

A Cross-Sectional Survey of Physical Activity Among Middle Aged Women in Singapore

T W Lee, W B Khor, N W H Tan, C L Cheng, A Seow, S C Foo

ABSTRACT

Objectives: To assess the extent to which middle-aged women in Singapore engage in physical activity of a level which would result in long-term health benefits, and to determine the factors associated with this.

Methods: We conducted a cross-sectional survey of women aged between 35 and 60 years residing in Marine Terrace. A standardised questionnaire incorporating a modified Seven-Day Recall Questionnaire was used to record the level and type of physical activity engaged in over the past week. Demographic information and factors promoting or discouraging sports and exercise were also elicited. The total energy expenditure for household, occupational and sports activities of moderate intensity and above was calculated using metabolic equivalents (METs) in kcal/kg/week.

Results: Of the 341 respondents, 50.7% reported engaging in at least moderate activity for 30 minutes or more every day during the past week, thus fulfilling the WHO recommendations on physical activity. Housework contributed significantly to the energy expenditure on these activities among our target population. After adjusting for age, body mass index and educational level, we found that housewives without domestic help were most likely to fulfill the WHO recommendations. Housewives or working women with domestic help were the two groups at highest risk of low physical activity. A lack of time was the reason most commonly cited for not engaging in sports or exercise.

Conclusion: Studies assessing physical activity in relation to disease risk among women should include domestic work in addition to the traditional leisure-time activities. There is a scope for further efforts to improve the level of activity in this population, which could be facilitated by the support of health professionals, employers and family members.

Keywords: community-based, prevalence survey, females, demographic profile, physical activity, Singapore

BACKGROUND

Chronic degenerative diseases such as cancer, cardiovascular disease and diabetes mellitus are

responsible for a major proportion of morbidity and mortality among Singaporeans^(1,2). It is widely recognised that lifestyle and environmental factors play an important role in the aetiology of many of these. Among the modifiable risk factors investigated, physical activity has demonstrated a fairly consistent association with risk of colon cancer⁽³⁾, cardiovascular disease⁽⁴⁾, Type II diabetes mellitus⁽⁵⁾, osteoporosis⁽⁶⁾ and mental health^(7,8).

The mechanism by which physical activity is thought to reduce risk of disease varies; in the case of colon cancer, increased activity is thought to shorten bowel transit time and thus reduce the exposure of the colonic mucosa to mutagens⁽³⁾. Cardioprotective effects, on the other hand, have been shown to be related to a reduction in risk factors such as body habitus and plasma fibrinogen level^(9,10). Physical activity may protect against the development of Type II diabetes mellitus by helping to maintain a proper lean-to-fat balance with respect to body mass⁽⁵⁾. Physical activity has been associated with higher bone mineral density among perimenopausal women, suggesting a beneficial role in reducing risk of osteoporosis⁽⁶⁾.

A shortcoming of many of the older studies on physical activity is their inclusion of exercise and leisure time physical activity only, without considering other forms of energy expenditure, such as housework and childcare. Greendale et al, in the Post-menopausal Estrogen/Progestin Intervention (PEPI) study⁽¹¹⁾, showed that higher home-related activity is associated with a favourable fibrinogen, insulin and HDL-C profile, hence reducing cardiac risk. Based on this, he commented that omission of household and occupational physical activity from self-reported scale of activity may be an important source of misclassification.

Other studies^(9,12) have shown that higher levels of total physical activity are also associated beneficially with health indicators like cardiorespiratory fitness, skin fold thickness, chronic heart disease risk factors and HDL/LDL ratio.

At the 1994 World Health Organisation (WHO) and International Federation of Sports Medicine meeting on Health Promotion and Physical Activity⁽¹³⁾, a joint committee, recognising

Department of Community,
Occupational and Family
Medicine
National University of Singapore
Lower Kent Ridge Road
Singapore 119260

T W Lee
Medical Undergraduate

W B Khor
Medical Undergraduate

N W H Tan
Medical Undergraduate

C L Cheng
Medical Undergraduate

A Seow
Assistant Professor

S C Foo
Associate Professor

Correspondence to:
Dr A Seow

the importance of total physical activity, and not just exercise, to health, made recommendations to encourage this. Specifically, the WHO recommends that adults should be encouraged to increase habitual activity gradually, culminating in at least 30 minutes of physical activity of moderate intensity every day. Examples of moderate activity include brisk walking, housework and stair-climbing. More strenuous activity such as slow jogging, cycling, fields and court games (soccer, tennis, etc.) and swimming can provide additional benefits. It was also recommended that women, in particular, should preferably be offered a variety of opportunities to engage in healthy exercise.

