The association between sedentary leisure and physical activity in middle-aged adults

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ABSTRACT

Aim The aim of this study was to examine the association between time spent in sedentary leisure and physical activity level in mid-aged men and women.

Methods Data were from the 2007 HABITAT study in Brisbane, Australia. A mail survey sent to 17 000 adults (40–65 years) provided 11 037 responses (68.5%), and 9121 (82.6%) were analysed. Sedentary leisure was quantified as hours/day spent sitting watching television, in home computer use, in general leisure, and overall, on a usual week and weekend day. Physical activity level (no activity, low, recommended, high, very high) included walking, moderate and vigorous activity combined into a measure of MET.min/week. Data were analysed separately for men and women using multilevel multinomial logistic regression with adjustment for sociodemographic and health variables.

Results The only significant negative associations were between watching television on a week day and high activity in men (0.91; 0.83–0.98), and home computer use on a weekend day and very high activity in men (0.89; 0.81–0.98). For both men and women, there were significant positive associations between overall sedentary leisure time on a week day and very high activity (men: 1.07, 1.02–1.13; women: 1.10, 1.04–1.16), home computer use on a week day and very high activity (men: 1.11, 1.01–1.22; women: 1.15, 1.04–1.27) and general leisure on a week day and most activity levels.

Conclusions Sedentary leisure is mainly independent of physical activity and does not preclude meeting physical activity recommendations.

INTRODUCTION

The risks associated with physical inactivity are well documented, and include obesity, cardiovascular disease and type II diabetes.[1 2] Cardiovascular and metabolic health may also be compromised by high levels of sedentary behaviour, that is, activities of low energy expenditure (1–1.5 metabolic equivalents) such as sitting. Several prospective studies have shown a positive association between sedentary behaviour and obesity, diabetes, cardiovascular risk biomarkers[3–6] and premature mortality[3 7 8] independent of inactivity.

It could be speculated that people who spend a lot of time in sedentary behaviour also engage in little physical activity. Few researchers have, however, purposively examined this association. Data from the Scottish Health Survey indicated that time spent watching television and in other screen-based entertainment was negatively associated with meeting recommendations of ≥150 min/week of moderate-to-vigorous activity.[9] An Australian study, however, found no significant association between time spent watching television and meeting recommendations.[10] Other studies with a more sensitive measure of activity (ie, multiple categories based on, eg, MET.min/week, time/day) have demonstrated negative associations between watching television and activity.[3 5 11 12]

Few researchers have examined associations between physical activity and sedentary leisure other than watching television. Vandelanotte *et al*[13] reported that leisure time spent in internet/computer use was largely independent of physical activity, although those with low computer use (<3 h/week) were significantly more likely to have high levels of activity (>3 h/week) than non-users. van Uffelen *et al*[14] used a measure of sitting time that encompassed visiting friends, driving, reading and working at a desk/computer, and found inconsistent relationships with activity in women, with slight downward trends in sitting time for low and moderately active women, as well as long sitting times among high active women. This inconsistency was attributed in part to combining occupational and non-occupational sitting time in one measure. Proper *et al*[15] reported a negative association between physical activity and a combined measure of occupational and non-occupational sitting time on both week and weekend days, but no association between physical activity and time spent in sedentary leisure that included computer use, reading, socialising, watching television and riding in a car.

There is some evidence to suggest that patterns of sedentary leisure may differ in men and women. Studies have indicated that men spend more time than women watching television and using a computer,[9 10 16–19] and sitting to relax,[17] whereas women spend more time than men reading and socialising[18 19] and talking on the telephone.[17] Sugiyama *et al*,[11] however, reported a negative association between time spent watching television and physical activity in women, but not in men. It is therefore justifiable for studies in this area to conduct separate analyses for men and women.

The aim of this study was to examine the associations between time spent in sedentary leisure and physical activity level in mid-aged adults, and if there was a negative association between time spent in sedentary leisure and meeting physical activity recommendations. This study builds on and extends previous research by focusing on leisure (vs occupational) sedentary time, assessing several contexts of sedentary leisure (watching television, home computer use, general leisure),

differentiating between week and weekend day sedentary leisure time, using a multicategory (vs dichotomous) measure of physical activity level and conducting separate analyses for men and women. As previous research has demonstrated negative associations between time spent watching television and physical activity,[3 5 11 12] and that men spend more time than women watching television and using a computer,[9 10 16–19] it was hypothesised that among men, there would be negative associations for physical activity with time spent watching television and time spent in home computer use. As weekend days may provide more discretionary time for both sedentary and active leisure than week days, it was also hypothesised that there would be fewer associations between physical activity and sedentary leisure in all contexts on weekend days than week days.

