Self-reported knowledge and pattern of physical activity among school students in Al Khobar, Saudi Arabia

A.Z.A. Taha[1]

المعرفة الذاتية وأنماط الأنشطة البدنية بين تلاميذ المدارس في الخُبَر، بالمملكة العربية السعودية

عطية زين العابدين طه

الخلاصة: كان الهدف من هذه الدراسة المستعرضة هو تحديد المعرفة الذاتية وأنماط الأنشطة البدنية بين 1240 تلميذاً و1331 تلميذة من تلاميذ مدارس المرحلتين المتوسطة والثانوية في مدينة الخُبَر، بالمملكة العربية السعودية. وكان الغالبية العظمى من التلاميذ والتلميذات على دراية بأن النشاط البدني يقي بصورة عامة من الأمراض (92.9٪ و91.8٪ على التوالي)، كما يقي من السمنة (69.4٪ و78.5٪) ولكن كانت معارفهم هزيلة عن دور النشاط البدني في الوقاية من داء السكري وارتفاع ضغط الدم. وكانت ممارسة الذكور للأنشطة البدنية (ثلاث مرات في الأسبوع) أكثر من ممارسة الإناث لها بصورة يُعْتَدُّ بها، إذ بَلَغَت 45.6٪ بين الذكور مقابل 33.7٪ بين الإناث. كما كانت المحدِّدات الرئيسية وراء ممارسة الذكور للنشاط البدني هي المجموعة العمرية، بالإضافة إلى معرفتهم بأن النشاط البدني يقي من السمنة.

ABSTRACT The aim of this cross-sectional study was to determine the self-reported knowledge and pattern of physical activity among a sample of 1240 male and 1331 female intermediate and secondary school students in Al-Khobar city, Saudi Arabia. The majority of male and female students knew that physical activity is protective against diseases in general (92.9% and 91.8% respectively) and in the prevention of obesity (69.4% and 78.5%) but had poor knowledge about the role of physical activity in the prevention of diabetes mellitus and hypertension. Significantly more male students than female students practised physical activity 3+ times per week (45.6% versus 33.7%). Age and the knowledge that exercise protects from obesity were the main determinants of the practice of physical activity among male students.

Connaissances déclarées et habitudes en matière d'exercice physique chez les écoliers d'Al Khobar (Arabie saoudite)

RÉSUMÉ Cette étude transversale avait pour objectif de déterminer les connaissances et les habitudes en matière d'exercice physique d'un échantillon de 1240 garçons et 1331 filles fréquentant des établissements scolaires de niveau intermédiaire et secondaire à Al Khobar (Arabie saoudite). La majorité de ces garçons et filles savaient que l'exercice physique a une action protectrice contre les maladies en général (92,9 % et 91,8 % respectivement) et une action préventive contre l'obésité (69,4 % et 78,5 %), mais connaissaient mal le rôle de cette activité dans la prévention du diabète sucré et de l'hypertension. Les garçons qui pratiquaient une activité physique au moins trois fois par semaine étaient beaucoup plus nombreux que les filles (45,6 % contre 33,7 %). L'âge et la connaissance du rôle protecteur de l'exercice physique contre l'obésité étaient les principaux déterminants de la pratique de cette activité parmi les écoliers.

[1]*Department of Family and Community Medicine, College of Medicine, King Faisal University, Dammam, Saudi Arabia (Correspondence to A.Z.A. Taha: aztaha@hotmail.com).*
Received: 13/07/05; accepted: 23/01/06

Introduction

Several studies have shown that regular exercise and physical activity reduces the risk of coronary heart disease (CHD) [*1–5*] and has benefits in reducing morbidity and mortality from several chronic diseases in adults [*2,6*]. The relative risk for CHD associated with physical inactivity is approximately 1.9, slightly lower than the relative risks associated with increased systolic blood pressure (2.1), cigarette smoking (2.5) and elevated serum cholesterol levels (2.4) [*5,7*]. Scientific evidence also shows an association between regular physical exercise and the lowering of several other risk factors for cardiovascular disease, including blood lipid levels, resting blood pressure among persons with borderline hypertension, overweight, and glucose tolerance and insulin sensitivity [*8–10*].