In Singapore, middle-aged women have been shown to have a low level of sports participation⁽¹⁴⁾ and are generally assumed to lead sedentary lifestyles. However, in our local context, a significant part of their total energy expenditure may consist of activities other than exercise, such as housework, child care and occupational activities. Since these women will form a significant proportion of the elderly after the turn of the century, it is important to understand their level of physical activity in all its different aspects, so that appropriate advice may be given at the individual and community level. To our knowledge, there has not been any previous study describing the level of total physical activity among women in Singapore.

The objectives of our study were to:

1. Assess the extent to which our study population fulfills the WHO recommendations adequately and describe the type of physical activity commonly engaged in.
2. Identify risk factors for low physical activity.
3. Identify factors that promote or discourage exercise.

For the purpose of this study, physical activity is defined as any event that requires energy expenditure and encompasses recreational, occupational and household activity.

METHOD

Study design

Our study design was that of a cross-sectional survey, based on a standardised, structured interviewer-administered questionnaire. Our target population consisted of all females aged 35 – 60 at the time of our study; living in Marine Terrace, a Housing and Development Board estate located in eastern Singapore, and consisting of 5,816 housing units. The survey proper was conducted over 3 days from 10 to 12 January 1998.

From the sampling frame of 5,816 household units, a single-stage random cluster sampling was performed using the Epistat programme to select 1,200 household units. The sample size was chosen to allow for a household eligibility rate of 42% and a further 40% non-participation rate. The selected

units were distributed amongst 15 pairs of trained interviewers.

Survey instrument

Our questionnaire elicited information on the respondents' demographic data, health status, social factors, individual perception of fitness, the measurement of height and weight and physical activity.

In our study, we recognised the need to assess both the regularity and quantity of physical activity to present a more accurate picture. Fulfillment of the WHO recommendations was taken as a measure of regularity, while the Seven-Day Recall Questionnaire (7DRQ) originally used in the Stanford Five Cities Project⁽¹⁵⁾ was adapted for use in our study to quantify and categorise respondents' level of total physical activity. This instrument has the advantage of measuring all aspects of physical activity: occupational, household and leisure time activities and has been shown to have a good agreement with the Seven Day Physical Activity Diary⁽¹⁶⁾. In addition, it can be administered within 20 minutes and the unit of measurement (kilocalories/kg) could be used for comparison with other studies. The time frame is a compromise between short-term and long-term recall to ensure a balance between accuracy and representativeness.

Using the 7DRQ, respondents were required to recall their activities over the past 7 days, weekends and weekdays considered separately. Firstly respondents were specifically asked for the number of hours spent on sleep. Then a list of activities (classified as household, occupational and sports) categorised by intensity into moderate, hard and very hard was provided⁽¹⁷⁻²⁰⁾. Certain activities in the original 7DRQ were replaced with others unique to our local female population. For example, *qi gong* and *tai chi* were included as activities of moderate intensity⁽²⁰⁾.

Interviewers assisted the subjects in listing their activities in each category, and subsequently quantifying the time spent on each activity during the past week. To minimise subjectivity on the interviewers' part, guidelines were established for rounding off the duration to the nearest half-hour. The questionnaire only required the recording of sleep, moderate, hard and very hard activities. Time spent on light activities was subsequently obtained by subtraction. The sum of the number of hours spent on the different classes of activities was computed and the total energy expenditure was calculated.

The respondents' fulfillment of the WHO recommendations was determined by the following 2 questions:

1. Looking at the list of activities, does the time spent doing all these activities add up to more than half an hour on any one day?
2. If so, on how many days in a week does this happen?

Subjects who reported at least half an hour of activity of moderate or greater intensity for all days of the week were considered to have fulfilled the WHO recommendations for the purpose of our study.

Table I – Demographic characteristics and BMI of survey respondents

Characteristic	Percent of *		
	Respondents (n = 341)	Eligible women (n = 522)	
<u>Age (years)</u>			Chi-square test: p = 0.44
35 – 39	19.9 (68)	19.9 (104)	
40 – 44	16.4 (56)	20.5 (107)	
45 – 49	18.8 (64)	18.4 (96)	
50 – 54	18.5 (63)	19.4 (101)	
55 – 60	26.4 (90)	21.8 (114)	
<u>Ethnic group</u>			Chi-square test: p = 0.82
Chinese	73.6 (251)	74.5 (389)	
Malay	16.4 (56)	15.9 (83)	
Indian/Pakistani/Ceylonese	6.5 (22)	7.1 (37)	
Others	3.5 (12)	2.5 (13)	
<u>Type of housing</u>			Chi-square test: p = 0.90
2-room flat	18.2 (62)	16.3 (85)	
3-room flat	36.9 (126)	37.4 (195)	
4-room flat	19.1 (65)	19.3 (101)	
5-room flat	25.8 (88)	27.0 (141)	
<u>Highest educational level attained</u>			
Lower than PSLE	24.3 (83)		
PSLE	18.8 (64)		
O-levels	37.2 (127)		
A-levels and above	19.7 (67)		
<u>Per capita income (\$) **</u>			
0 – 500	34.9 (119)		
501 – 1000	36.7 (125)		
1001 – 1500	10.6 (36)		
1501 – 2000	9.7 (33)		
2001 and above	8.2 (28)		
<u>Occupation</u>			
Professional/Managerial	16.7 (57)		
Clerical/Sales/Services	21.4 (73)		
Production/Unskilled worker	8.2 (28)		
Housewife	48.7 (166)		
Others	5.0 (17)		
<u>Level of domestic help</u>			
Full-time domestic help	19.1 (65)		
No full-time domestic help	80.9 (276)		
<u>Marital Status</u>			
Married	78.3 (267)		
Single	13.8 (47)		
Divorced	3.8 (13)		
Widowed	4.1 (14)		
<u>BMI (kg/m²)</u>			
< 20.0	14.7 (50)		
20.0 to < 25.0	51.6 (176)		
25.0 to < 30.0	25.5 (87)		
30.0 and above	8.2 (28)		
Total	100.0 (341)		