METHOD

Data were collected as part of the 2007 HABITAT (How Areas in Brisbane Influence healTh and AcTivity) study in Brisbane, Australia. This study was awarded ethical clearance by the Queensland University of Technology Human Research Ethics Committee. Survey return was taken as informed consent.

Sample design and data collection

Details on the design, sampling and data collection for HABITAT have been published elsewhere.[20] A multistage probability sampling design was used to select a stratified random sample of 200 (from 1625) Census Collector's Districts (CCDs) in Brisbane, Australia. From within each CCD, a random sample of 85 people aged 40–65 years was selected (N=17 000), using data from the Australian Electoral Commission (registration with the commission is mandatory for Australians ≥18 years of age). A mail survey was administered during May to July 2007 using a method that included advance mail notice, personalised mail, a thank you/reminder notice, resending to non-respondents and a final letter to non-respondents.[21]

Measures

Physical activity level

We used items from the Active Australia Survey to assess time spent in the previous week (1) walking 'continuously for at least 10 min for recreation, exercise, or to get to or from places', (2) doing 'vigorous physical activity which made you breathe harder or puff or pant', such as jogging, cycling and aerobics (excluding household chores, gardening or yardwork) and (3) doing 'moderate physical activities' such as gentle swimming, social tennis and golf (excluding household chores, gardening or yardwork).[22] These items have acceptable levels of reliability and validity in Australian samples[23 24] and have been recommended for use in Australian population-based research.[25] As walking and moderate activity require less energy expenditure than vigorous activity, a weighted measure (MET.min/week) was used to obtain an index of total physical activity level: ((walking minutes×3 METS) + (moderate minutes×3 METS) + (vigorous minutes×7.5 METS)). This was categorised into five levels: no activity (PA<90), low (≥90≤PA <450), recommended (≥450≤PA <900), high (≥900≤PA<1800) and very high (PA≥1800). The recommended category is comparable with recommendations to achieve 5×30 min of moderate intensity activity, or 3×20 min of vigorous intensity activity, to expend 450–750 MET.min/week.[26]

Sedentary leisure time

Respondents indicated the time (hours and minutes) spent sitting on a usual week day and a usual weekend day (A) watching television (including DVDs, videos, video games), (B) using a computer at home and (C) in leisure time (excluding watching television and using a computer, eg, hobbies, reading, dining out). This measure has acceptable levels of reliability and validity for mid-aged Australian adults,[27] and is more detailed than other measures that use simple descriptive categories (eg, all of the time, sometimes), or that do not differentiate among contexts or between weekend and week days. To minimise potential error associated with over-reporting, responses for each sitting context >480 min/day were excluded from the analyses (1–5% of cases in different contexts). This value was chosen as a maximum of 8 h/day in each of the three contexts equals one complete day. Data were converted to hours/day for each context. A measure of overall sedentary leisure time was derived by summing the time across the three contexts, for those cases with complete data on all three contexts.

Sociodemographic and health variables

Questionnaire items were used to assess sex, date of birth, country of birth, level of education completed, household composition, employment status, general health, cigarette smoking status, physical activity restrictions and weight and height (used to derive body mass index (BMI; kg/m^2) and categorised using the WHO classification system[28]).

Analyses

To reflect the multistage sample selection, a multilevel approach was used which allows partitioning error variance in the outcome (physical activity level) across models so that the variance due to clustering is assessed and accounted for in estimating model parameters. A random intercept for CCD was considered in the model to account for clustering within CCDs. Multilevel multinomial logistic regression analyses with random effects were conducted using GLLAMM (generalized linear latent and mixed models) commands of Stata version 10.1 (StataCorp, College Station, Texas, USA). The assumption of parallel regression, essential for ordinal logistic regression, was assessed using the Brant test. The estimation procedure used was numerical integration (10 integration points) with adaptive quadrature in order to obtain more reliable estimates of parameters.[29]

Preliminary analyses indicated that country of birth, household composition and employment status were not significantly associated with physical activity level. These variables were therefore subsequently dropped from the analyses. Separate analyses were conducted for men and women, and models were adjusted for age, general health, BMI, smoking status and education. No activity was the reference category. We report the estimates of association (ORs and 95% CIs) between sedentary leisure time and physical activity level from eight fitted models (four models for women and four models for men).