Observations and current studies indicate that today's children are probably less fit than children decades ago [*11–13*]. Children tend to be more overweight and sedentary than before. A study in the United States of America (USA) of male and female adolescents aged 10–16 years examined the effects of physical activity, television viewing, videogame playing, socioeconomic status and ethnicity on body mass index (BMI) [*14*]. The study showed that the weight of male adolescents appeared to be more related to exercise habits than to television or videogame habits. Increased participation in high-intensity exercise appeared to be important. A cohort study of 9 to 14-year-old girls and boys in the USA showed that for both boys and girls, the increase in BMI over 1 year was larger in those who reported spending more time on television/videos/games during the year, and in those who reported increased caloric intakes over 1 year [*13*]. Larger year-to-year increases in BMI were also seen among girls who reported higher caloric intakes and less physical activity during the year between the 2 BMI measurements. We observed a similar pattern in Saudi Arabia from research projects conducted by medical students during their field courses in different parts of the country.

A survey of the associations between physical activity and other health behaviours in a sample of USA high-school students showed that low physical activity was associated with several other negative health behaviours in teenagers, such as cigarette smoking, marijuana use, lower fruit and vegetable consumption, greater television watching, and failure to wear a seat belt in cars [*15*].

In Saudi Arabia, sport is usually included in the school curriculum for boys' schools at all levels (primary, intermediate and secondary). However, there are no sport classes in girls' schools. Girls and women in Saudi Arabia practice physical exercise in private women centres and in playgrounds. Al Refaee and Al-Hazza, in their study of 1333 Saudi males aged 19 years and older in Riyadh, Saudi Arabia, showed that over 53% were totally physically inactive and another 27.5% were irregularly active. Only 19% of the entire sample were active on a regular basis [*16*].

The aim of the present study was to determine self-reported patterns of physical activity, and knowledge about the benefits of physical activity, among male and female school students in Al-Khobar city, Saudi Arabia.

Methods

Sample

This was a cross-sectional study conducted in the Al-Khobar area of Eastern Province of Saudi Arabia in 2001–02. Al-Khobar is

the second largest modern city after Dammam, the capital of the Eastern Province of Saudi Arabia, with an estimated population of 150 000 [*17*]. There are 14 government and 12 private intermediate schools and 8 government and 4 private secondary schools for boys. Regarding girls, there are 16 government and 11 private intermediate schools, and 10 government and 8 private secondary schools. The target population consisted of 3rd grade intermediate and all 3 grades of secondary school male and female students (both Saudis and non-Saudis) in the Al-Khobar area. The size of this target population was 13 868 students, comprising 5870 males and 7998 females.

It was decided to take a random sample of 25% of schools in the Al-Khobar area, taking into consideration the resources available for the field survey (in terms of manpower, time and money). A multistage stratified self-weighting sampling design was adopted. Each school was divided into government and private, and further classification was made on the basis of intermediate and secondary level. At the 1st stage, a systematic random sampling procedure (with probability proportional to size) was used to select 9 schools for boys (5 government and 4 private) out of 38 schools, and 13 schools for girls (8 government and 5 private) out of 45 schools. At the 2nd stage the classes were selected at each level using a simple random sampling design. All students in the selected classes were included in the study. The total number of selected students was 2571, comprising 1240 males and 1331 females.

Data collection

Two sets of self-administered questionnaires were used: one for male and the other for female students. The questionnaires were designed by the author and other experts after reviewing the literature. The 2 questionnaires were similar except that questions on drug abuse and use of seatbelts when driving were not included in the female questionnaires. The questionnaire was part of a comprehensive questionnaire on lifestyle, knowledge and self-reported behaviours among school students and teachers in Al-Khobar schools. The questionnaire contained questions on demographic data, knowledge about the benefits of physical activity and details of their own practice of physical exercise (frequency, duration). Other questions included knowledge about healthy foods, obesity, diabetes mellitus, hypertension, smoking and drug abuse.

