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Lifestyle risk factors for overweight in Japanese male college students

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Abstract

Objective: To identify lifestyle and sociodemographic risk factors of overweight among male college students.
Design: A retrospective cohort study.
Setting: Annual health checkup in a single university in Japan.
Participants: Male students who underwent two successive health checkups from their third school year between 2000 and 2007 and whose BMI at baseline of this study was 22·0 kg/m^2 or more (*n* 4634).
Results: During the 1-year follow-up, 598 students (12·9 %) reached the study endpoint, i.e. more than a 5 % increase in BMI. Independent risk factors for substantial BMI increase included infrequent exercise (OR = 1·33; 95 % CI 1·11, 1·60), no or infrequent alcohol drinking (OR = 1·30; 95 % CI 1·08, 1·57), frequently skipping breakfast (OR = 1·34; 95 % CI 1·12, 1·61), preference for fatty food (OR 1·36; 95 % CI 1·04, 1·78) and living alone (OR = 1·23; 95 % CI 0·99, 1·52). Students were readily stratified according to risk for substantial BMI gain by counting the number of their risk factors. OR (95 % CI) for the risk between the no risk factor group and students with two, three, four and five risk factors were 1·61 (0·96, 2·70), 2·24 (1·34, 3·75), 2·42 (1·39, 4·23) and 6·22 (2·58, 15·0), respectively.
Conclusion: These data suggest that avoidance of certain risk factors in college life is associated with a decrease in incidence of overweight among male students.

Keywords
Overweight
Students
Risk factors

Obesity has become one of the most important public health problems in the world[1]. Difficulties of weight control for obese people indicate that prevention may be the best possible approach to struggle against this obesity epidemic; interventions should be taken before adult lifestyle patterns solidify such as high fat intake and sedentariness. An article on schoolchildren revealed that the attitude towards healthy lifestyle in their school days had a significant impact on their later life[2]. Thus far, however, lifestyle modification in younger generations has not been thoroughly discussed.

According to the white paper on college student health[3,4] issued every 5 years by the National University Council of Health Administration Facilities, the proportion of male overweight or obese students (BMI ≥25·0 kg/m^2) increased from 9·8 % in 2000 to 11·7 % in 2005 in Japan. Furthermore, the prevalence of obesity increased at around age 23 years and thereafter, indicating that many students would graduate without acquiring a healthy lifestyle and begin to gain weight when employed because of the decrease in exercise and the exposure to many stressors in hardworking Japanese society. According to the annual report of the Japanese Ministry of Education, Culture, Sports, Science and Technology, as many as 51·5 % of the Japanese people matriculated to a university in 2005[5]. We, therefore, must discuss in more detail student lifestyle modification as a matter of higher education.

Because factors of obesity may vary among and within societies exposed to different environments[6] and little is known about the factors that contribute to the worldwide obesity epidemic, it is meaningful to evaluate the factors that determine the obesity process in different regions and different cultures. BMI in childhood, parents' weights and 'Western' dietary pattern, characterised by high intakes of meats, fats and oils, seasonings, processed meats and eggs, have been suggested to have an association with overweight or obesity among Japanese college students[7,8]. However, all these studies were conducted in a cross-sectional manner, and the causal relationship between lifestyle of Japanese college students and incidence of overweight has not been examined by a cohort design.

Thus, the objective of the current study is to identify lifestyle and sociodemographic risk factors for becoming overweight among male college students and to construct

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a self-administered tool to stratify students according to the risk of overweight based on the cohort data collected at the annual health checkups.

Methods

We carry out a health checkup for the students of Kyoto University every spring according to the School Health Law (http://www.houko.com/00/01/S33/056.HTM). We analysed the data from anthropometry and the self-administered questionnaire about lifestyle, both of which were routinely collected in the annual health checkups between 2000 and 2007. The data included sex, age, major, nationality, height, weight, family history of some specific pathologies (diabetes mellitus, hypertension and dyslipidaemia), past medical history, current illness and residential environment (living alone or with family). Information on dietary habits such as frequencies of eating out for dinner and skipping breakfast, dietary preferences, exercise frequency, as well as sleeping, smoking and drinking habits were also included. The lifestyle questionnaire was delivered to individual students in advance and collected at the health checkup site. Weight and height were measured while wearing light clothes, but with their shoes off, subtracting the presumed weight of clothes, and determined to the nearest 0·1 kg and 0·1 cm, respectively. BMI was calculated as weight (kg) divided by the square of height (m).