* Number of women in parenthesis

** Total household income/total number of family members

BMI : Body Mass Index

Data analysis

Data was entered into a computer, verified and analysed using the SPSS® software. Bivariate analysis was carried out to determine the association between fulfillment of WHO recommendations and various predictor variables. The predictor variables in our study included ethnic group, age, housing type, highest level of education attained, per capita income, occupation, level of domestic help, combined occupational/domestic help status and body mass index (BMI). Prevalence rate ratios (the relative likelihood of fulfilling the WHO recommendations) and the chi-square test were utilised to determine the relationship between these predictor variables and the likelihood of a woman fulfilling WHO recommendations for physical activity.

Since bivariate analysis does not take into account the potential confounding effect of other variables, we further estimated the prevalence rate ratios with adjustment for confounding. Stepwise regression using the proportional hazards model, a multivariate model, was adopted⁽²¹⁾ as this allowed us to compute directly the adjusted prevalence rate ratios for the independent predictors retained in the final model.

The Mann-Whitney U test, a non-parametric test, was used to determine if the difference in median energy expenditure between those who fulfilled the WHO recommendations and those who did not was statistically significant.

RESULTS

Of the 1,200 households canvassed, we encountered 548 eligible households (containing at least one woman between the ages of 35 and 60) and of these, 338 agreed to participate, giving a household participation rate of 62%. Within the participating households, 343 (95%) out of a total of 361 eligible women responded. However the final sample population comprised only 341 individuals as two participants were considered extreme outliers and were excluded. One was a baker who had an atypically high total energy expenditure because of increased baking during the Chinese New Year period. The other subject, in addition to having an extremely high body mass index (BMI), was depressed, compromising her response reliability.

Table I shows the distribution of respondents by demographic characteristics and BMI. The age, ethnicity and housing type of non-respondents were found not to differ significantly from the respondents.

Among our respondents, about half (43.1%) had fewer than 10 years of education, while the remainder had completed O-levels or above. More than 70% of respondents reported a monthly per capita income of SGD1000 or less. Almost half (48.7%) of the sampled population were housewives. Fewer than one-fifth (19.1%) had full-time domestic help (for example, live-in maids)

while the majority had part-time or no domestic help. More than 75% (78.3%) of the respondents were married while the remainder were divorced, widowed or single. The majority (51.6%) of the sampled population fell into the normal BMI range of 20.0 – 25.0. [BMI = weight (kg)/height² (m²)]. BMI < 20.0: underweight; 20.0 < BMI < 25.0: normal weight; 25.0 ≤ BMI < 30.0: overweight; BMI ≥ 30.0: obese) (Table I).

When we asked the respondents to compare the intensity of their activities over the past seven days with that of the past three months, we found that most (78%) of the participants reported the same level of intensity of activities. The rest were divided equally between those who felt that their activities in the last week were higher (11%) and lower (11%) in intensity compared to the last three months. This suggests that on the whole, the intensity of activities captured in the seven-day recall at the time of the survey was fairly representative of the intensity of activities of the survey population as a whole for the past three months.

Fulfillment of WHO recommendations

We used the fulfillment of WHO recommendations as a measure of regular physical activity. From our survey, about half (50.7%, 95% confidence interval: 45.4% – 56.0%) of our respondents fulfilled the WHO recommendations.

Table II shows the associations between the demographic variables, BMI and the fulfillment of WHO recommendations.

We observed an increase in the likelihood of fulfillment of WHO recommendations with age until the age of 54 years beyond which this likelihood decreased. Women in the 50 to 54-year age group were 1.5 times more likely to fulfill the WHO recommendations compared to women in the 35 to 39-year age group. This trend for the 35 to 54-year age group was statistically significant (Chi-square test for trend: $p = 0.014$).

With the population's increasing socioeconomic status, as measured by highest educational level attained, housing type and per capita income, women were less likely to fulfill WHO recommendations. These trends are statistically significant (Chi-square test for trend: $p < 0.05$ for all three covariates). For example, women with A-level qualifications and above were only half as likely to fulfill the WHO recommendations compared to women with PSLE or lower qualifications.