The data collection was made under standardized conditions (i.e. written protocol and guidelines for measuring weight and height) by 3 male physicians for male students and by 3 females (1 pharmacist and 2 female nurses) for female schools. Physical activity was defined as any bodily movement produced by skeletal muscles that resulted in energy expenditure above the basal level [*18*]. Effective physical activity was defined as regular exercise 3 or more times per week for at least 20 minutes per session [*19*]. Data on physical activity was collected by self-reported questionnaire. Heights and weights were measured for each student barefoot wearing light clothes. A digital weighing scale (SECA 708) with a height measuring rod attached to the scale was used. BMI was estimated as weight (kg)/height^2 (m^2) [*20*].

A pilot study was conducted in a male and female school to test the questionnaires and organizational procedures. The fieldwork took about 8 weeks. The students answered the questions themselves under the supervision of the field workers. Those who were absent or on vacation were noted and interviewed during subsequent days of fieldwork (8 weeks). A response rate of 100% was obtained. The response rate for

specific questions ranged between 84.1% and 100.0% for boys and 89.6% and 100.0% for girls.

Data analysis

SPSS-PC, version 10 computer software was used for data analysis. The difference between the 2 proportions was tested using the chi-squared test to detect any significant difference between male and female students. Logistic regression analysis was used to determine associations between different variables while controlling for confounding variables. A test–retest method was used to check for reliability. Reliability was calculated for each question concerned with self-reported knowledge and behaviour. The kappa statistic ranged from 0.4 to 0.7. This was considered as fair to good reliability [*21*].

The independent variables entered into the logistic regression model were: type of school (government/private; intermediate/secondary), age, nationality, father's and mother's education, weight, height, BMI, knowledge of healthy fats in food, knowledge of benefits of fibre-rich diets, knowledge of dangers of drug abuse, knowledge of complications of diabetes mellitus, knowledge of complications of high blood pressure, knowledge of complications of obesity, knowledge that exercise protects from disease, knowledge that exercise protects from heart disease, knowledge that exercise protects from obesity, knowledge of toxic substances in cigarettes, knowledge of dangers of passive smoking and current cigarette smoking habit.

Results

The mean [standard deviation (SD)] age of all students was 16.3 (1.7) years: 16.5 (SD 1.8) for male students with age ranging from 12 to 23 years, and 16.1 (SD 1.7) for females with age ranging from 13 to 26 years. Table 1 shows the demographic characteristics of school students. About three-quarters of the selected schools were government schools. Secondary-school students formed the majority for both sexes. The majority of students were of Saudi Arabian nationality. There were statistically significant differences between male and female students with respect to both father's and mother's education.

The majority of the students of both sexes knew that exercise in general protects from certain diseases (92.9% and 91.8% for male and female student respectively) and can prevent obesity (69.4% and 78.5%) (Table 2). Fewer students of both sexes knew about the beneficial effects of physical activity in the prevention of heart disease, hypertension, diabetes mellitus or psychological stress. Male students had significantly better knowledge about the benefits of physical activity in preventing hypertension, diabetes mellitus and smoking than female students. However, female students had significantly better knowledge about the role of physical activity in preventing obesity (78.5% versus 69.4%). The striking result was the poor knowledge of both male and female students about the role of physical activity in the prevention of diabetes mellitus and hypertension, which are common health problems in Saudi Arabia.

