Physical activity, quality of life, weight status and diet in adolescents

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Abstract

Purpose This cross-sectional study aimed to investigate the relationship between quality of life (QoL), physical activity (PA), diet and overweight status in children 11 to 15 years old.

Study participants Participants ($N = 1,771$) children with self-reported physical activity and QoL outcome data.

Methods Cross-sectional survey of four secondary schools, using the PedsQL and EQ-5D QoL instruments; the CAPANS physical activity instrument and a food intake screener questionnaire.

Results The correlational analysis indicates little or no relationship between self-reported QoL, BMI and moderate to vigorous PA. We found no statistically significant differences between the two groups of children, who achieved the recommended PA guidelines and those who did not, on any of the dimensions of the PedsQL and the EQ-5D utility score. Only on the EQ-5D VAS dimensions score was there a statistically significant difference. Children who self-reported a BMI of overweight to obese had significantly lower QoL on both dimensions of the EQ-5D and every dimension of the PedsQL apart from School functioning.

Conclusion Overall this study showed mixed results for pupils achieving the recommended targets for physical activity and diet and their relationship with QoL. Hence, further study into PA and diet and their effects on QoL is needed.

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Abbreviations

SEN	Special educational needs
GSCE	General secondary certificate examination
BMI	Body mass index
PedsQL	PF PedsQL Physical functioning dimension
PedsQL EF	PedsQL Emotional functioning
PedsQL SF	PedsQL Social functioning
PedsQL SchF	PedsQL School functioning
PedsQL PHSS	PedsQL Psychosocial health summary score
PedsQL Total	PedsQL Total scale score
EQ-5D VAS	Visual analogue scale
EQ-5D	Utility overall utility (Tariff)

Introduction

Physical activity (PA) and its associated benefits to health are now well established. Examples of these benefits include skeletal health, obesity prevention (coupled with dietary intervention), psychological health and esteem, and prevention of Cardiovascular disease (CVD) risk factors [1–5].

The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) have explicitly quantified the amounts and intensities of PA that should be accumulated for optimum health. During a week, adults are recommended to participate in aerobic PA (of a moderate

intensity level) for at least 30 min, on at least 5 days, or 20 min of vigorous intensity cardiovascular exercise on 3 days (or a combination of the two) alongside eight to ten strength-based exercises twice per week [6]. In the UK, the Department of Health recommends that children take part in 60 min of PA per day on each day of the week and at least twice per week the activity should be muscle strength and flexibility based [7].

A positive association between PA and a higher perceived health-related quality of life (HRQoL) in adults has also been documented [8]. Some evidence exists that children who regularly participate in PA are more likely to report higher quality of life than those who had never participated [9]. However, PA and QoL studies in children are often confined to populations with a chronic condition or specific health problem. For example, Shoup and colleagues reported that physical, psycho-social and total quality of life scores were significantly lower in obese children compared to overweight children [10]. Further studies by Schwimmer, Friedlander and Pinhaus-Hamiel and colleagues all examined overweight compared to normal weight children and found normal weight children reporting higher quality of life scores [11–13].

Few studies are available that examine whether English secondary school pupils who meet the recommended guidelines for PA show any difference in self-reported QoL to those children not attaining the recommendations. Therefore, the main aim of this cross-sectional survey was to explore the relationship between self-reported physical activity and QoL (as measured by the PedsQL and EQ-5D) in English school children aged 11–15. Secondary objectives were to investigate the relationship between self-reported dietary intake, Body Mass Index (BMI) and QoL.

Methods

Design and setting

Four comprehensive secondary schools were matched according to characteristics described in the Office for Standards in Education (Ofsted) reports; two were in the northwest of England, two in the southwest. The schools were selected on the basis of a close match in examination results, percentage of children on free school meals and percentage of children with special educational needs (SEN). The participating schools were part of a cross-sectional study examining PA, diet and QOL. Questionnaires were completed in class in the presence of a teacher and the same questionnaires were completed twice, once in the summer term and once in the winter term.

