Building the Evidence—International Approaches

Environmental and Lifestyle Factors Associated With Overweight and Obesity in Perth, Australia

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Abstract

Purpose. *To examine associations between environmental and lifestyle factors and overweight or obesity.*

Design. *A cross-sectional survey and an environmental scan of recreational facilities.*

Setting. *Metropolitan Perth, Western Australia.*

Subjects. *Healthy sedentary workers and homemakers aged 18 to 59 years (n = 1803) living in areas within the top and bottom quintiles of social disadvantage.*

Measures. *Four lifestyle factors, one social environmental factor, and five physical environment factors (three objectively measured).*

Results. *After adjustment for demographic factors and other variables in the model, overweight was associated with living on a highway (odds ratio [OR], 4.24; 95% confidence interval [CI], 1.62–11.09) or streets with no sidewalks or sidewalks on one side only (OR, 1.35; 95% CI, 1.03–1.78) and perceiving no paths within walking distance (OR, 1.42; 95% CI, 1.08–1.86). Poor access to four or more recreational facilities (OR, 1.68; 95% CI, 1.11–2.55) and sidewalks (OR, 1.62; 95% CI, .98–2.68) and perceiving no shop within walking distance (OR, 1.84; 95% CI, 1.01–3.36) were associated with obesity. Conversely, access to a motor vehicle all the time was negatively associated with obesity (OR, .56; 95% CI, .32–.99). Watching 3 or more hours of television daily (ORs, 1.92 and 1.85, respectively) and rating oneself as less active than others (ORs, 1.66 and 4.05, respectively) were associated with both overweight and obesity. After adjustment for individual demographic factors and all other variables in the model, socioeconomic status of area of residence and leisure-time physical activity were not associated with overweight or obesity.*

Conclusion. *Factors that influence overweight and obesity appear to differ, but aspects of the physical environment may be important. Objectively measured neighborhood environment factors warrant further investigation. (Am J Health Promot 2003;18[1]:93–102.)*

Key Words: Obesity, Overweight, Physical Activity, Exercise, Physical Environment, Prevention Research

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This manuscript was submitted September 17, 2002; revisions were requested December 13, 2002; the manuscript was accepted for publication March 4, 2003.

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0890-1171/03/$5.00 + 0

INTRODUCTION

Globally, there is mounting concern about increases in overweight and obesity that have occurred during the last few decades.[1,2] In Australia, about half of adult women and almost two-thirds of adult men are overweight or obese, and there is a clear trend toward increasing prevalence.[3] These trends are similar to those in the United States[4,5] and the United Kingdom.[6,7] There are enormous health and economic implications if this epidemic is not curbed.

Obesity is associated with a range of chronic diseases and disabilities.[1,8] Ignoring indirect costs associated with attendance at weight loss programs, in 1996 it was estimated that in Australia, the health-related costs of obesity were $830 million.[8] Recently, it has been estimated that more than 4% of the total burden of disease in Australia can be attributed to obesity and nearly 7% to physical inactivity.[9] In the United States, the mean estimate for obesity-attributable deaths is just under 0.3 million annually.[10] In England, it is estimated that obesity causes 18 million sick days and 30,000 deaths a year, resulting in 40,000 lost years of working life. In addition, obesity shortens life expectancy by 9 years on average. The estimated financial cost is 0.5 billion pounds sterling a year in treatment costs to the National Health Service and 2 billion pounds a year to the economy.[7]

From an evolutionary perspective, human beings are ill-adapted to the "circumstances of perpetual plenty and physical leisure in modern society.''[11] For example, studies on sedentary leisure-time repeatedly show an association between obesity and time spent watching television in both adults[12–14] and children.[15,16] Moreover, energy expenditure associated with daily living has been declining since industrialization. This decline appears to be associated with the growth in the availability and uptake of labor-saving technologies, declines in the use of public transport, and, more recently, the design of buildings, communities, and appliances.[5] Together these factors increase sedentariness and minimize energy expenditure.

The relationship between diet and physical activity and overweight and obesity is complex and still the subject of investigation. For example, in the United Kingdom, the National Food Survey continues to show a decrease in food intake since the second world war, suggesting that rising body weight may be due to decreasing energy expenditure.[17] In the United States, on the other hand, energy intake continues to rise year after year.[18] These differences may be due to improved dietary assessment procedures adopted in the United States. Nevertheless, the United States,[18,19] like Australia, has developed both nutrition and physical activity guidelines.