A significantly higher proportion of male students reported that they practised physical activity than did female students (91.0% versus 81.8% respectively) (Table 3). Significantly more male students practised exercise 3 or more times per week and for more than 0.5 hour per session than did female students ($P < 0.001$). The main types of exercise habits of male students were football (69.8%), swimming (39.6%) and walking (32.7%) (Table 4). Female students mainly practised walking (60.3%),

Table 1 **Demographic characteristics of male and female school students**

Demographic characteristic	Males (n = 1240[a])		Females (n = 1331[a])		Total		P-value (χ^2-test)
	No.	%	No.	%	No.	%	
Type of school							
Government	822	74.8	967	72.8	1789	73.3	
Private	277	25.2	362	27.2	639	26.3	
School level							
Intermediate	508	41.0	342	25.7	850	33.1	
Secondary	732	59.0	988	74.3	1720	66.9	
Nationality							
Saudi Arabian	836	69.8	1276	96.1	2112	83.6	
Non-Saudi Arabian	362	30.2	52	3.9	414	16.4	
Father's education							0.001
Illiterate	219	18.8	152	12.1			
Primary & intermediate	420	36.1	357	28.4			
Secondary	218	18.7	304	24.2			
University/higher education	308	26.4	445	35.4			
Mother's education							0.001
Illiterate	377	32.7	253	20.5			
Primary & intermediate	383	33.2	471	38.1			
Secondary	223	19.3	309	25.0			
University/higher education	170	14.7	202	16.4			

[a]***Data missing for some questions.***
n ***= total number of respondents.***

Table 2 **Self-reported knowledge of benefits of physical exercise by male and female students in Al-Khobar area**

Knowledge of benefits	Males (n = 1240)		Females (n = 1331)		P-value (χ^2-test)
	No.	%	No.	%	
Protects from disease	1152	92.9	1193	91.8	0.003
Prevents heart disease	533	43.0	558	41.1	NS
Prevents hypertension	357	28.8	313	23.6	0.002
Prevents diabetes mellitus	454	36.6	365	27.5	< 0.001
Prevents obesity	861	69.4	1040	78.5	< 0.001
Prevents smoking	657	53.0	354	26.7	< 0.001
Prevents psychological stress	352	28.4	381	29.4	NS
Prevents other diseases	30	2.4	26	2.0	NS

Data were missing for some questions.
n ***= total number of respondents; NS = not significant.***

Table 3 **Self-reported practice of physical exercise by male and female students in Al-Khobar area**

Self-reported practice of physical exercise	Males (*n* = 1240) No.	%	Females (*n* = 1331) No.	%	*P*-value (χ^2-test)
Practise physical exercise	1129	91.0	1089	81.8	< 0.001
Practise physical exercise 3+ times/ week	565	45.6	448	33.7	< 0.001
Spend > 0.5 h in physical exercise per session	884	71.3	458	34.4	< 0.001

n = *total number of respondents.*

swimming (34.0%) and jogging (29.2%). Gymnasium was the activity practised least by both male and female students (7.1% versus 5.6% respectively). In general, significantly more male students practised physical exercise than females.

Obesity was significantly associated with the practice of physical activity among male students ($P < 0.001$). About 75.3% of non-obese males (BMI < 25 kg/m^2) practised physical exercise compared with 13.3% who were overweight and 11.5% who were obese (BMI > 30 kg/m^2). Among female students, although there was a decreased trend of practice of physical exercise with increase in body weight (72.9% of non-obese versus 16.5% of overweight and 10.6% of obese students), it did not reach statistical significance ($P = 0.35$). There was no statistically significant difference between obese and non-obese students concerning knowledge of the health benefits of physical activity for both male and female students. In males 828 non-obese students had knowledge of the health benefits of physical activity compared with 304 overweight and obese students ($P = 0.79$). A total of 865 non-obese female students knew that physical activity prevents disease compared with 308 overweight and obese students ($P = 0.09$). Furthermore, non-obese and overweight students had better knowledge than obese students although this was not statistically significant.