University of Sheffield research ethics committee approval was obtained for this study, and the Local Education Authority was consulted in order to gain initial contact with the secondary schools involved. Consultation with the heads of the secondary schools followed this. Initially, the study details were circulated in a school newspaper, which every parent receives, at each school. After this process, the whole school populations were given an information letter to take home with a consent slip to be returned by a parent or guardian. As children were of secondary school age, it was thought they could sign consent to fill out a survey on the day of the study, if a parental slip had not been returned [14].

Participants

Two thousand eight hundred and fifty-eight pupils aged 11–15 in four secondary schools in England (2 in the northwest (NW) and 2 in the southwest (SW) region) were sent a letter with consent slip attached explaining the survey study and invited to participate in an anonymous survey on two occasions (once in the winter and again in the summer). The participating children had to give written consent to take part in the study. Eight hundred and sixty-nine children (869/2858 or 30%) responded to the winter survey and had valid self-reported physical activity data, and 35% (1000/2858) responded to the summer survey, an overall response rate of 33% (1869/5716) (see Table 1). Of these, 1,771 also completed the PedsQL and had valid QoL and physical activity outcome data which were analysed in this study.

There were no differences between the children who completed the QoL assessments and declined to complete the QoL assessment, on self-reported physical activity, BMI, fruit intake, fat intake, sex and receipt of free school meals. The only significant differences were that those who did not complete the QoL assessments were more likely to be younger (mean of 12.2 vs. 13.2 years of age); more likely to be at school in the SW (6.8 vs. 4.4%) and of white ethnicity (6.6 vs. 3.1%). As this was an anonymous survey, no information was collected on the characteristics of the non-respondents to the questionnaire; therefore, a comparison of respondents to non-respondents cannot be made. Also, since this was an anonymous survey, we have no information on how many children completed the survey twice once in the winter and again in the summer.

Measures

Self-reported demographic information was collected from the pupils such as age, sex, ethnicity, entitlement to free school meals, height and weight.

Table 1 Survey response rates and school characteristics

	School				
	1	2	3	4	Totals
Number of children role	1198	923	922	671	3714
GSCE Examination Results (2004) % five or more passes with grades A to C	43%	52%	42%	51%	National Average = 54.5%
Key stage 3 assessment results (2004) (average point score)	32.8	32.5	31.9	33.9	England Average Point Score = 34.1
Percentage of SEN pupils on statement (2005)	1.8%	2.1%	7.1%	3.4%	National Average SEN with Statement = 2.9%
Percentage, with SEN but not on statement	25.1%	27.1%	5.9%	16.7%	without statement = 14.9%
1st wave: winter 2006					
No. of children sent letters	965	744	567	582	2858
Questionnaires returned	438	343	213	64	1058
Incomplete questionnaires	81	83	25	0	189
Responders	357	260	188	64	869
1st wave overall response rate	357/965 (37%)	260/744 (35%)	188/567 (33%)	64/582 (11%)	869/2858 (30%)
2nd wave: summer 2007					
No. of children sent letters	965	744	567	582	2858
Questionnaires returned	543	261	225	279	1308
Incomplete questionnaires	118	84	53	53	308
Responders	425	177	172	226	1000
2nd wave overall response rate	425/965 (44%)	177/744 (24%)	172/567 (30%)	226/582 (39%)	1000/2858 (35%)

SEN Special educational need; GCSE General certificate of secondary education examination

Physical activity

The self-completed Western Australian Child and Adolescent Physical Activity and Nutrition Survey (CAPANS) questionnaire was used to assess physical activity [15]. The CAPANS consists of 24 questions and was first successfully used in a sample of 2274 children aged 7–16 in 2003 [16]. The CAPANS asks children to select the type of physical activity (from a comprehensive list of activities), they usually do in a typical week; and then to record the number of times they did the activity and the time spent on that activity. The total time spent on physical activity per week was calculated by totaling the time children spent in moderate or vigorous activity per day and then dividing this figure by seven to give an average for the week. The UK government recommends children are physically active at a moderate intensity for 60 min per day [7]. Therefore, the physical activity data were further classified into whether or not children were meeting the recommendations or not.