Housewives were 1.4 times more likely than working women to meet WHO recommendations and this difference was statistically significant ($p = 0.001$). Women without full-time domestic help were 1.5 times more likely to fulfill the WHO recommendations as women with full-time domestic help ($p = 0.006$). When occupational and domestic help status were combined as a single variable, we observed that housewives without full-time domestic help had the highest likelihood of regular physical activity and housewives with full-time domestic help, the lowest. The prevalence rate ratios

for working women were intermediate ($p < 0.01$).

We found that the likelihood of a woman fulfilling the WHO recommendation increased with BMI. This trend was statistically significant (Chi-square test for trend: $p = 0.017$). Women with a BMI of 30.0 kg/m² and higher were 1.7 times more likely to fulfill the WHO recommendation compared to women with BMI of less than 20.0 kg/m².

We used multivariate analysis to determine which of these covariates were independent predictors of regular physical activity, and to obtain adjusted rate ratios for these variables. In our modelling procedure, covariates which were significantly associated with the fulfillment of the WHO recommendations like highest educational level attained, combined occupational/domestic help status and biologically important variables like age and BMI were entered into the multivariate model. As socioeconomic indicators like highest educational level attained, housing type and per capita income were highly correlated, only educational level was chosen to represent socioeconomic status.

Of the four variables entered, the model containing only occupational and domestic help status was shown to fit the data adequately (chi-square for goodness of fit, $p < 0.05$). The adjusted prevalence rate ratios did not differ from the unadjusted prevalence rate ratios (Table II). We conclude that this variable was an independent predictor of regular physical activity in our study population.

Energy expenditure

The quantitative measurement of total physical activity used in our study was total energy expenditure based on the 7DRQ. The median total energy expenditure of the respondents was 253.3 kcal per kg per week. (P₂₅ 241.9, P₇₅ 281.5 kcal/kg/week). The median total energy expenditure for those who fulfilled the WHO recommendations was significantly higher than those who did not (Table III).

We sought to characterise the distribution of energy expenditure for activities of moderate intensity and above into housework, occupation and sports. It is important to note that housework contributed more than half (56.3%) of the energy expenditure for activities of moderate intensity and above (Fig 1) performed by our respondents in the previous week.

Women who fulfilled WHO recommendations spent, on average, 8 hours on housework of moderate intensity or above per week (Table III). In contrast, women who did not fulfill WHO recommendations only spent 3.5 hours per week, on average. The median energy expenditures also differed accordingly (Fig 2). The distribution of energy and time expended on sports or occupational activities in both these groups was too skewed to allow us to compute meaningful average measures. For example, only 17.3% of respondents engaged in occupational activities which were of

Table II – Associations between demographic variables, BMI and fulfillment of WHO recommendations

Covariate	WHO Recommendations Fulfilled	WHO Recommendations Not fulfilled	Unadjusted prevalence rate ratio* (95% CI)	Adjusted prevalence rate ratio** (95% CI)
<u>Ethnic group</u>				
Chinese	48.2 (121)	51.8 (130)	1.00	
Malay	57.1 (32)	42.9 (24)	1.19 (0.91 – 1.54)	
Indian/Pakistani/Ceylonese	63.6 (14)	36.4 (8)	1.32 (0.94 – 1.86)	
Others	50.0 (6)	50.0 (6)	1.08 (0.58 – 1.85)	
<u>Age (years)</u>				
35 – 39	41.2 (28)	58.8 (40)	1.00	
40 – 44	44.6 (25)	55.4 (31)	1.08 (0.72 – 1.63)	
45 – 49	56.3 (36)	43.8 (28)	1.37 (0.96 – 1.95)	
50 – 54	60.3 (38)	39.7 (25)	1.47 (1.04 – 2.07)	
55 – 60	51.1 (46)	48.9 (44)	1.24 (0.88 – 1.76)	
<u>Highest educational level attained</u>				
Lower than PSLE	60.2 (50)	39.8 (33)	1.00	
PSLE	62.5 (40)	37.5 (24)	1.04 (0.80 – 1.34)	
O levels	49.6 (63)	50.4 (64)	0.82 (0.64 – 1.06)	
A levels and above	29.9 (20)	70.1 (47)	0.50 (0.33 – 0.74)	
<u>Type of housing</u>				
2-room flat	56.5 (35)	43.5 (27)	1.00	
3-room flat	54.8 (69)	45.2 (57)	0.97 (0.74 – 1.27)	
4-room flat	53.8 (35)	46.2 (30)	0.85 (0.70 – 1.31)	
5-room flat	38.6 (34)	61.4 (54)	0.68 (0.49 – 0.96)	
<u>Per capita income (\$)</u>				
0 – 500	57.1 (68)	42.9 (51)	1.00	
501 – 1000	51.2 (64)	48.8 (61)	0.90 (0.71 – 1.13)	
1001 – 1500	50.0 (18)	50.0 (18)	0.88 (0.61 – 1.26)	
1501 – 2000	45.5 (15)	54.5 (18)	0.80 (0.53 – 1.19)	
2001 and above	28.6 (8)	71.4 (20)	0.50 (0.27 – 0.92)	
<u>Occupation</u>				
Working women	42.3 (74)	57.7 (101)	1.00	
Housewives	59.6 (99)	40.4 (67)	1.41 (1.41 – 1.75)	
<u>Level of domestic help</u>				
Full-time domestic help	35.4 (23)	64.6 (42)	1.00	
No full-time domestic help	54.3 (150)	45.7 (126)	1.54 (1.09 – 2.17)	
<u>Occupational and domestic help status</u>				
Housewives without full-time domestic help	65.0 (91)	35.0 (49)	1.00	1.00
Housewives with full-time domestic help	30.8 (8)	69.2 (18)	0.47 (0.26 – 0.85)	0.47 (0.23 – 0.98)
Working women without full-time domestic help	43.4 (59)	56.6 (77)	0.67 (0.53 – 0.84)	0.67 (0.48 – 0.93)
Working women with full-time domestic help	38.5 (15)	61.5 (24)	0.59 (0.39 – 0.90)	0.59 (0.34 – 1.02)
<u>BMI (kg/m²)</u>				
< 20.0	38.0 (19)	62.0 (31)	1.00	
20.0 to < 25.0	50.0 (88)	50.0 (88)	1.32 (0.90 – 1.93)	
25.0 < 30.0	55.2 (48)	44.8 (39)	1.45 (0.97 – 2.17)	
30.0 and above	64.3 (18)	35.7 (10)	1.69 (1.08 – 2.65)	