Recent reviews on obesity point to the potential contribution of obesogenic environments that promote excessive food consumption and discourage physical activity.[20,21] From a physical activity perspective, obesogenic environments include those with poor access to recreational facilities and infrastructure that discourages incidental activity, walking, and cycling. Thus, recently there has been a growing recognition of the need to rethink the way we design buildings and communities in terms of urban planning, transport, and road networks,[5,22] with a view to encouraging communities to be more active.

Interest in the concept of obesogenic environments is paralleled by interest in the physical activity research literature on real and perceived environmental factors associated with physical activity.[23] Our own research has found that although there is only a weak relationship between access to recreational facilities and physical activity generally,[24] access to a supportive physical environment is strongly associated with walking.[25,26]

Despite the intuitive appeal of the contribution of obesogenic environments to overweight and obesity, there do not appear to be any published studies that explore this relationship. The aim of our study is to examine the association between lifestyle, social environmental, and physical environmental factors (subjectively and objectively measured) and overweight and obesity.

METHODS

The Study of Environmental and Individual Determinants (SEID1) was a social ecological study designed to examine individual, social environment, and physical environment factors associated with leisure-time physical activity.[24] Comprehensive details of the study methods are reported elsewhere.[24,25] The study was conducted in Perth, Western Australia, one of the smaller Australian State capital cities, with a population of approximately 1.2 million. The study also included measures of self-reported height and weight. These variables (together with variables associated with physical activity) were used in the current analyses.

Design

A cross-section of healthy homemakers and workers aged 18 to 59 years (n = 1803) living in a 408-km^2 area of metropolitan Perth participated in face-to-face interviews in their homes between August 1995 and March 1996. The study also included an environmental scan of all formal recreational facilities (n = 219) and public open spaces (n = 516) in the study area. The Australian Bureau of Statistics drew a probability cluster sample from collectors' districts in the top and bottom quintile of social advantage to enable the effect of the socioeconomic status (SES) of place of residence to be examined.[26]

Sample

Households were randomly selected from each collector's district (approximately 200 households) using a skip pattern designed to ensure a probability sample. Trained interviewers randomly selected one eligible person from each household to interview (i.e., if more than one, the person whose birthday fell closest to that day). Because the focus of SEID1 was on correlates of recreational physical activity and use of recreational facilities, the study was restricted to those with no reason not to undertake recreational physical activity or to use recreational facilities (e.g., illness, very active job, and unemployment). After three call backs to each household, a response rate of 52.9% was achieved. Compared with the general population, the age distribution of the sample was similar; however, there were more women and fewer men than expected. In all multivariate analyses, we adjusted for age and sex.

Measures

Items developed specifically for the SEID1 project were assessed for test-retest reliability. Only items with an intraclass coefficient or κ greater than or equal to .60 were included in the main study.

Dependent Variables. The main dependent variables were based on self-reported height and weight,[27] which were used to estimate individual body mass index (BMI). BMI was recoded into two comparison variables: (1) not overweight or obese (BMI $\leq$ 25 kg/m^2) compared with overweight (25 $<$ BMI $\leq$ 30 kg/m^2), and (2) not overweight or obese compared with obese (BMI $>$ 30 kg/m^2) in accordance with the World Health Organization recommendations.[1] Due to the *a priori* hypothesis that factors associated with overweight and obesity may differ, the analyses of overweight subjects excluded those who were obese, and the analyses of obese subjects excluded those who were overweight.

Independent Variables. A subset of variables used in the main study[24] were used for the current analyses. These included five demographic factors (age, sex, education, occupation, SES of area of residence); three lifestyle factors (hours per week spent watching television [recoded to hours per day], recreational physical activity,[27] access to a motor vehicle); one social environmental factors (compared with other people your own age, was the amount of physical activity you did more, less, or the same); and five physical environmental factors (three objectively measured variables, including the type of street in which the respondent lived [i.e., cul-de-sac, highway, or other], whether there were sidewalks [none or on one or both sides of road], and a measure of poor spatial access to four or more recreational facilities [described below]; and two measures of perceptions related to whether there were walking or cycle paths within walking distance or a 5-minute drive from the respondent's residence and a shop within walking distance).