Parents' education (both father and mother) was not significantly associated with physical exercise among male students. Among female students, only mother's education was statistically significantly associated with physical exercise. The higher the educational level of the mother (from primary to university), the higher was the proportion of females who practised exercise ($P = 0.009$). About 193 (76.6%) female students whose mothers were illiterate practise physical activity compared with 367

Table 4 **Practice of different types of physical exercise by male and female students in Al-Khobar area**

Type of physical exercise	Males (*n* = 1240) No.	%	Females (*n* = 1331) No.	%	*P*-value (χ^2-test)
Football	866	69.8	242	18.2	< 0.001
Swimming	491	39.6	453	34.0	0.003
Walking	405	32.7	802	60.3	< 0.001
Jogging	343	27.7	389	29.2	NS
Volleyball	204	16.5	52	3.9	< 0.001
Basketball	156	12.6	122	9.2	0.005
Gymnasium	88	7.1	74	5.6	NS
Other	169	13.6	86	6.5	< 0.001

n = *total number of respondents; NS = not significant.*

(82.8%) whose mothers had primary and intermediate education, 221 (81.0%) whose mothers had secondary education, and 226 (88.3%) whose mothers had university and higher education respectively.

For both male and female students, mother's education was significantly associated with student's knowledge that physical activity prevents hypertension ($P < 0.001$ for males and 0.001 for females), heart disease ($P < 0.001$ for both males and females), obesity ($P < 0.001$ for both males and females), smoking ($P = 0.02$ for males and 0.04 for females), and psychological stress ($P < 0.001$ for males and 0.014 for females). There was no statistically significant association of parents' occupation and family income with both knowledge and self-reported practice of physical exercise for both male and female students. A total of 1015 (94.0%) male students whose mothers were housewives reported that physical exercise prevents disease occurrence compared with 112 (93.3%) students whose mothers were working ($P = 0.78$). Of male students, 998 (92.4%) whose mothers were housewives practise physical exercise compared with 107 students (90.7%) who had working mothers ($P = 0.51$).

Male and female students in government schools were no different from those in private schools in terms of exercise patterns. A total of 759 (93.1%) male students in government schools practiced physical exercise compared with 248 (91.9%) students in private schools. However, knowledge of students in government schools about the benefits of physical activity was significantly better than students in private schools ($P < 0.05$). A higher proportion of both male and female students in government schools reported that exercise prevents hypertension (209 versus 105 males and 211 versus 102 females respectively), diabetes mellitus (266 versus 129 males and 274 versus 91 females respectively), and heart disease (328 versus 148 males and 367 versus 189 females respectively).

Logistic regression analysis was used to identify the determinants of practice of physical activity among male students while controlling for other variables. A total of 19 independent variables were entered into the model (see Methods). The only 2 variables found to be significantly associated with practice of physical activity were age and the knowledge that exercise protects from obesity as shown in Table 5. Younger students were 7% more likely to practice physical activity than older students. Students who had the knowledge that exercise protects from obesity were 7 times more likely to practice physical activity than students who had no such knowledge. No significant associations were detected among female students in the logistic regression analysis.

Further analysis showed that there was a statistically significant steady and consist-

Table 5 **Logistic regression analysis showing determinants of practice of physical exercise among male students**

Variable	B coefficient	SE of B	Odds ratio	95% CI	*P*-value
Age	–0.3874	0.1858	0.68	0.47–0.98	0.037
Exercise protects from obesity	1.9245	0.7146	6.85	1.69–27.80	0.007
Constant	7.4237	3.1182			

SE = standard error; CI = confidence interval.

ent decline in the level of exercise habits with age from 3rd grade intermediate all the way to 3rd grade secondary school (96.8% practised exercise at age 14 years compared with 85.1% at age 18 years for males and 89.9% practised exercise at age 14 years compared with 70.6% at age 18 years for females). This decline was also coupled with inadequate knowledge about benefits of physical activity. A non-significant ($P > 0.05$) lower proportion of older (ages 18–23 years) than younger (ages 12–17 years) students reported that exercise prevents smoking (180 versus 376 males and 68 versus 250 females respectively), hypertension (97 versus 211 males and 55 versus 225 females respectively), diabetes mellitus (209 versus 105 males and 211 versus 102 females respectively), heart disease (126 versus 326 males and 104 versus 409 females respectively), psychological stress (91 versus. 215 males and 61 versus 299 females respectively).