* Prevalence rate ratio is the relative likelihood of fulfilling the WHO recommendations.

** Adjusted prevalence rate ratio is the relative likelihood of fulfilling the WHO recommendations adjusted for the remaining variables.

CI : Confidence Interval

BMI : Body Mass Index

Table III – Distribution of energy expenditure and total time spent on housework according to WHO recommendation fulfillment among respondents

	WHO recommendation fulfilled	WHO recommendation not fulfilled	Mann-Whitney U test
Median total energy expenditure in kcal per kg per week (P ₂₅ , P ₇₅)	263.0 (249.6, 308.1)	245.6 (235.9, 257.5)	p < 0.01
<u>Housework</u>			
Median energy expenditure on housework activities of moderate intensity and above in kcal per kg per week (P ₂₅ , P ₇₅)	33.0 (22.0, 59.5)	16.0 (8.0, 25.0)	p < 0.01
Median total time spent on housework activities of moderate intensity and above in hours per week (P ₂₅ , P ₇₅)	8.0 (5.0, 14.3)	3.5 (2.0, 6.0)	p < 0.01

(P₂₅, P₇₅) : 25th percentile, 75th percentile

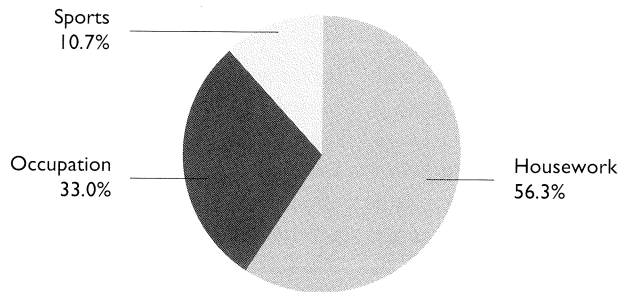


Fig 1 – Proportion of energy expenditure per week spent on activities of moderate intensity and above.

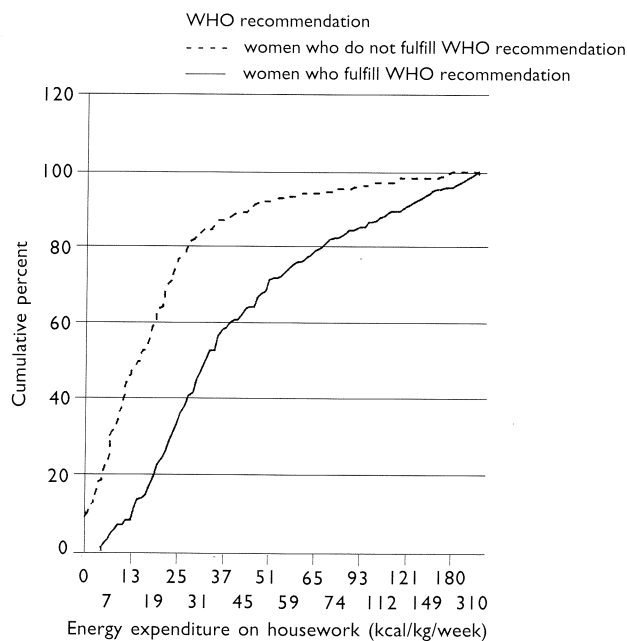


Fig 2 – Cumulative frequency curve of energy expenditure on housework activities of moderate intensity and above.

moderate intensity and above. Non-parametric analyses, however, showed that there were no significant differences in terms of these categories of activities between the groups. We conclude that housework contributed significantly to the fulfillment of the WHO recommendations and also to the difference in energy expenditure between those who fulfilled the WHO recommendations and those who did not.