For the physical environmental variables, the interviewers assessed the street in front of the respondent's house to determine access to footpaths and the type of street. Distance between the respondent's home and eight recreational facilities (sport and recreation centers, gyms, golf courses, tennis courts, swimming pools, public open space, and the beach or river foreshores) was measured using Geographic Information Systems. This was used in a spatial access model that adjusted for the desire and the ability of people to overcome spatial separation (i.e., distance or travel time) to access a facility or activity distance.[24] The individual spatial access variables were recoded into quartiles of access (top = 1, bottom = 4). We created a dichotomous variable by counting the number of recreational facilities to which respondents had the poorest access (i.e., they were in the bottom quartile of access) and recoding as follows: 1, poor access to three or fewer of the eight recreational facilities; or 2, poor access to four or more of the eight recreational facilities. Those who had poor access to four or more recreational facilities had the poorest access.

The physical activity items were based on a modified version of items previously used in Australia[28] for which reliability and validity have been assessed. The frequency and total duration of all types of recreational physical activity undertaken in the previous 2 weeks were collected: vigorous activity, light-to-moderate activity, and walking for recreation. In addition, respondents were asked whether they walked for transport, e.g., to or from work or shops. Examples of the type of activity were provided to prompt respondents.[29]

The different types of activity were aggregated by developing a total activity index, independent of body weight, by multiplying time spent in each activity by the average metabolic equivalent (MET) specific to each activity. MET·minutes expresses the intensity of an activity compared with resting energy expenditure. The following formula was used:

$$\text{MET·minutes/week} = \Sigma_i \{(\text{MET})_i d_i f_i\},$$

where $(\text{MET})_i$, d_i, and f_i are, respectively, the MET level, duration in minutes, and frequency per week of the activity.[30,31] MET levels were based on the compendium of activities developed by Ainsworth and colleagues.[30] Vigorous activity was assigned a MET value of 8.0, light-to-moderate activity was assigned a MET of 4.0, walking for recreation was assigned a MET of 3.5, and walking for transport was assigned a MET of 4.0.

Two factors influenced the decision to use an index independent of body weight: (1) the caution by Ainsworth et al.[30] about using kilocalorie scores in correlation analyses, since coefficients may reflect body weight rather than the energy costs of activities; and (2) the fact that public health messages focus on duration, frequency, and intensity of physical activity with no attempt to vary messages for people of different body weight. Moreover, initial analyses demonstrated that using weight-dependent energy expenditure had the potential to misclassify individuals who were active above or below recommended levels of physical activity, depending on how much they weighed.[32,33]

Exercising at high vigorous levels was defined as undertaking at least three 20-minute sessions of vigorous activity each week and expending at least 1680 MET·minutes/week. Moderate physical activity as recommended was defined as the accumulation of at least 30 minutes of moderate daily physical activity[1] and expending 840 MET·minutes/week or more on recreational physical activity (i.e., the equivalent of 30 or more minutes × 7 days × 4 METs). Consistent with other studies and to avoid measurement error caused by overreporting, those reporting energy expenditure of 10,000 MET·minutes/week or more were excluded (n = 30).[28]

Analysis

The analyses were based on 1755 respondents for whom there were no out-of-scope for physical activity (n = 30) or missing data for BMI (n = 18) and were undertaken using SPSS statistical software version 10.[34] Initial cross-tabulations examined unadjusted bivariate associations. The data were then analyzed using a series of unconditional logistic regressions. Demographic variables (age, sex, educational levels, occupation, and area of residence) were included as potential confounding variables in all subsequent multivariate models, as well as behavioral variables (smoking and physical activity). The *a priori* criteria for inclusion in the final parsimonious model were statistical significance ($p < .05$), empirical significance (point estimates at least 20% greater or lower than the reference category), and theoretical importance (variables the literature suggested were important for inclusion regardless of the empirical results).

RESULTS

Overall, 33.5% (n = 588) of those surveyed were either overweight or obese, and 9.2% (n = 161) were obese. Excluding those who were obese, 427 respondents were overweight (Table 1). Table 1 reports unadjusted associations between independent variables and the two dependent variables: overweight (excluding the obese) and obesity (excluding those who were overweight). The unadjusted results are not discussed but are presented for completeness. All variables in Table 1 were entered into the multivariate models presented in Tables 2 and 3.

Overweight

The analyses examining overweight excluded those who were obese (n = 161) and who had missing data (n = 39) (Table 2). After adjustment for sociodemographic and other variables in Table 2, the odds of being overweight were three times higher in men than women and positively associated with age (test for trend $p < .000$). Those with trade or secondary education levels were less likely to be overweight compared with those with tertiary qualifications (odds ratio [OR], 0.67).