In addition to estimating and testing the fixed effects of different individual level covariates, we examined the presence of additional variability across CCDs by estimating random intercept models, using a likelihood ratio (LR) test.[30] This LR test with a statistical significant result provides evidence that the likelihood of physical activity level varies from CCD to CCD and introducing a random intercept allows us to account for this unobserved variability in estimating the model parameters.

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RESULTS

Participants

Of the 17 000 people originally sampled, 869 were subsequently identified as ineligible (ie, deceased, living overseas). A total of 11 037 people returned surveys with data (68.4% response rate). Cases were excluded if respondents reported that their health restricted physical activity all or most of the time (n=817), there was no physical activity data (n=341), sitting time in any of the contexts was >480 min/day or sitting time for week day and weekend day pairwise data were not available across three contexts (n=758). This provided 9121 cases (4083 men, 5038 women). The sociodemographic and health profile of the analytic sample is provided in table 1.

Table 1 Sociodemographic and health characteristics of analytic sample

	Males (n=4083)		Females (n=5038)	
	n	%	n	%
Age group (years)[a]				
40–44	992	24	959	19
45–49	947	23	1100	22
50–54	806	20	1072	21
55–59	740	18	972	19
60–64	598	15	935	19
Country of birth				
Australia	2991	74	3836	76
Other	1077	26	1182	24
Highest educational qualification				
School only (up to 12 years)	1231	30	2140	43
Certificate/diploma	1393	34	1315	26
University degree	1448	36	1567	31
Employment status				
Full time paid	3076	75	1975	39
Part time/casual paid	465	11	1682	34
Not in paid work (unemployed, retired, home duties)	532	13	1359	27
Household composition				
Single, living alone	607	15	651	13
Single, living with others	478	12	821	16
Single parent	1045	26	1398	28
Couple, no children	1924	47	2120	42
Couple, with children	607	15	651	13
General health status				
Excellent/very good	1804	44	2503	50
Good	1700	42	1882	38
Fair/poor	559	14	609	12
Body mass index				
<25	1289	32	2485	52
≥25 to <30	1865	47	1408	29
≥30	826	21	906	19
Tobacco smoking status				
Never smoked	702	17	620	12
Ex-smoker	1421	35	1512	30
Current smoker	1927	48	2863	57
Physical activity level (MET.min/week)				
No activity (<90)	540	13	667	13
Low (≥90 to <450)	797	20	1146	23
Recommended (≥450 to <900)	626	15	922	18
High (≥900 to <1800)	892	22	1119	22
Very high (≥1800)	1228	30	1184	24

a, Categorical age data are provided for descriptive purposes but a continuous measure was used in the analyses.

Sedentary leisure time across contexts

The average time spent sitting in each sedentary leisure context and overall is presented in table 2. Both men and women spent approximately 4 h on a week day and 5 h on a weekend day in sedentary leisure. Watching television tended to account for at least half of this time. Time spent in sedentary leisure tended to be higher on a weekend day than on a week day.

Associations between sedentary leisure time and physical activity level

A summary of the results is presented in tables 3–6. A significant Brent test provided evidence of violation of parallel regression assumption, and as such, unordered multinomial logistic regression models were used in the present analyses. None of the LR test results for variance components of random intercepts suggested statistical significance, and as such, the estimated variance components are not presented in the tables.

Overall sedentary leisure

There were significant positive associations between overall time spent in sedentary leisure on a week day and a very high physical activity level for both women and men (table 3). There were no significant associations between overall sedentary leisure time on a weekend day and other levels of physical activity, or between overall sedentary leisure time on a weekend day and physical activity level.

Watching television

There was a significant negative association between time spent watching television on a weekend day and a high physical activity level among men (table 4). There were no significant associations between time spent watching television on a weekend day and physical activity level for women, or between time spent watching television on a week day and physical activity level in men or women.