Factors that promote or discourage exercise

Respondents were asked to list their three most important sources of information regarding exercise (referring specifically to sports and recreational activities). We found a majority of 70.1% listing television as one of their three sources followed by newspapers, relatives and friends. Pamphlets were the least effective means by which they got their information (Fig 3). A greater proportion of housewives (73.5%) cited television as one of their three most significant sources of information regarding exercise compared to working women (66.9%). On the other hand, a larger proportion of working women (54.9%) cited newspapers compared to housewives (44.6%).

We also found that the most common perceived benefit of exercise among our respondents was its contribution to physical well-being (77.1% of responses). Psychological well-being was cited by 13.8% of subjects. Only 9.1% of the responders either did not know the benefits, or thought that there was no benefit at all.

There was a variety of reasons given for not exercising. Lack of time because of work and children was cited by 47.2% of respondents, (37.3% of housewives and 56.6% of working women). The perception that they had enough “exercise”, for example by doing housework alone was cited by 27.9% of women (33.7% of housewives and 22.3% of working women). “Laziness” or a lack of interest was the reason given by 15.5% of respondents (16.3% of housewives and 14.9% of working women).

It was interesting to note that a substantial proportion (41.0%) of women interviewed were not aware of any existing health programmes. Only 32.3% were able to give specific examples like Fit for Life, Healthy Lifestyle and Sports for Life campaigns while the remainder claimed that they were aware of health programmes but were unable to cite any examples when asked.

DISCUSSION

Using the 1994 WHO recommendations as a benchmark, our results suggest that 50.7% of middle-aged women in the area surveyed fulfilled the recommendations to engage in physical activity

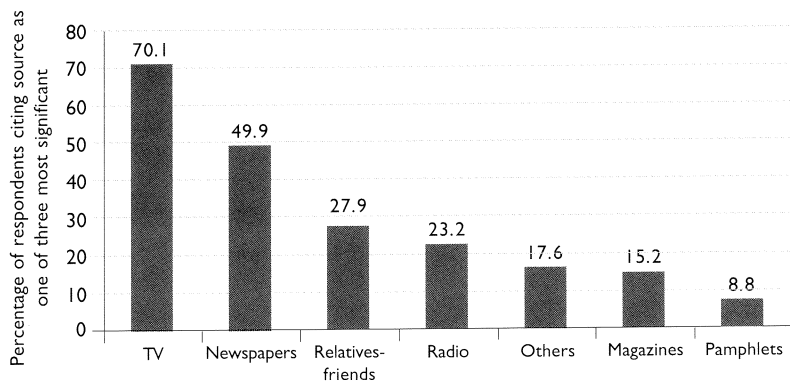


Fig 3 – Respondents' most significant sources of information regarding exercise.

of at least moderate intensity for 30 minutes or more a day. Those who reported regular physical activity were of a lower socioeconomic status and more likely to be housewives without full-time domestic help. Housework contributed a large proportion (56.3%) of weekly energy expenditure for activities of moderate intensity and above, and was a more important factor than sports or occupational activity in distinguishing between women who fulfilled WHO recommendations and those who did not.

In the interpretation of our results, several limitations should be borne in mind. Due to time constraints, the study was limited to a single housing estate in the eastern part of Singapore. Compared with the national population⁽²²⁾, our respondents tended to be older and more highly educated. There was also a slight over-representation of women of Malay ethnicity. This is probably a reflection of the composition of the population residing in Marine Terrace.

Secondly, while the Seven Day Recall Questionnaire classifies activities into different categories of moderate, hard and very hard, the exact intensity with which the reported activities were carried out may vary between individuals. Likewise, the intensity of the different activities within each category inevitably differs. Hence the total energy expenditure calculated from this questionnaire should be viewed as an estimate only. Other more accurate methods of measuring energy expenditure for each respondent were neither practical nor feasible in the context of a community-based survey.