Lifestyle factors appeared important. The odds of being overweight nearly doubled in respondents who watched 3 or more hours of television per day compared with those who watched none (OR, 1.92). The odds of being overweight were higher in those who saw themselves as less (OR, 1.66) or equally active (OR, 1.35) as others their own age, compared with those who saw themselves as more active. Nevertheless, participating below recommended levels of leisure-time physical activity was not associated with being overweight after adjustment for other factors.

Those who were overweight were more likely to live on a highway (OR, 4.24) (however, the wide confidence interval [CI] reflects the small number of respondents in this category (95% CI, 1.62–11.09)). Those who were overweight were also more likely to live in a street with no sidewalks or sidewalks on one side of the street only (combined OR, 1.35; 95% CI, 1.03–1.78) and to perceive there was no walking or cycle paths within walking distance (OR, 1.42). The SES of the respondent's area of residence was not associated with being overweight. Moreover, poor spatial access to recreational facilities and perceived access to a shop were not significant and were not included in the final model.

Obesity

The analyses examining obesity excluded those who were overweight

Table 1

Demographic, Individual and Social and Physical Environmental Factors Associated With Overweight and Obesity

Variable	No. of Subjects (n = 1594)	% Overweight†	No. of Subjects (n = 1328)	% Obese‡
Age (y)				
18–29	433	19.6	372	6.5
30–39	460	27.6	376	11.4
40–49	417	28.3	356	15.0
50–59	284	34.2	224	16.5
		***		***
Sex				
Female	1069	20.4	955	12.5
Male	523	39.8	351	11.0
		***		
Education				
Tertiary	449	28.5	341	5.9
Diploma/certificate	366	25.1	308	11.0
Trade/secondary	467	22.9	398	9.5
Subsecondary	307	31.9	277	24.5
		*		***
Occupation				
Blue collar	185	35.7	133	10.5
White collar	423	26.0	349	10.3
Paraprofessional/professional	383	28.5	297	7.7
Home duties	388	25.3	366	20.8
Other	215	20.5	183	6.5
		*		***
Socioeconomic status of area of residence				
High	828	25.4	691	9.4
Low	738	28.3	637	15.1
				**
Type of street				
Cul-de-sac	225	21.8	207	15.0
Other	1343	27.3	1105	11.6
Highway	23	47.8	14	14.3
		*		
Sidewalks in street				
Both sides	521	25.0	420	6.9
One side	532	27.6	448	14.1
None	541	27.7	460	15.0
				***
No. of recreational facilities to which respondent had poor spatial access				
≤3	1237	26.5	1007	9.7
≥4	357	27.7	321	19.6
				***
Walking or cycle paths perceived within walking distance or a 5-min drive				
Available	1149	24.7	969	10.7
Not available	445	32.1	359	15.9
		**		*
Perceive shop within walking distance				
Yes	1439	26.3	1196	11.4
No	107	32.7	92	21.7
				**

Table 1

Continued

Variable	No. of Subjects (n = 1594)	% Overweight†	No. of Subjects (n = 1328)	% Obese‡
Current smoker				
Yes	350	27.4	296	14.2
No	1243	26.5	1032	11.5
Leisure-time physical activity				
High vigorous levels	250	25.2	202	7.4
Moderate as recommended	712	27.7	573	10.2
Below recommended	632	26.4	546	14.8
				*
Hours per day spent watching television				
<3	1426	25.0	1192	10.3
≥3	168	41.7	136	27.9
		***		***
Access to motor vehicle				
No	162	26.5	153	22.2
Yes, sometimes	129	25.6	108	11.1
Yes, always	1285	26.8	1054	10.8
				***
Compared with other people your age, is amount of physical activity you do:				
More	576	24.7	465	6.7
Same	584	25.9	483	10.4
Less	405	30.1	359	21.2
				***

† Excludes obese.
‡ Excludes overweight.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

(n = 427) and who had missing data (n = 78) (Table 3). After adjustment for other factors, obesity was positively associated with age (test for trend $p = .000$), and the odds were nearly three times higher in those only achieving subsecondary education compared with tertiary educated respondents (OR, 2.71). Men were 65% more likely to be obese than women, but this sex influence was not as high as in overweight respondents.

The odds of being obese were 4.05 times higher in those who perceived themselves as less active than other people their own age compared with those who perceived themselves as more active. Obesity was positively associated with hours spent watching television (test for trend $p = .002$) but not with leisure-time physical activity or smoking. After adjustment for other factors, those who always had access to a motor vehicle were about half as likely to be obese as those who never had access to a motor vehicle (OR, 0.56).