Home computer use

There were significant positive associations between time spent in home computer use on a week day and a very high physical activity level for both men and women (table 5). There was a significant negative association between time spent in home computer use on a weekend day and a very high physical activity level among men. There were no significant associations between time spent in home computer use on a weekend day and physical activity level in women.

General leisure

There were significant positive associations between time spent in general leisure on a week day and all physical activity levels in men, and all but the recommended activity level in women (table 6). There were no significant associations between time spent in general leisure on a weekend day and physical activity level in men or women.

DISCUSSION

Overall, men and women reported spending approximately 4 h on a usual week day and 5 h on a usual weekend day in sedentary leisure. Watching television tended to account for at least half of this time, with approximately 2.3 h/week day for men and women and 2.7 h/weekend day for women and 3.0 h/weekend day for men. This is comparable with the data from the 2006 Australian Time Use Survey, which indicated that men spent an average of 2.4–2.7 h/day and women 1.7–2.6 h/day watching television.[16] Time use surveys from

Table 2 Observed mean (and 95% CIs) time (hours/day) spent in sedentary leisure on a usual week day and weekend day, for each context and overall, for men and women

	Males		Females	
	Week day	Weekend day	Week day	Weekend day
Overall	3.96 (3.91 to 4.02)	4.93 (4.86 to 4.99)	3.96 (3.91 to 4.02)	4.81 (4.75 to 4.87)
Television	2.32 (2.28 to 2.37)	3.04 (2.99 to 3.10)	2.25 (2.21 to 2.29)	2.70 (2.66 to 2.74)
General leisure	1.24 (1.20 to 1.28)	1.87 (1.82 to 1.92)	1.47 (1.43 to 1.51)	2.12 (2.08 to 2.16)
Home computer use	1.18 (1.13 to 1.22)	1.29 (1.28 to 1.34)	0.94 (0.90 to 0.97)	0.95 (0.92 to 0.99)

Overall mean was derived using cases with complete data from all three contexts.

Table 3 The association (ORs and 95% CIs) between week day and weekend day overall sedentary leisure time and physical activity level

	Men		Women	
	Week day	Weekend day	Week day	Weekend day
No activity	1.00	1.00	1.00	1.00
Low activity	1.00 (0.94 to 1.06)	0.99 (0.94 to 1.04)	1.04 (0.99 to 1.10)	0.98 (0.93 to 1.02)
Recommended	1.02 (0.96 to 1.08)	1.00 (0.95 to 1.06)	1.01 (0.96 to 1.07)	0.99 (0.94 to 1.04)
High activity	1.05 (0.99 to 1.11)	0.97 (0.92 to 1.02)	1.03 (0.97 to 1.09)	1.00 (0.95 to 1.05)
Very high activity	1.07 (1.02 to 1.13)*	0.98 (0.93 to 1.03)	1.10 (1.04 to 1.16)**	0.99 (0.94 to 1.04)

Adjusted for age, current health status, body mass index, smoking status and education.
*p <0.05; **p <0.001.

Table 4 The association (ORs and 95% CIs) between week day and weekend day time spent watching television and physical activity level

	Men		Women	
	Week day	Weekend day	Week day	Weekend day
No activity	1.00	1.00	1.00	1.00
Low activity	0.96 (0.87 to 1.06)	0.95 (0.88 to 1.04)	1.02 (0.94 to 1.12)	0.97 (0.90 to 1.05)
Recommended	0.96 (0.87 to 1.07)	0.99 (0.91 to 1.08)	0.98 (0.90 to 1.08)	0.97 (0.90 to 1.06)
High activity	1.06 (0.96 to 1.16)	0.91 (0.83 to 0.98)*	0.99 (0.91 to 1.09)	0.97 (0.89 to 1.06)
Very high activity	1.05 (0.96 to 1.15)	0.95 (0.87 to 1.02)	1.07 (0.98 to 1.17)	0.98 (0.90 to 1.07)

Adjusted for age, current health status, body mass index, smoking status and education.
*p <0.05.