Diet

The Block food intake screener [17] was used to assess diet and the intake of fat, fibre, fruit and vegetables. The responses to the screener can then be used to estimate the amount of fat, fruit and vegetables a child is consuming in their diet. Fat and fruit intake for each child was then further classified as achieving the optimal of fats (<35% of calories consumed per day) or fruit and vegetable (at least 5 portions per day) or not.

Body mass index (BMI)

The pupils estimated their own height and weight which was then used to calculate each child's BMI. UK-specific BMI reference values and cut-off points were then used to classify each child as having normal weight or being overweight or obese [18, 19].

Quality of life

The Pediatric Quality of Life Inventory (PedsQL version 4.0) and European Quality of Life 5 Dimension measure (EQ-5D) were used to assess QoL [20, 21]. The 23-item PedsQL instrument is designed to measure QoL in children aged 4–18 and includes four QoL scales of (1) Physical Functioning (PF- 8 items), (2) Emotional Functioning (EF–5 items), (3) Social Functioning (SF- 5 items) and (4) School Functioning (Sch F 5 items). Two further scales can be created a Total scale and a Psycho-social health summary score. The Psychosocial health summary score is

computed as the sum of the items over the number of items answered in the Emotional, Social and School functioning scales. The Total scale score is computed as the sum of all the items over the number of items answered on all of the scales. Responses to the items are scored and transformed to a 0–100 scale, so that a higher score indicates better QoL [21].

The six-item EQ-5D (previously referred to as the EuroQol) is a generic quality of life instrument, designed to assess health outcomes. We used the youth version, EQ-5D-Y, which has been especially adapted for children [22, 23]. It was divided into two sections; section one addresses mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, which are each assessed by a single question on a three-point ordinal scale (no problems, some problems, extreme problems). An EQ-5D 'health state' is defined by selecting one level from each dimension. A total of 243 health states are thus defined. Values or preference weights for a sample of these health states were obtained from a general community sample using a time-trade-off (TTO) technique [24]. Estimates for all health states were extrapolated from this sample by statistical regression modelling. The EQ-5D preference-based measure can be regarded as a continuous outcome scored on a −0.59 to 1.00 scale, with 1.00 indicating 'full health' and 0 representing dead [24]. The negative EQ-5D scores represent certain health states valued as worse than death. The sixth item consists of a 100-point Visual Analogue, which asks responders to rate their overall health today on 0 (worst possible health) to 100 (best possible health) scale.

Statistical analyses

We used statistical methods to analyse the QoL outcome data as described in Walters [25]. The association between the QoL outcomes and BMI and minutes of physical activity per day was examined using Pearson correlation coefficients. Two independent sample t-tests were used to compare mean QoL scores between those children meeting or not meeting the recommended guidelines for physical activity; fat dietary consumption; fruit and vegetable dietary consumption and weight status. Finally, a multiple linear regression analysis was used to compare QoL outcomes between the above groups and allow for the potential confounding factors of age, sex (male vs. female), ethnicity (white vs. non-white), receipt of free school meals (yes/no), and area (NW/SW). Ninety-five per cent confidence intervals for the mean difference in QoL scores between the groups are reported for the unadjusted and adjusted analyses. This was an anonymous survey and we have no information about whether or not the children

completed the survey twice once in the winter and again in the summer. Therefore, the majority of the statistical analyses were performed and reported separately by season. To interpret the mean differences, we assumed a minimal important difference (MID) of 4.5 points for the PedSQL dimensions [26] and 0.07 for the EQ-5D utility score [27]. A P-value of less than 0.05 was regarded as statistically significant. SPSS version 14.0 was used for analysis of the data.