Those who were obese were nearly twice as likely as others to perceive that there was no shop within walking distance (OR, 1.84). Using more objective measures of the physical environment, those who had poor access to four or more recreational facilities were 68% more likely to be obese compared with others. Finally, compared with those living in streets with sidewalks on both sides of the street, the odds of being obese were higher in respondents living in streets with no sidewalk or a sidewalk on one side of the street only (combined OR, 1.62), although chance could not be ruled out for this latter result (95% CI, .98–2.68; $p = .059$).

DISCUSSION

The level of overweight and obesity in the current study was somewhat lower than other studies in Australia[8] and overseas,[7,18] reflecting the population we surveyed, which was healthy and aged 18 to 59 years. However, even in this healthy, somewhat younger population, one in three adults was overweight or obese, and nearly one in 10 was obese, reflecting the trend observed in the wider population.

Our results confirmed previous studies in terms of the home environment, in that sedentary pursuits, such as television viewing, are strongly associated with both overweight and obesity, particularly if television is watched for 3 or more hours per day. However, the work environment may also be important, particularly since increased use of technology minimizes energy expenditure at work (e.g., use of computers and elevators or escalators rather than stairs). We made no attempt to examine time spent at the computer (at home or at work) or other relevant sedentary behaviors (e.g., video games). Future studies might consider their inclusion. Given current international trends toward longer working hours in developed countries,[35] those in sedentary occupations who also have a sedentary lifestyle may be at particular risk of becoming overweight or obese.

Ellaway and colleagues[36] in Glasgow found that area of residence was associated with overweight and obesity. After adjusting for other variables, our study showed no evidence of this when comparing healthy working populations living in the top and bottom quartiles of SES. Nevertheless, in the population studied, the quality of the physical environment appeared important. Respondents with poor access to sidewalks (even on one side of the street) were more likely to be overweight and obese (although for obesity this did not reach statistical significance). Similarly, those living in areas more deprived of recreational facilities, regardless of the SES of the geographic area, were also more likely to be obese. Macintyre and colleagues[37] found that disadvantaged neighborhoods in Glasgow had poorer access to recreational facilities than advantaged neighborhoods, although we did not replicate this in Perth, which has a relatively high standard of living by national and international standards.[25]

Perceptions of the physical environment have been shown to be associated with physical activity.[26,38,39] In the West of Scotland, those who reported more negative features of their local neighborhood (i.e., more litter, graffiti, vandalism) were also less likely than others to report going for a 2-mile walk in their local neighborhood in the last year (Anne Ellaway, personal communication, July 2002). We found that those who perceived there to be no walking or cycle paths within walking distance or a 5-minute drive were more likely to be overweight and those who perceived no shop within walking distance were more likely to be obese. It is possible that those not predisposed to being physically active simply do not notice local facilities to which they can walk. Moreover, individuals may self-select environments that support a preferred lifestyle. In this article, it was not possible to validate perceptions of the environment or examine self-selection. Future studies need to explore the association between objectively measured environmental variables and these conditions[40] and also to consider issues of self-selection.

It is often said that sedentary lifestyles, including those associated with increasing motor dependence, decrease walking, cycling, and public transport,[41] which in turn, may contribute to levels of overweight and obesity.[42] However, we found no evidence of this in our study, highlighting the complexity of the relationship between the environment and behavior. Even after adjusting for demographic factors, individual SES, and SES of area of residence, those who had access to a motor vehicle all the time were, in fact, less likely to be obese (although they were no more likely to exercise as recommended; data not shown). This is counterintuitive, given the current

Table 2

Odds Ratios From Logistic Regression Associating Individual, Social Environmental, and Physical Environmental Factors With Overweight*