Table 6 shows sources of knowledge about health and disease as reported by male and female students. The main sources of knowledge about health and disease for both male and female students were television, magazines and daily newspapers. The primary health care centre was the lowest source of knowledge for both male and female students (17.4% and 15.7% respectively). Gender differences in sources of health knowledge were statistically significant for hospital, school and magazines which were utilized significantly more by female than male students.

Table 6 **Sources of knowledge about health and disease as reported by male and female students in Al-Khobar area**

Source of knowledge	Males (*n* = 1240)		Females (*n* = 1331)		*P*-value (χ^2-test)
	No.	%	No.	%	
Television	723	58.3	811	60.9	NS
Daily newspapers	408	32.9	458	34.4	NS
Magazines	387	31.2	519	39.0	< 0.001
School	355	28.6	432	32.5	0.035
Books	308	24.8	374	28.1	NS
Radio	292	23.5	296	22.2	NS
Hospital	291	23.5	381	28.6	0.003
Primary health care centre	216	17.4	209	15.7	NS

n = *total number of respondents; NS = not significant.*

Discussion

The study showed that the knowledge of the beneficial effect of physical exercise as a preventive measure against ill-health in general was high among students. This is a desirable situation that has to be maintained, developed and improved by well-concerted school health education programmes. However, both male and female students' knowledge about the beneficial effects of exercise against specific serious chronic problems, such as diabetes mellitus and hypertension, was inadequate, with female students having significantly less knowledge than males on several questions. This reflects their lack of orientation about these common chronic health problems which might be due to lack of health information at school or through the mass media. This result was similar to the study of Khattab et al. in a family practice centre in Abha, Saudi Arabia [*22*]. This showed that only 22.6% of 146 inactive males and females and 33.0% of 60 moderately active people perceived their inactivity as harmful to their health. The results were also similar to studies conducted among college students in Canada, Nigeria and the USA to detect the adequacy of health knowledge necessary to live a healthy life, which showed that poor knowledge about chronic disease was one

of the greatest weaknesses in health knowledge [*23–25*].

The practice of physical exercise was reported by high proportions of both male and female students. This is an encouraging finding that should be fostered as a counterbalance to intense television watching by all age groups. On the other hand, the practice of physical exercise among females was less than that among male students. This finding could be partly accounted for by the inadequate knowledge of female students about the benefits of physical exercise and by the lack of physical exercise classes in female schools. Data analysed by the Centers for Disease Control and Prevention in the USA from the 1994 Behavioral Risk Factor Surveillance System showed that in every state surveyed, most adults were not participating in regular physical activity [*26*].

The finding that the practice of physical activity was significantly lower among obese students is consistent with several studies that have shown that obese adolescents are less active than non-obese young people [*11,12*]. Al-Refaee and Al-Hazzaa in their study on Saudi males aged 19 years and older showed a higher percentage of obesity among the inactive (18%) than among the active (13%) men [*16*]. Our study showed a higher proportion of respondents practising physical exercise than Al-Refaee and Al-Hazzaa, who showed only 47% practicing physical exercise. This may be explained by the difference in the age of the sample. In our study the mean age of boys was 16.5 years (range 12–23 years) while in Al-Refaee and Al-Hazzaa study the mean age was 41.1 years (range 19–68). Other studies of heart rate telemetry of Saudi boys during and after school time indicated that Saudi boys spent a limited time on activities that raised the heart rate above 159 beats per minute [*27,28*]. The study showed that levels of both moderate and vigorous physical activities among Saudi boys were considerably lower than those levels reported from other countries [*29–31*].

The influence of mother's education on student's knowledge of the benefits of physical activity was an interesting finding. A possible explanation might be that educated mothers are more conscious and concerned about the health of their children and convey this message to them. Further enquiry is needed to explore this point for future intervention strategies to promote physical activity. Students in government schools were more knowledgeable about the benefits of physical activity than those in private schools. Although three-quarter of students were from government schools, no explanation could be given for this difference. The curriculum of the schools, the teachers' roles and health education opportunities might have played a role in this aspect.

