215 (12.0%)	215 (12.3%)	142 (12.2%)	135 (13.4%)	<0.001
Education					
Bachelor degree or higher	546 (30.6%)	557 (31.9%)	461 (38.7%)	385 (38.2%)	
Diploma /vocational	534 (29.9%)	505 (28.9%)	365 (31.3%)	255 (25.3%)	
School only	704 (39.5%)	686 (39.2%)	349 (30.0%)	367 (36.4%)	<0.001
Employment					
Managers and professionals	593 (35.2%)	555 (33.1%)	420 (37.2%)	360 (37.3%)	
White collar	281 (16.7%)	262 (15.6%)	140 (12.4%)	162 (16.8%)	
Blue collar	284 (16.8%)	297 (17.7%)	190 (16.8%)	146 (15.1%)	
Retired	296 (17.6%)	343 (20.4%)	260 (23.0%)	193 (20.0%)	
Not in workforce	233 (13.8%)	222 (13.2%)	119 (10.5%)	104 (10.8%)	<0.001

Notes: [a] Participant reported 'Don't know' or 'Don't want to answer this'

Table 4.
Comparison of self-reported health characteristics between the four clusters (n=5854; from the HABITAT study, Brisbane, Australia, 2011).

	Poor Sleepers n=1829	Moderate Sleepers n=1799	Mixed Sleepers/ Highly Active n=1198	Excellent Sleepers/ Mixed Activity n=1028	
Health characteristics	n (%)	n (%)	n (%)	n (%)	p
BMI (kg/m^2)					
<25	564 (32.8%)	638 (37.4%)	511 (43.7%)	449 (45.0%)	
25-30	662 (38.4%)	637 (37.4%)	453 (38.7%)	362 (36.3%)	
>30	496 (28.8%)	429 (25.2%)	206 (17.6%)	187 (18.7%)	<0.001
General health					
Excellent/very good	486 (26.7%)	601 (33.5%)	728 (61.0%)	678 (66.1%)	
Good	819 (44.9%)	904 (50.4%)	381 (31.9%)	272 (26.5%)	
Fair/poor	518 (28.4%)	288 (16.1%)	85 (7.1%)	76 (7.4%)	<0.001
No. chronic health conditions					
0 conditions	462 (25.3%)	566 (31.5%)	437 (36.5%)	408 (39.7%)	
1-2 conditions	809 (44.2%)	795 (44.2%)	556 (46.4%)	459 (44.7%)	
≥3 conditions	558 (30.5%)	438 (24.4%)	205 (17.1%)	161 (15.7%)	<0.001
Psychological distress					
No distress	1374 (75.8%)	1572 (88.5%)	1085 (91.3%)	960 (94.1%)	
Distress	439 (24.2%)	205 (11.5%)	104 (8.8%)	60 (5.9%)	<0.001