Male students who underwent the health checkups in both their third and fourth years and whose BMI in the third year was 22·0 kg/m^2 or more were included in the analyses because the increase in BMI should not be a health problem for the students whose baseline BMI was less than 22·0 kg/m^2. The study endpoint was more than a 5 % increase in BMI over the former year: corresponding weight gain of 3·2 kg or more in a student with 170 cm in height and 64 kg in weight (BMI, nearly equal 22·0 kg/m^2). Because the present study was merely a retrospective analysis of routinely collected data in the legislated health checkup, informed consent from participants was not required for the study[9].

Statistical analysis

OR of potential predictive factors for BMI increase were estimated using the logistic regression model. The independent effect of each variable was assessed by multivariable analysis. Here, frequencies of skipping breakfast, eating out and exercise were dichotomised by twice a week or more or not. Even though the drinking habit was also dichotomised by no or infrequent drinking or not for the construction of the prediction model, it was classified in more detail to closely assess the relationship between alcohol consumption and BMI gain: non- or infrequent, sometimes (several times per week or per month), daily (five times per week or more, less than 633 ml of beer per day), and daily heavy (five times per week or more, 633 ml of beer per day or more) drinkers. Height and weight were not included in the multivariable analysis because of their close relation with BMI. The number of significant predictors that the individual students possess was taken to be a score to estimate the risk of a substantial increase in BMI.

To clarify the utility of this prediction score, the actual proportion of students with an increase in BMI of more than 5 % among those with the same score was calculated. The OR for the risk with the 95 % CI in students with each risk score compared to those without any risk factors were also calculated. The area under the receiver-operating characteristic (ROC) curve for the risk of a substantial increase in BMI was estimated by the non-parametric method.

The prediction score was applied to 100 bootstrap samples of the same size as the original data, and the 95 % CI of the OR between the no risk factor group and other risk groups were estimated to validate the discriminant ability of the model[10].

To assess how or whether in fact the prediction score related to the incidence of overweight, students with a baseline BMI of less than 24·0 kg/m^2 were stratified by the individual risk score. The incidence rate of overweight, a BMI of more than 25·0 kg/m^2 in the fourth year, was then calculated.

Analyses were computed using Stata 10·1 software (Stata Corporation, College Station, TX, USA, 2009). All tests of significance were two-tailed, and values of $P < 0.05$ were considered statistically significant.

Results

Among 14 129 male students who underwent the health checkups in both their third and fourth years between 2000 and 2007 and their lifestyle data were available, 4634 students whose BMI in the third year was 22·0 kg/m^2 or more were included in the current analysis. The analysis sample was on average 21·5 (SD 1·9) years of age and 24·2 (SD 2·3) kg/m^2 of BMI, and 1080 students (23·3 %) had a BMI of more than 25·0 kg/m^2 in the third year. In the next year, 598 students (12·9 %) reached the endpoint, an increase in BMI of more than 5 %.

Table 1 summarises the demographic, anthropometric and lifestyle characteristics of the study subjects and their association with a 5 % increase in BMI by univariable analysis. Living alone, sedentariness, no or infrequent alcohol drinking, frequently skipping breakfast and preference for fatty food were associated with the risk of BMI increase.

In the multivariable analysis, four of five variables significant in the univariable analysis were also independent predictors of weight gain, and another, living alone, had a marginally significant association with the risk (Table 2).

In Table 3, we show the proportion of students with an increase in BMI of more than 5 % among each risk score

Table 1 Demographic, anthropometric and lifestyle characteristics of students and their association with a 5 % increase in BMI (univariable analysis)