To our knowledge, this is the first community-based study to examine total physical activity in the light of the 1994 recommendations by WHO. Our data suggest that only half of middle-aged women in our target population are currently engaged in physical activity of a level that would benefit their health. The average (median) total energy expenditure was 36.2 kcal/kg/day, which is fairly similar to the values obtained (mean energy expenditure between 34 – 37 kcal/kg/day) for women of this age group in the Stanford Five-City Project⁽²³⁾. Housework such as mopping, sweeping or scrubbing contribute significantly to both the overall energy expenditure, and to regular moderate

physical activity among our study population. This helps to explain the independent relationship observed between adequate regular physical activity (as measured by fulfillment of WHO recommendations) and occupational/domestic help status. Among the four groups, housewives with full time domestic help were at highest risk of inadequate physical activity, as they had neither the domestic responsibilities of a full-time housewife, nor occupational activity or adequate leisure time physical activity to compensate for this. Working women were also less likely, compared with full-time housewives, to report adequate regular physical activity.

We can also explain the observed trend with age and socioeconomic status in relation to the amount of housework performed. With increasing socioeconomic status, respondents were less likely to fulfill WHO recommendations. This is an interesting finding in that, presumably, a more educated person is likely to be more knowledgeable about the benefits of regular exercise or physical activity. Therefore, it would seem likely that they should have had a higher likelihood of fulfilling the WHO recommendations. However, this was not the case in our study. More highly educated women in our study population were also more likely to work and to have full-time domestic help. One possible explanation is that highly educated working women are more likely to have a job that requires less energy expenditure than housework and this, together with the increased likelihood of having full-time domestic help, tend to decrease the level of physical activity they perform. Another explanation could be that because work consumes time in the day, they may feel that they lack time to actively participate in recreational activities. This is probably especially true for working mothers.

The association between age and physical activity may also be attributed to the larger proportion of housewives among older women. Beyond the age of 55, however, it is likely that the level of activity, housework or otherwise, will fall due to increasing morbidity among the elderly.

There is much scope for further research on how women can be encouraged to increase their physical activity to a level which would have a positive impact on their health. One important implication of our findings is that future population-based surveys of physical activity should not only include the traditional categories of recreational and occupational activities but also household activity. This is especially relevant when applied to the female population because we have shown that household work contributes significantly to women's energy expenditure. Several other studies also support this observation: for example, leisure time physical activity has been shown to increase with increasing educational level^(24,25); however, when total physical activity is considered, the reverse trend is observed⁽¹⁵⁾.

Our findings also suggest that efforts to encourage physical activity among women in

Singapore should be aimed specifically at housewives who do not perform housework regularly, and also at working women. The television may serve as a useful channel for communication with housewives, and newspapers were cited as an important information source among working women in our study population. Many (47.2%) of these women cited a lack of time due to work or childcare as the main barrier to leisure-time activity. This observation is consistent with the 1990 Census Report⁽²²⁾ which found that married women, and especially those with childcare responsibilities, to be least likely to engage in sports or exercise. This implies that convenience and family support are major factors, and in this regard, the recent efforts of the Ministry of Health to promote home- and family-based 'workouts' will go some way to meet this need. By increasing awareness among health professionals of these women 'at risk', a more personal and active approach may be taken towards encouraging them. For example, a doctor may take the opportunity during a routine consultation to enquire about physical activity if he is aware that his patient falls into one of these categories. Alternatively, companies and employers with an active interest in health could provide them with opportunities and facilities within the workplace, at a reasonable or subsidised cost, and at a time convenient to them, say during lunch breaks or immediately before or after work.

At the same time, we should note that not all types of housework are of sufficient intensity to provide health benefits – many household chores, such as light ironing or cooking, do not fall in the category of 'moderate and above' intensity. Respondents who gave housework as a reason for not engaging in other forms of physical activity may need to be reminded of this.

CONCLUSION

In conclusion, we showed through this small study that housework constitutes a substantial proportion of the physical activity engaged in among middle-aged women in Singapore, and identified the groups of women at highest risk of inadequate activity. We hope that this will provide a basis for further research and efforts to improve the level of physical activity among middle-aged women in Singapore.

ACKNOWLEDGEMENTS

This study was part of a community health project carried out in January 1998 by the Department of Community, Occupational and Family Medicine (COFM), National University of Singapore. The authors would like to thank Dr Patrick Goh of the Singapore Sports Council for his kind support, encouragement and contribution. We would also like to acknowledge the help rendered us by the COFM staff. The medical students of the 1998 community health project (Group 3) were: Lee Tze

Wee, Khor Wei Boon, Natalie Tan WH, Cheng Chee Leong, Goh Han Meng, Joan Khoo JC, Yash Pal Rakhee, Michelle Tan WJ, Glenn Tan YK, Ivan Tan YJ, Tan Yung Ming, Vikneshwaran s/o Namasivayam, Yeo Wee-Lee, Steven Kum WC, Vincent Tan CW, Terence Teo KB, Andrea Yeo WC, Lee Yian Ping, Teng Po Ming, Law Yan Mee, Terence Tan HL, Chew Su Yah, Lau Chin Hoh, Mohammad Ashik BZ, Ong Hang Shyan, Tan Peh Khee, Tan Yeow Meng, Chan Kim Poh, Chee Weng Chung, Gan Han Nee, Jimmy Lee CK and Seow Yong Tong.