other countries have also indicated that watching television accounts for at least half of all leisure time.[16 18 19] In our study, time spent in general leisure (eg, hobbies, socialising, reading) (1.2–2.1 h/day) was slightly higher than for home computer use (0.9–1.3 h/day). Data from the UK Time Use Survey indicated that among those aged 45–64 years, men spent approximately 1.9 h/day and women spent 2.2 h/day in social activities, hobbies and reading,[18] and data from the US Time Use Survey indicated that adults aged 55–64 years spent an average of 0.29 h/week day and 0.31 h/weekend day using a computer for leisure.[19] As our measure of home computer use did not specify for leisure only, it may have also included 'work' use, which could account for the longer time in our study. Approximately 13% of men and women (aged 40–64 years) were physically inactive, and 52% of men and 64% of women were categorised as meeting or exceeding physical activity recommendations. One Western Australian survey in 2006 indicated 12.5% of adults aged 45–59 years were inactive, and 61% met or exceeded physical activity recommendations,[31] which is comparable with our results.

Overall, there were few associations between time spent in sedentary leisure and physical activity level. There were no negative associations between time spent in sedentary leisure in any context and meeting physical activity guidelines. Our hypotheses were mostly supported. There was a negative association for time spent watching television and physical activity level among men, although this was only for watching television on a week day and the high activity level. Similarly, there was a negative association between time spent in home computer use and physical activity level among men, although this was only for home computer use on a weekend day and the highest activity level. There was only one significant association between sedentary leisure time on a weekend day and physical activity level – this was for home computer use among men.

Although our results were for men and not women, other researchers have also found a negative association between watching television and physical activity.[3 5 9 11–13 32] We also found a negative association between home computer use on a weekend day and a high activity level among men. Although these results could be interpreted as indicating that watching television and using a computer at home are competing time demands against physical activity for men, it should be emphasised that the negative relationship in our study was only significant at the higher levels of physical activity, comparable to at least 2 h/week of vigorous activity, or 5 h/week walking or moderate intensity activity. This is much higher than recommendations to achieve 3×20 min/week of vigorous intensity activity or 5×30 min/week of moderate activity.[26] Time spent by men watching television or for home computer use is, therefore, not incompatible with meeting activity recommendations. Among women, there was no association between time spent watching television and physical activity level. This may reflect that this type of sedentary leisure is less

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Table 5 The association (ORs and 95% CIs) between week day and weekend day time spent in home computer use and physical activity level

	Men		Women	
	Week day	Weekend day	Week day	Weekend day
No activity	1.00	1.00	1.00	1.00
Low activity	0.95 (0.86 to 1.05)	1.04 (0.94 to 1.15)	1.04 (0.94 to 1.15)	0.91 (0.82 to 1.01)
Recommended	1.05 (0.94 to 1.17)	0.94 (0.85 to 1.05)	1.05 (0.94 to 1.16)	0.92 (0.82 to 1.02)
High activity	1.04 (0.94 to 1.15)	0.91 (0.83 to 1.01)	1.10 (0.99 to 1.22)	0.93 (0.83 to 1.03)
Very high activity	1.11 (1.01 to 1.22)*	0.89 (0.81 to 0.98)*	1.15 (1.04 to 1.27)**	0.91 (0.82 to 1.01)

Adjusted for age, current health status, body mass index, smoking status and education.
*p <0.05; **p <0.01.

Table 6 The association (ORs and 95% CIs) between week day and weekend day time spent in general leisure and physical activity level

	Men		Women	
	Week day	Weekend day	Week day	Weekend day
No activity	1.00	1.00	1.00	1.00
Low activity	1.15 (1.02 to 1.30)*	1.00 (0.91 to 1.10)	1.13 (1.03 to 1.24)*	0.96 (0.88 to 1.04)
Recommended	1.18 (1.04 to 1.34)*	1.03 (0.93 to 1.14)	1.04 (0.94 to 1.16)	1.06 (0.97 to 1.15)
High activity	1.21 (1.08 to 1.37)**	1.02 (0.93 to 1.12)	1.12 (1.02 to 1.24)*	1.04 (0.95 to 1.12)
Very high activity	1.28 (1.14 to 1.44)***	1.04 (0.95 to 1.14)	1.26 (1.15 to 1.39)***	0.99 (0.91 to 1.07)

Adjusted for age, current health status, body mass index, smoking status and education.
*p <0.05; **p <0.01; ***p <0.0001.

common among women than men.[9 10 16 17] Our results contrast those of Hu *et al*[5] and Sugiyama *et al*[11] who found significant inverse associations between watching television and physical activity in women. However, neither of these other studies focused on mid-aged adults.