	Logistic Regression Odds Ratios			
Correlate†	**Single-Factor Model**	**Adjusted for Age and Sex**	**Adjusted for All Other Variables**	**95% Confidence Interval Final Model**
Age				
18–29	1.00	1.00	1.00	
30–39	1.70	1.80	1.73	1.21–2.46
40–49	1.84	1.84	1.91	1.31–2.77
50–59	2.21	2.71	2.19	1.47–3.25
Education				
Tertiary	1.00	1.00	1.00	
Diploma/certificate	0.83	0.96	0.76	0.53–1.08
Trade/secondary	0.71	0.85	0.67	0.47–0.96
Subsecondary	0.99	1.36	0.97	0.65–1.45
Occupation				
Blue collar	1.00	1.00	1.00	
White collar	0.61	0.88	0.98	0.65–1.49
Paraprofessional/professional	0.71	0.80	0.82	0.52–1.28
Home duties	0.60	1.03	0.93	0.59–1.47
Other	0.46	0.66	0.75	0.45–1.24
Sex				
Female	1.00	1.00	1.00	
Male	2.59	2.71	3.12	2.36–4.12
Current smoker				
Yes	1.00	1.00	1.00	
No	0.94	0.88	1.02	0.76–1.37
Access to motor vehicle				
No	1.00	1.00	§	
Yes, sometimes	0.71	0.70		
Yes, always	0.85	0.74		
Hours per day spent watching television				
<3	1.00	1.00	1.00	
≥3	2.18	2.21	1.92	1.33–2.79
Leisure-time physical activity				
As recommended	1.00	1.00	1.00	0.67–1.40
Below recommended	0.97	1.01	0.80	0.61–1.04
Compared with other people your age, is amount of physical activity you do:				
More	1.00	1.00	1.00	
Same	1.09	1.32	1.35	1.01–1.80
Less	1.33	1.71	1.66	1.19–2.31
Socioeconomic status of area of residence‡				
High	1.00	1.00	1.00	
Low	1.13	1.16	1.03	0.78–1.35
Type of street where respondent lives‡				
Cul-de-sac	1.00	1.00	1.00	
Other	1.39	1.32	1.43	0.97–2.11
Highway	3.37	3.77	4.24	1.62–11.09

Table 2

Continued

Correlate†	Logistic Regression Odds Ratios: Single-Factor Model	Adjusted for Age and Sex	Adjusted for All Other Variables	95% Confidence Interval Final Model
Sidewalks in street‡				
Both sides	1.00	1.00	1.00	
One side	1.17	1.20	1.32	0.98–1.79
None	1.15	1.21	1.40	1.01–1.95
Perceive walking or cycle paths perceived within walking distance or a 5-min drive				
Available	1.00	1.00	1.00	
Not available	1.43	1.53	1.42	1.08–1.86
Perceive shop within walking distance				
Yes	1.00	1.00	§	
No	1.41	1.18		
No. of recreational facilities to which respondent had poor spatial access				
≤3	1.00	1.00	§	
≥4	1.06	1.11		

* n = 1555. Excludes obese (n = 161) and missing (n = 39).
† First category is reference category.
‡ Objective measure.
§ Not included in the final model because not statistically significant.

hypotheses that motor vehicle dependency contributes to the global epidemic of overweight and obesity, and requires further exploration in future research. However, the finding is consistent with findings elsewhere. For example, in the Scottish Health Survey 1998 more desirable waist-hip ratio was associated with car access even after controlling for age, sex, and social class (Anne Ellaway, personal communication, July 2002). Clearly, car ownership is a proxy for SES, and the relationship between car ownership and BMI deserves further examination. Future studies might consider examining car use rather than simply car access.

These findings provide some preliminary support for the concept of an obesogenic environment.[20] The relationship between physical environmental factors and overweight and obesity warrant further investigation because subtle shifts in behavior may produce important population effects. According to James,[42] in the United Kingdom between 1970 and 1990, incidental energy expenditure associated with activities of daily living declined by 800 kcal/d. Although energy intake appeared to decline by 750 kcal/d during this period, mean weight increased by 2.5 kg. James concluded that subtle shifts in incidental activities without sufficient compensatory declines in food intake may explain the secular trends in overweight. Thus, a reduction in incidental activities, such as regular short walks for errands, may play a role in upsetting the energy balance. For this reason, assessing environmental factors that contribute to inactivity may be important.