REFERENCES

1. Singapore Government. Report on the registration of births and deaths. Singapore: Government Printing Office, 1995.
2. Seow A, Lee HP. From colony to city state: changes in health needs in Singapore from 1950 to 1990. *J Public Health Med* 1994; 16:149-58.
3. Gerhardsson de Verdier M, Steineck G, Hagman U, Rieger A, Norell SE. Physical activity and colon cancer: a case-referent study in Stockholm. *Int J Cancer* 1990; 46:985-99.
4. Morris JN, Moss S, Chave SPW. Vigorous exercise in leisure time and the death rate: a study of male civil servants. *J Epidemiol Community Health* 1978; 32:239-43.
5. Helmrich SA, Ragland DR, Leung RW, Paffenbarger RS. Physical activity and reduced occurrence of NIDDM. *N Eng J Med* 325:147-52.
6. Zhang J, Feldblum PJ, Fortney JA. Moderate physical activity and bone density among perimenopausal women. *Am J Public Health*; 1992 May; 82:736-8.
7. Thirlaway K, Benton D. Participation in physical activity and cardiovascular fitness have different effects on mental health and mood. *J Psychosom Res* 1992; 36:657-65.
8. Ruuskanen JM, Ruoppila I. Physical activity and psychological well-being among people aged 65 to 84 years. *Age Aging* 1995; 24:292-6.
9. Rauramaa R, Tuomainen P, Vaisanen S, Rankinen T. Physical activity and health related fitness in middle-aged men. *Med Sci Sports Exerc* 1995; 27:707-12.
10. Rankinen T, Rauramaa R, Vaisanen S, Penttila I, Saarikoski S, Tuomilehto J, Nissnen A. Inverse relationship between physical activity and plasma fibrinogen in post-menopausal women. *Atherosclerosis* 1993; 102:181-6.
11. Greendale GA, Bodin-Dunn L, Ingles S, Haile R, Barrett-Connor E. Leisure, home and occupational physical activity and cardiovascular risk factors in post-menopausal women. *Arch Intern Med* 1996; 156:418-24.
12. Sallis JF, Patterson TL, Buono MJ, Nader PR. Relation of cardiovascular fitness and physical activity to cardiovascular disease and risk factors in children and adults. *Am J Epidemiol* 1988; 127:933-9.
13. WHO/FIMS Committee on physical activity for health. Exercise for health. *WHO Bulletin OMS* 1995; 73:135-6.
14. Singapore Sports Council. Women and Sports Survey 1995.
15. Sallis JF, Haskell WL, Wood PD, Fortmann SP, Rogers T, Blair SN, Paffenbarger RS. Physical activity assessment methodology in Five City Project. *Am J Epidemiol*; 121: 91-106.
16. Alsagoff F. Agreement study between two methods of measuring physical activity. Master of Medicine (Public Health) Dissertation 1993/1994. National University of Singapore.

17. Wilson PWF, Paffenbarger RS, Morris JN, Havlik RJ. Assessment methods for physical activity and physical fitness in population studies: report of a NHBLBI workshop. *Am Heart J* 1986; 111:1177-92.
18. Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, Montoye HJ, Sallis JF, Paffenbarger RS. Compendium of physical activities: classification of energy costs of human physical activities. *Med Sci Sports Exerc* 1993; 25:71-80.
19. Mayer EJ, Aderman BW, Regenstein JG, Marshall JA, Haskei WL, Baxter J, Hammann RF. Physical activity assessment measures compared in biethical rural population: the San Luis Valley diabetes study. *Am J Clin Nutr* 1991; 53:812-20.
20. Lai JS, Wong MK, Lan C, Chong CK. Cardiorespiratory fitness of Tai Ji Chuan practitioners. 3rd Asian Pacific symposium on cardiac rehabilitation 15-17 March 1991. Conference handbook.
21. Quek CM, Koh K, Lee J. Parental body mass index: a predictor of childhood obesity? *Ann Acad Med Singapore* 1993; 22:342-45.
22. Lau KE. Census of population 1990. Singapore. Department of statistics, 1992.
23. Blair SN, Haskell WL, Ho P, Paffenbarger RS, Vranizan KM, Farquhar JW, Wood PD. Assessment of habitual physical activity by a seven day recall in a community survey and controlled experiments. *Am J Epidemiol* 1985; 122:794-804.
24. Iribarren C, Luepker RV, McGovern PG, Arnett DK, Blackburn H. Twelve-year trend in cardiovascular disease risk factors in Minnesota Heart Survey. Are socioeconomic differences widening? *Arch Intern Med* 1997; 157:873-81.
25. Macera CA, Croft JB, Brown DR, Ferguson JE, Lane MJ. Predictors of adopting leisure-time physical activity among a biracial community cohort. *Am J Epidemiol* 1995; 142:629-35.