With one exception, there were no significant associations between weekend sedentary leisure time in any context and physical activity level. This may reflect that men and women have time on weekends to engage in both sedentary and active leisure. Interestingly, our results indicated positive associations for week day time spent in home computer use, time spent in general leisure and overall sedentary leisure, with a very high level of physical activity, comparable with at least 4 h/week of vigorous activity or 10 h/week of moderate intensity activity or walking. This is consistent with other research indicating long sitting times among high active women.[14] It may be that these people have a strong achievement orientation that precipitates a high level of engagement in multiple pursuits – including both sedentary leisure and physical activity. This result challenges assumptions of less discretionary time on week days (because of, eg, work and family/household obligations) and a forced choice between sedentary or active leisure.

There was a positive association between time spent in general leisure on a week day and all levels of physical activity for men, and all but the recommended level for women (which had a positive trend). For every 1-h increase in time spent in general leisure on a week day, there was a 15% increase in the odds of a man being in the low-activity group compared to the no activity group, an 18% increase in the odds of being in the recommended activity group, a 21% increase in the odds of being in the high-activity group and a 28% increase in the odds of being in the very high-activity group. It would seem, therefore, that time spent in general sedentary leisure (eg, hobbies, reading, dining out) does not preclude physical activity participation at any level. This may be because these types of sedentary pursuits are less substantive and more negotiable than other sedentary leisure such as watching television and home computer use.

Methodological considerations

A comparison of the HABITAT respondent sample with census data suggests modest under-representation of those with school-only education, not in the workforce, and living in disadvantaged areas.[33] This under-representation may have influenced our results as these sociodemographic groups have previously been reported as having high levels of sedentary behaviour[3 5 34 35] and low levels of physical activity.[35 36] Self-report data are vulnerable to social desirability bias and measurement error, but pragmatic for large population-based studies. The unstructured nature of sedentary leisure, particularly on weekend days, may make it difficult for respondents to accurately recall the time spent in this type of behaviour. Our previous work indicated a lower level of test–retest reliability and validity for the measure of time spent in general sedentary leisure (ie, hobbies, dining out) than for the other contexts of watching television and home computer use, and for on weekend day than a week day. This study did not include time spent in travel or occupational sitting time, which can make considerable contributions to sedentary behaviour. Time spent in these other contexts was, however, considered to be less discretionary than time spent in sedentary leisure.

In this study, we used a week as the referent period for physical activity so as to be consistent with current activity recommendations, but we used a usual week/weekend day for sedentary leisure. Although we acknowledge that physical activity can vary between week and weekend days, current activity recommendations do not make this distinction and the survey items we used did not provide the data needed for us to examine this. To have a week as the referent period for the sitting time measures, we would need to manipulate the data (eg, usual week day time×5+usual weekend day×2) which would compound reporting errors. As the pattern of associations between sedentary leisure and physical activity differed on week and weekend days, a combined measure of week day and weekend day sedentary leisure time may have obscured associations.

What is already known on this topic

Sedentary behaviour and physical inactivity are health risks. Several studies have demonstrated a negative association between time spent watching television and physical activity, but few studies have examined other types of sedentary leisure.

What this study adds

Sedentary leisure and physical activity are largely unrelated, particularly on weekend days. The only significant negative associations between sedentary leisure and physical activity were for activities well above national recommendations. There were no significant negative associations between sedentary leisure and meeting recommended levels of physical activity.

CONCLUSIONS

Overall, there were only two inverse associations between time spent in sedentary leisure and physical activity level, and these were for the highest level of physical activity, which was markedly higher than the recommended level of activity. Other significant associations between sedentary leisure and physical activity were actually positive. There was only one association between sedentary leisure time on a weekend day and physical activity level. Sedentary leisure should not, therefore, be seen as the competing 'enemy' of physical activity. It is instead a separate and unrelated component of adults' leisure time use. Health promotion interventions could subsequently target time spent in sedentary leisure and time spent in physical activity, without pitting one against the other. By combining messages about recommended levels of physical activity and sedentary behaviour, advocates can contribute to promoting health-enhancing lifestyles across the many contexts of adult life.

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