	BMI gain ≥ 5 %						
	Yes (*n* 598)		No (*n* 4036)				
	Mean or *n*	SD or %	Mean or *n*	SD or %	OR	95 % CI	*P* value
Age (years)	21·5	1·3	21·6	1·9	0·97	0·92, 1·03	0·33
Nationality							
Japan	584	12·8	3978	87·2	–		
Other countries	14	19·4	58	80·6	1·64	0·91, 2·97	0·099
Major							
Sciences	370	12·5	2598	87·5	–		
Arts	228	13·7	1438	86·3	1·11	0·93, 1·33	0·24
Height (cm)	172·0	6·2	172·1	5·8	1·00	0·99, 1·00	0·89
Weight (kg)	72·1	9·1	71·6	8·5	1·00	0·99, 1·00	0·15
BMI (kg/m^2)	24·3	2·4	24·1	2·3	1·03	0·99, 1·07	0·062
Current illness							
Absent	561	13·1	3708	86·9	–		
Present	37	10·1	328	89·9	0·75	0·52, 1·06	0·10
Past medical problem							
Absent	575	13·1	3820	86·9	–		
Present	23	9·6	216	90·4	0·71	0·46, 1·10	0·12
Family history of diabetes mellitus							
Absent	566	12·8	3851	87·2	–		
Present	32	14·8	185	85·3	1·18	0·80, 1·73	0·41
Family history of dyslipidemia							
Absent	586	12·9	3969	87·1	–		
Present	12	15·2	67	84·8	1·21	0·65, 2·26	0·54
Residence							
Living with family	133	11·0	1073	89·0	–		
Living alone	465	13·6	2963	86·4	1·27	1·03, 1·55	0·024
Exercise							
Twice a week or more	211	10·8	1735	89·2	–		
Once a week or less	382	14·4	2268	85·6	1·38	1·16, 1·66	<0·001
Sleeping hours							
Less than 8 h	550	12·7	3786	87·3	–		
8 h or more	42	15·4	230	84·6	1·26	0·89, 1·77	0·19
Current smoking							
No	509	12·6	3521	87·4	–		
Yes	89	14·7	515	85·3	1·20	0·94, 1·52	0·15
Alcohol drinking							
Every day/often	395	12·1	2868	87·9	–		
Never/seldom	203	14·8	1168	85·2	1·26	1·05, 1·51	0·012
Eating out for dinner							
Once a week or less	183	12·7	1261	87·3	–		
Twice a week or more	415	13·0	2775	87·0	1·03	0·86, 1·24	0·75
Skipping breakfast							
Once a week or less	274	11·2	2180	88·8	–		
Twice a week or more	324	14·9	1856	85·1	1·39	1·17, 1·65	<0·001
Current dietary restriction for particular illnesses							
No	586	12·8	3989	87·2	–		
Yes	12	20·3	47	79·7	1·74	0·92, 3·30	0·090
Dietary preferences							
Distaste for meat							
No	591	12·9	4006	87·1	–		
Yes	7	18·9	30	81·1	1·58	0·69, 3·62	0·28
Distaste for fish							
No	584	12·9	3960	87·2	–		
Yes	14	15·6	76	84·4	1·25	0·70, 2·22	0·45
Distaste for vegetables							
No	578	12·9	3918	87·1	–		
Yes	20	14·5	118	85·5	1·15	0·71, 1·86	0·57
Preference for salty foods							
No	534	12·8	3652	87·2	–		
Yes	64	14·3	384	85·7	1·14	0·86, 1·51	0·36
Preference for fatty foods							
No	524	12·5	3662	87·5	–		
Yes	74	16·5	374	83·5	1·38	1·06, 1·80	0·017
Preference for sweets							
No	506	12·8	3447	87·2	–		
Yes	92	13·5	589	86·5	1·06	0·84, 1·35	0·61

Values are expressed as mean and SD or number and %. Sample sizes may vary among presented variables because of missing data.

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group and the OR of the risk using those without risk factors as the reference group. If the students did not have any risk factors, the incidence rate of a substantial increase in BMI was 7·8 %, whereas students with all five risk factors had a 34·4 % incidence. Compared to students without risk factors, the OR for a substantial increase in BMI in those with two, three, and five risk factors were 1·6 (95 % CI 0·96, 2·70), 2·2 (95 % CI 1·34, 3·75) and 6·2 (95 % CI 2·58, 15·0), respectively. The area under the ROC curve of this prediction model was 0·577 (95 % CI 0·553, 0·600).