Limitations

This study has a number of limitations. Perth, Western Australia, enjoys a high standard of living, and the physical environment is homogenous compared with other Australian cities and by international standards. The modest response rate limits the generalizability of these findings but is similar to other cross-sectional population-based studies.[39] In addition, the age profile of the sample matched the general population. We used self-reported height and weight and physical activity levels. Although self-reported height and weight have been shown to be reliable,[43] there is evidence that those who are overweight underestimate their weight.[44] Moreover, there are measurement problems associated with self-reported physical activity,[45] and those who are overweight may overestimate the intensity of their activity. We tried to overcome this latter problem by providing concrete examples of each type of activity (e.g., for vigorous activity the examples included were football, netball, athletics, jogging, aerobics, and vigorous swimming).[29]

The cross-sectional study design and the potential for self-selection limit our ability to draw causal inferences. The study design combined with measuring self-reported physical activity in the last 2 weeks may account for the lack of association between leisure-time physical activity and weight status. In a cohort study, Kronenberg and colleagues[12] asked how many months respondents had engaged in different types of activity during the last year and found a strong relationship between leisure-time physical activity and BMI. Although weight loss attributable to increased physical activity appears to be small,[46] longitudinal studies have demonstrated that a high baseline physical activity and an increase in activity are both inversely related to weight gain.[47] Thus, the results related to leisure-time physical activity and BMI are counterintuitive but have been found elsewhere.[48] Timperio and colleagues[43] found that, at any one time, half of the population is trying to lose or maintain weight. Consistent with this finding, we found that half of the respondents surveyed were doing more or less physical activity than they usually do. In addition, overweight and obesity were associated with doing more or less rather than reporting a consistent exercise habit. In the current study, we used a cross-sectional design and collected self-reported physical activity in the previous 2 weeks. Together, these are limitations to our study that may have contributed to the results.

Our study did not cover the full range of neighborhoods in Perth, because it included only areas in the top and bottom quintile of social advantage. Also, because the study aimed to examine the role of recreational facilities in influencing recreational physical activity, major confounding variables that might affect participation in leisure-time physical activity (e.g., unemployment, very active occupation, illness) were controlled for in the design. Thus, the study subjects represented the working well living in high and low SES areas. This also limits the extent to which the results can be generalized.

Conclusion

Our findings provide preliminary support for the concept of an obesogenic environment. Poor access to a supportive physical environment that encourages physical activity may contribute to overweight and obesity. It is recommended that future studies objectively measure a wider range of environmental factors that are hypothesized to be important.

SO WHAT? Implications for Health Promotion Practitioners and Researchers

This study provides preliminary support for the concept of an obesogenic environment in younger, healthy, working adult populations. It may be that poor access to a supportive physical environment that encourages incidental and planned physical activity may contribute to overweight and obesity. There are a number of implications for researchers. Future studies should include a wider range of objectively measured environmental factors that are hypothesized to be important, and these should be studied in the general population. The extent to which individuals self-select physical environments that support a preferred active or sedentary lifestyle warrants investigation. Finally, the complex relationship between car ownership and BMI deserves further examination. In particular, future studies might consider examining car use rather than car ownership.

Table 3

Odds Ratios From Logistic Regression Associating Individual, Social Environmental, and Physical Environmental Factors With Obesity*

	Logistic Regression Odds Ratios			
Correlate†	Single-Factor Model	Adjusted for Age and Sex	Adjusted for All Other Variables	95% Confidence Interval Final Model
Age (y)				
18–29	1.00	1.00	1.00	
30–39	1.90	1.88	2.07	1.14–3.74
40–49	2.77	2.76	3.47	1.91–6.29
50–59	2.89	2.87	2.89	1.51–5.48
Education				
Tertiary	1.00	1.00	1.00	
Diploma/certificate	2.06	2.09	1.61	0.85–3.05
Trade/secondary	1.73	2.01	1.19	0.61–2.33
Subsecondary	5.39	5.51	2.71	1.37–5.33
Occupation				
Blue collar	1.00	1.00	1.00	
White collar	0.99	1.04	1.48	0.70–3.10
Paraprofessional/professional	0.72	0.67	1.64	0.72–3.73
Home duties	2.23	2.38	2.46	1.19–5.10
Other	0.60	0.85	1.20	0.50–3.15
Sex				
Female	1.00	1.00	1.00	
Male	0.85	0.91	1.65	1.02–2.68
Current smoker				
Yes	1.00	1.00	1.00	
No	0.79	0.69	1.11	0.71–1.74
Access to motor vehicle				
No	1.00	1.00	1.00	
Yes, sometimes	0.45	0.40	0.64	0.28–1.47
Yes, always	0.43	0.33	0.56	0.32–0.99
Hours per day spent watching television				
<3	1.00	1.00	1.00	
≥ 3	3.43	3.49	1.85	1.13–3.04
Leisure-time physical activity				
As recommended	1.00	1.00	1.00	
Below recommended	1.52	1.51	0.94	0.63–1.41
Compared with other people your age, is amount of physical activity you do:				
More	1.00	1.00	1.00	
Same	1.66	1.73	1.52	0.91–2.55
Less	3.90	4.76	4.05	2.39–6.85
Socioeconomic status of area of residence‡				
High	1.00	1.00	1.00	
Low	1.71	2.16	1.45	0.94–2.23
Type of street where respondent lives‡				
Cul-de-sac	1.00	1.00	§	
Other	0.75	0.79		
Highway	0.97	1.24		

sion viewing, body fat, and physical fitness. *Am J Health Promot.* 1998;12:363–368.