Possible reasons for younger students practising physical exercise more than older students are that older students might be spending more of their time using the Internet, watching television or playing video games. Another reason might be due to the high prevalence of obesity among older students. This study showed a significant association between knowledge that exercise protects from obesity and the practice of physical exercise. A similar study in the USA found a significant relation between physical activity and eating healthy foods [*32*].

A limitation of the study is that some students might have over-reported their practice of physical exercise and their knowledge of healthy behaviours. In addition, psychosocial factors and students' beliefs, which were shown by some studies to be important determinants of physical exercise [*33,34*], were not explored.

Conclusions and recommendations

Both male and female students had good knowledge about the benefits of physical activity. However, they had poor knowledge about the role of physical activity in the prevention of diabetes mellitus and hypertension. Health education should concentrate on clarifying these areas. Age and the knowledge that exercise protects from obesity were the main determinants of the practice of physical activity among male students. These findings support the need for health promotion programmes that increase the number of physically active students.

Positive long-term lifestyle changes, including physical exercise, need to be established early in life, because cardiovascular risk factors, including obesity, tend to track from childhood to adulthood [*2,8,35*]. Programmes to increase regular physical activity should be established. Such programmes should include health education, increase supervised physical education and physical exercise sessions, competition and prizes, and active involvement of teachers. More intervention efforts need to be directed towards female students in particular, as their knowledge and practice of physical activity were inadequate. Extracurricular physical activity programmes that address the needs and interests of all students should be provided by school authorities.

Acknowledgements

The author extends great thanks and appreciation to King AbdulAziz City for Science and Technology for their support to conduct this study and to all school administrators, and students.

References

1. Haapanen N et al. Association of leisure time physical activity with the risk of heart disease, hypertension and diabetes in middle-aged men and women. ***International journal of epidemiology***, 1997, 26:739–47.
2. Paffenbarger RS, Wing AL, Hyde R. Physical activity as an index of heart attack risk in college alumni. ***American journal of epidemiology***, 1978, 108:161–75.
3. Oberman A. Exercise and the primary prevention of cardiovascular disease. ***American journal of cardiology***, 1985, 55:10D–20D.
4. Paffenbarger RS Jr, Hyde RT. Exercise in the prevention of coronary heart disease. ***Preventive medicine***, 1984, 13:3–22.
5. Berlin JA, Colditz GA. A meta-analysis of physical activity in the prevention of coronary heart disease. ***American journal of epidemiology***, 1990, 132:612–28.
6. May GS et al. Secondary prevention after myocardial infarction: a review of long term trials. ***Progress in cardiovascular diseases***, 1982, 24:331–52.
7. Pooling Project Research Group. Relationship of blood pressure, serum cholesterol, smoking habit, relative weight and ECG abnormalities to incidence of major coronary events: final report of the Pooling Project. ***Journal of chronic diseases***, 1978, 31:202–306.
8. ***Physical activity and health: a report of the Surgeon General***. Atlanta, Gerogia, Department of Health and Human Services, National Center for Chronic Disease Prevention and Health Promotion, President's Council on Physical Fitness and Sports, 1996.
9. Burchfiel CM, Sharp DS, Curb JD. Physical activity and incidence of diabetes: the

Honolulu Heart Program. ***American journal of epidemiology***, 1995, 141:360–8.

10. Perry IJ, Wannamethee SG, Walker MK. Prospective study of risk factors for development of non-insulin dependent diabetes in middle-aged British men. ***British medical journal***, 1995, 310:560–4.

11. Proimos J, Sawyer S. Obesity in childhood and adolescence. ***Australian family physician***, 2000, 29(4):321–6.

12. Klesges RC, Shelton ML, Klesges LM. Effects of television on metabolic rate: potential implications for childhood obesity. ***Pediatrics***, 1993, 91:281–6.

13. Berkey CS et al. Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. ***Pediatrics***, 2000, 105: E56.

14. McMurray RG et al. The influence of physical activity, socioeconomic status, and ethnicity on the weight status of adolescents. ***Obesity research***, 2000, 8(2):130–9.