The bootstrap estimates of 95 % CI of the OR for more than 5 % of an increase in BMI between the no risk factor group and other risk groups were reasonably narrow for most of the risk groups (Table 3). The subgroup analysis including students with a BMI of less than 24·0 kg/m^2 (*n* 2868) showed a gradual increase in the incidence of overweight, BMI of more than 25·0 kg/m^2, by increasing the number of risk factors at baseline; incidence rates of overweight during the next year were 2/142 (1·4 %), 11/626 (1·8 %), 37/1003 (3·7 %), 53/822 (6·5 %), 11/230 (4·8 %) and 4/20 (20·0 %) among students with zero, one, two, three, four and five risk factors, respectively.

In the multivariable model including the more closely classified alcohol variable instead of just the dichotomised one, the adjusted OR of sometimes (*n* 3085), daily (*n* 91), and daily heavy (*n* 54) drinkers compared with non- or infrequent drinkers (*n* 1371) were 0·76 (95 % CI 0·63, 0·92), 0·82 (95 % CI 0·44, 1·54) and 1·01 (95 % CI 0·49, 2·12), respectively.

Discussion

On the basis of the data obtained in our annual health checkup for college students, we identified the predictive indicators for substantial BMI increase and developed a prediction score for stratifying the students by risk of weight gain during 1 year. Sedentariness, no/infrequent alcohol drinking, frequently skipping breakfast, preference for fatty food and living alone were independently related to BMI increase. The prediction score successfully classified students according to their BMI-increase risk.

As the differences between males and females in exposure and vulnerability to obesogenic environments and the consequences of child and adolescent obesity were suggested in a review article[11], and the proportion of female students among students with a baseline BMI of more than 22·0 kg/m^2 was small (636/5270, 12·1 %), we included only male students in the current analysis. Actually, there was a significant male excess in risk of the substantial BMI increase (OR = 2·40; 95 % CI 1·70, 3·38) when analysing the data set including both genders.

No or infrequent alcohol drinking was independently associated with the risk of substantial BMI increase in the current analysis. Alcoholic beverages may not substitute for other foods, but are energy dense and added to the total daily energy intake[12]. In addition, fat oxidation might be inhibited by the antilipolytic properties of metabolites from alcohol degradation[13–15]. These features could potentially promote fat storage and hence increase the risk of developing obesity. Nevertheless, results from the earlier epidemiological studies for the association between alcohol intake and obesity are inconsistent as to the role of alcohol consumption in obesity development[16]. If the observed associations between drinking frequency and obesity actually represent causal associations, a possible biological mechanism is a difference in the induction of the microsomal ethanol-oxidising system (MEOS) by drinking frequency. In daily alcohol consumers, a larger fraction of the alcohol energy might be disposed of due to the induction of MEOS[17,18].

Because the current results can be misconstrued by students as an encouragement to engage in heavy drinking, they must be carefully presented to the general public. Heavy drinking would cause considerable health problems and the significant excess risk of substantial BMI increase among non- or infrequent drinkers was not found in comparison with daily heavy drinkers in the current subanalysis. It is not easy to restrict alcohol consumption to low-to-moderate levels. Therefore, university health-care providers who use these results for health

Table 2 Predictors of substantial BMI increase by multivariable analysis

	OR	95 % CI	*P* value
Skipping breakfast, twice a week or more	1·34	1·12, 1·61	0·002
Exercise, once a week or less	1·33	1·11, 1·60	0·002
No or infrequent alcohol drinking	1·30	1·08, 1·57	0·005
Preference for fatty food	1·36	1·04, 1·78	0·024
Living alone	1·23	0·99, 1·52	0·063

Table 3 The proportion of students with an increase in BMI of more than 5 % among each risk group and the OR for the risk

Number of risk factors	Proportion of students with more than 5 % of the BMI increase (%)	OR	95 % CI	95 % CI estimated by the bootstrap method
0	17/219 (7·8)	–	–	–
1	93/996 (9·3)	1·22	0·71, 2·10	0·77, 1·93
2	192/1612 (11·9)	1·61	0·96, 2·70	1·01, 2·57
3	209/1318 (15·9)	2·24	1·34, 3·75	1·42, 3·54
4	71/419 (17·0)	2·42	1·39, 4·23	1·46, 4·03
5	11/32 (34·4)	6·22	2·58, 15·0	2·38, 16·3

promotion should make an appeal to students not to indulge in alcohol.