Table 3

Continued

Correlate†	Logistic Regression Odds Ratios: Single-Factor Model	Adjusted for Age and Sex	Adjusted for All Other Variables	95% Confidence Interval Final Model
Sidewalks in street‡				
Both sides	1.00	1.00	1.00	
One side	2.21	2.08	1.57	0.92–2.69
None	2.40	2.20	1.69	0.97–2.94
Perceive walking or cycle paths perceived within walking distance or a 5-min drive				
Available	1.00	1.00	§	
Not available	1.59	1.60		
Perceive shop within walking distance				
Yes	1.00	1.00	1.00	
No	2.20	2.05	1.84	1.01–3.36
No. of recreational facilities to which respondent had poor spatial access				
≤3	1.00	1.00	1.00	
≥4	2.29	2.30	1.68	1.11–2.55

* n = 1250. Excludes overweight (n = 427) and missing (n = 78).
† First category is reference category.
‡ Objective measure.
§ Not included in the final model because not statistically significant.

Acknowledgments

This research was supported by the Western Australian Health Promotion Foundation. The idea for the study was developed while the principal author was a visiting scholar at the Social and Public Health Unit, University of Glasgow, Glasgow, Scotland. The authors acknowledge helpful advice from Dr. Anna Timperio, now from Deakin University. Thanks to Professor Annie Anderson and Anne Ellaway (MRC Social and Public Health Sciences Unit, Glasgow, Scotland) and Dr. Jo McFarlane, who assisted with writing the manuscript.

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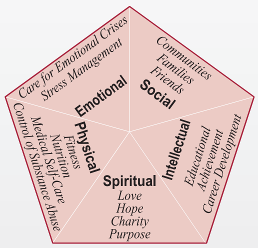

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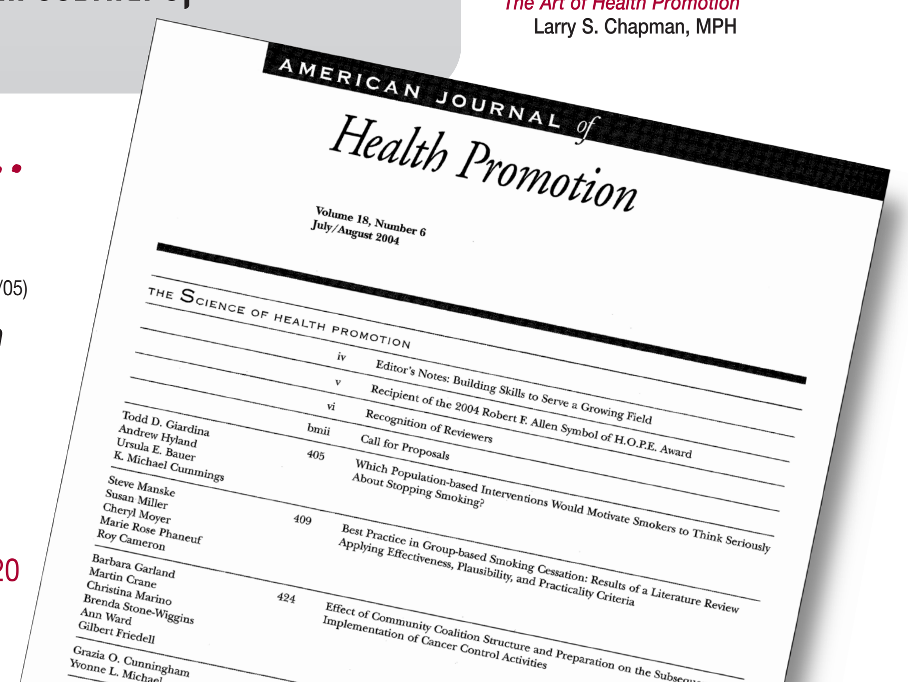
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Volume 18, Number 6
July/August 2004

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