15. Pate RR et al. Associations between physical activity and other health behaviors in a representative sample of US adolescents. ***American journal of public health***, 1996, 86:1577–81.

16. Al-Refaee SA, Al-Hazzaa HM. Physical activity profile of adult males in Riyadh City. ***Saudi medical journal***, 2001, 22(9):784–9.

17. Abdul Aziz A, Banerji S. ***Welcome to Eastern Province, Saudi Arabia***. Al Khobar, Saudi Arabia, Atariki Press (for Information Window Agency), 1993.

18. Caspersen C, Powell K, Christensen G. Physical activity, exercise, and physical fitness: definition and distinctions for health-related research. ***Public health reports***, 1985, 100:126–31.

19. LaPorte RE, Montoye HJ, Caspersen CJ. Assessment of physical activity in epidemiologic research: problems and prospects. ***Public health reports***, 1985, 100:131–46.

20. Macleod J, Edwards C, Bouchier I, eds. ***Davidson's principles and practice of medicine***, 15th ed. Hong Kong, Churchill Livingstone, 1987.

21. Fleiss JL. ***Statistical methods for rates and proportions***, 2nd ed. New York, John Wiley & Sons, 1981.

22. Khattab MS et al. Risk factors of coronary heart disease: attitude and behaviour in family practice in Saudi Arabia. ***Eastern Mediterranean health journal***, 1999, 5:35–45.

23. Schuster C et al. A multinational comparison of health knowledge: college students in Canada, Nigeria, and the United States. ***College student journal***, 1999, 33:8.

24. Nicholson T et al. The Health Knowledge Inventory-Alpha: a personal health knowledge test for high school seniors. ***Journal of school health***, 1991, 61(4):430–2.

25. Smith BA et al. Health knowledge of predominantly Mexican American high school students. ***Journal of health education***, 1998, 29(1):21–5.

26. State-specific prevalence of participation in physical activity—Behavioral Risk Factor Surveillance System, 1994. ***Morbidity and mortality weekly report***, 1996, 45(31):673–5.

27. Al-Hazzaa H, Sulaiman M. Maximal oxygen uptake and daily physical activity in 7 to 12-year-old boys. ***Pediatric exercise science***, 1993, 5:357–66.

28. Al-Hazzaa H et al. Cardiorespiratory fitness, physical activity patterns, and selected coronary artery disease risk factors in preadolescent boys. ***International journal of sports medicine***, 1994, 15:267–72.

29. Armstrong N, Bray S. Physical activity patterns defined by continuous heart rate

monitoring. ***Archives of disease in childhood***, 1991, 66:245–7.

30. Gilbey H, Gilbey M. The physical activity of Singapore primary school children as estimated by heart rate monitoring. ***Pediatric exercise science***, 1995, 7:26–35.
31. Sallo M, Sila R. Physical activity with moderate to vigorous intensity in preschool and first grade schoolchildren. ***Pediatric exercise science***, 1997, 9:44–54.
32. Johnson MF et al. Interrelationships between physical activity and other health behaviors among university women and men. ***Preventive medicine***, 1998, 27(4):536–44.
33. Reynolds KD et al. Psychosocial predictors of physical activity in adolescents. ***Preventive medicine***, 1999, 19:541–51.
34. Garcia AW et al. Changes in physical activity beliefs and behaviors of boys and girls across the transition to junior high school. ***Journal of adolescent health***, 1998, 22(5):394–402.
35. Kelder SH et al. Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. ***American journal of public health***, 1994, 84(7):1121–6.

WHO report on the global tobacco epidemic, 2008
The MPOWER package

This landmark new report presents the first comprehensive worldwide analysis of tobacco use and control efforts. It provides countries with a roadmap to reverse the devastating global tobacco epidemic that could kill up to one billion people by the end of this century.

The report outlines the MPOWER package, a set of 6 key tobacco control measures that reflect and build on the World Health Organization Framework Convention on Tobacco Control. It can be downloaded at: http://www.who.int/tobacco/mpower/en/index.html.