This prediction model is so simple that students can easily grasp their own risk for weight gain during the following year by counting the number of risk factors they have, which would be a cue to action towards establishing a healthy lifestyle. For example, a student with three risk factors can readily become aware that he is more than twice more likely to gain substantial weight (OR = 2·2) than the students without any risk factors. In addition, implementation of this prediction model in mass screening would promote social norms encouraging healthy behaviours. To be specific, we intend to post the results or give a leaflet to students at a health checkup site. Perhaps, health-care providers in the university health service might use this score to concentrate their effort on the high-risk students.

Because this is a retrospective analysis of routinely collected data, we could not obtain sufficient information about already known environmental and genetic risk factors of obesity in youths. For example, the amount of time spent in watching television and using electronic games is directly related to the prevalence of obesity in children and adolescents[19–24]. Parents' BMI was the best predictor of overweight according to the case–control study among Brazilian adolescents[25]. Furthermore, two studies suggested that a variant in the *FTO* gene on chromosome 16 would affect the risk of obesity in the general population[26,27]. Some specific eating patterns such as restrained, disinhibited and emotional eating were also indicated to be strong predictors of future weight gain[28–31]. The lack of information on these factors might cause the relatively low accuracy of the current predictive model (the area under the ROC curve, 0·58).

Some other potential limitations of the current analysis must be acknowledged. First, most of the candidate predictors were solely based on the students' self-report, and no objective measures were used except for height and weight. Indeed, the bias attributable to self-report may have occurred, but self-reporting has been widely used in behavioural sciences with some validity shown in comparative studies using physiological markers. It is also acceptable in terms of feasibility[32]. Second, body composition of the study subjects was not known from the obtained data. Therefore, we could not identify the components of weight gain, muscle or fat. Third, the current prediction model was developed in a single university in Japan, and the applicability of the results to other colleges and races was not verified. Even though the prevalence of overweight or obesity was lower in the population of the current analysis (1080/14 129 (7·6 %)) than in Japanese male college students as a whole (9·8 % and 11·7 % in 2000 and 2005, respectively)[3,4], lifestyles of the Kyoto University students did not much differ from those of other university students[3]. Thus, the current prediction model can be reasonably useful for Japanese university students. Additionally, because factors which determine the process of obesity may be closely related to the exposed environments[6], identification of the obesogenic factors in different regions in the world is meaningful.

In summary, the present study revealed that infrequent exercise, no or infrequent alcohol drinking, frequently skipping breakfast, preference for fatty food and living alone were independent risk factors for substantial BMI increase in Japanese male college students. These risk factors can predict future obesity rather well and are readily applicable for mass screening. A clear knowledge of such factors would thus help motivate students to improve their lifestyle health behaviours.

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References

1. Kellner K & Helmuth L (2003) Obesity – what is to be done? *Science* **299**, 845.
2. Cohen RY, Brownell KD & Felix MR (1990) Age and sex differences in health habits and beliefs of schoolchildren. *Health Psychol* **9**, 208–224.
3. Japanese National University Council of Health Addministration Facilities (2005) White Paper on College Student Health 2005. http://hotai1.htc.nagoya-u.ac.jp/ ~ kondo/hakusho/hakusho2005
4. Japanese National University Council of Health Addministration Facilities (2000) White Paper on College Student Health 2000. http://hotai1.htc.nagoya-u.ac.jp/ ~ kondo/hakusho/hakusho2000
5. Annual Report of the Japanese Ministry of Education, Culture, Sports, Science, and Technology (2005) http://www.mext.go.jp/b_menu/toukei/001/04073001/001.htm
6. Parsons TJ, Power C, Logan S *et al.* (1999) Childhood predictors of adult obesity: a systematic review. *Int J Obes Relat Metab Disord* **23**, S1–S107.
7. Okubo H, Sasaki S, Murakami K *et al.*, Freshmen in Dietetic Courses Study II group (2008) Three major dietary patterns are all independently related to the risk of obesity among 3760 Japanese women aged 18–20 years. *Int J Obes (Lond)* **32**, 541–549.
8. Kubo T, Furujo M, Ueda Y *et al.* (2008) Predicting obesity in early adulthood in Japanese women. *J Paediatr Child Health* **44**, 33–37.
9. Japanese Ministries of Education, Culture, Sports, Science and Technology and Health, Labour and Welfare (2002, revised in 2007) Ethical Guideline for Epidemiological Research. http://www.lifescience.mext.go.jp/bioethics/ekigaku.html
10. Efron B & Tibshirani R (1993) *An Introduction to the Bootstrap. Monographs on Statistics and Applied Probability.* New York: Chapman & Hall.
11. Sweeting HN (2008) Gendered dimensions of obesity in childhood and adolescence. *Nutr J* **7**, 1.

12. Colditz GA, Giovannucci E, Rimm EB *et al.* (1991) Alcohol intake in relation to diet and obesity in women and men. *Am J Clin Nutr* **54**, 49–55.
13. Suter PM, Schutz Y & Jequier E (1992) The effect of ethanol on fat storage in healthy subjects. *N Engl J Med* **326**, 983–987.
14. Sonko BJ, Prentice AM, Murgatroyd PR *et al.* (1994) Effect of alcohol on postmeal fat storage. *Am J Clin Nutr* **59**, 619–625.
15. Murgatroyd PR, Van De Ven ML, Goldberg GR *et al.* (1996) Alcohol and the regulation of energy balance: overnight effects on diet-induced thermogenesis and fuel storage. *Br J Nutr* **75**, 33–45.
16. Suter PM (2005) Is alcohol consumption a risk factor for weight gain and obesity? *Crit Rev Clin Lab Sci* **42**, 197–227.
17. Levine JA, Harris MM & Morgan MY (2000) Energy expenditure in chronic alcohol abuse. *Eur J Clin Invest* **30**, 779–786.
18. Suter PM (2000) The paradox of the alcohol-paradox – another step towards the resolution of the 'alcohol energy wastage' controversy. *Eur J Clin Invest* **30**, 749–750.
19. Dietz WH Jr & Gortmaker SL (1985) Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. *Pediatrics* **75**, 807–812.
20. Gortmaker SL, Must A, Sobol AM *et al.* (1996) Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. *Arch Pediatr Adolesc Med* **150**, 356–362.
21. Kaur H, Choi WS, Mayo MS *et al.* (2003) Duration of television watching is associated with increased body mass index. *J Pediatr* **143**, 506–511.
22. Berkey CS, Rockett HR, Gillman MW *et al.* (2003) One-year changes in activity and in inactivity among 10- to 15-year-old boys and girls: relationship to change in body mass index. *Pediatrics* **111**, 836–843.
23. Stettler N, Signer TM & Suter PM (2004) Electronic games and environmental factors associated with childhood obesity in Switzerland. *Obes Res* **12**, 896–903.
24. Kautiainen S, Koivusilta L, Lintonen T *et al.* (2005) Use of information and communication technology and prevalence of overweight and obesity among adolescents. *Int J Obes (Lond)* **29**, 925–933.
25. Neutzling MB, Taddei JA & Gigante DP (2003) Risk factors of obesity among Brazilian adolescents: a case–control study. *Public Health Nutr* **6**, 743–749.
26. Frayling TM, Timpson NJ & Weedon MN (2007) A common variant in the FTO gene is associated with body mass index and predisposes to childhood and adult obesity. *Science* **316**, 889–894.
27. Dina C, Meyre D & Gallina S (2007) Variation in FTO contributes to childhood obesity and severe adult obesity. *Nat Genet* **39**, 724–726.
28. Drapeau V, Provencher V, Lemieux S *et al.* (2003) Do 6-y changes in eating behaviors predict changes in body weight? Results from the Québec Family Study. *Int J Obes Relat Metab Disord* **27**, 808–814.
29. Stice E, Presnell K, Shaw H *et al.* (2005) Psychological and behavioral risk factors for obesity onset in adolescent girls: a prospective study. *J Consult Clin Psychol* **73**, 195–202.
30. McGuire MT, Wing RR, Klem ML *et al.* (1999) What predicts weight regain in a group of successful weight losers? *J Consult Clin Psychol* **67**, 177–185.
31. Van Strien T, Frijters JE, Bergers GPA *et al.* (1986) Dutch eating behavior questionnaire for assessment of restrained, emotional and external eating behavior. *Int J Eat Disord* **5**, 295–315.
32. Montoye HJ, Kemper HCG, Saris WHM *et al.* (1996) *Measuring Physical Activity and Energy Expenditure*. Champaign, IL: Human Kinetics.