Results

Table 2 shows the demographic, QoL and PA levels of the responders to the survey. Just over half (51.7%) of the recruited children were boys, and the average age of the participants was 13.2 years (SD 1.2). Forty per cent of the participants were non-white. In addition, approximately, 25% of the participants were meeting the recommended guidelines for physical activity, and 23.5% of participants were classified as overweight/obese.

Table 3 shows the correlations between BMI, PA and QoL. The correlations between QoL and PA; and QoL and BMI suggested a very weak relationship ($r < 0.20$). The strongest correlations were for the intra-dimension correlations of the PedsQL.

Table 4 shows that there were no statistically significant differences between the two groups of children, those who achieved the physical guidelines and those who did not, on any of the dimensions of the PedsQL and the EQ-5D utility score. When a multiple linear regression model was applied, to adjust the comparison between the groups for age, gender, ethnicity, free school meals and area, there was also no significant difference between those achieving the PA recommendation and those who did not on any of the dimensions of the PedsQL and the EQ-5D utility score. The EQ-5D VAS scores for summer and winter showed those achieving the 60 min of PA per day recommendations reported significantly better scores than those who did not achieve the recommendations. However, the observed differences in EQ-5D VAS scores between the groups were less than four points suggesting that these differences are small in magnitude and may not be of any clinical or practical importance.

Table 5 shows the mean QoL scores by weight status. Statistically significant differences were observed between the normal and overweight/obese groups for the PF, EF, SF, PHSS and Total dimensions of the PedsQL and the EQ-5D VAS in summer and winter, with the normal weight group reporting better QoL. These differences remained after adjustment for covariates. However, the observed differences in PedsQL and EQ-5D VAS scores between the groups were generally between four and five points, around

Table 2 Demographic characteristics of sample by season

			Season								
			Winter			Summer			Total		
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Age (years)			814	13.1	1.2	957	13.3	1.3	1771	13.2	1.2
Self-reported height (metres)			706	1.6	0.1	558	1.6	0.1	1264	1.60	0.11
Self-reported weight (kg)			696	48.9	11.2	465	48.6	12.6	1161	48.76	11.80
Estimated BMI (kg/m^2) from estimated height and weight			691	19.1	3.8	423	18.8	3.7	1114	19.00	3.76
Minutes of sedentary behaviour per day (last 7 days)			814	307.2	173.2	956	241.6	122.0	1770	271.8	151.3
Minutes of (mod/vig) Physical activity per day			813	36.5	36.4	957	50.5	39.1	1770	44.1	38.5
PedsQL Physical functioning			814	89.5	15.3	957	90.8	14.0	1771	90.2	14.6
PedsQL Emotional functioning			814	81.6	20.9	957	83.5	19.5	1771	82.6	20.2
PedsQL Social functioning			814	88.2	18.5	957	89.1	17.4	1771	88.7	17.9
PedsQL School functioning			814	79.8	20.3	957	81.0	19.8	1771	80.5	20.0
PedsQL Psychosocial health summary score			814	83.2	17.1	957	84.5	15.6	1771	83.9	16.3
PedsQL Total scale score			814	84.8	15.8	957	86.1	14.2	1771	85.5	14.9
EQ-5D VAS			772	78.7	16.9	819	78.1	17.1	1591	78.4	17.0
EQ-5D Overall utility (Tariff)			779	0.90	0.16604	896	0.89	0.21	1675	0.90	0.19
									N	%	
School year											
7	199	(24.4%)				355	(37.1%)		554	(31.3%)	
9	369	(45.3%)				344	(35.9%)		713	(40.3%)	
10	246	(30.2%)				258	(27.0%)		504	(28.5%)	
	814	(100.0%)				957	(100.0%)		1771	(100.0%)	
Gender											
Male	407	(50.0%)				508	(53.1%)		915	(51.7%)	
Female	407	(50.0%)				449	(46.9%)		856	(48.3%)	
	814	(100.0%)				957	(100.0%)		1771	(100.0%)	
Achieving 60 min of moderate/vigorous Physical activity per day											
No	673	(82.7%)				652	(68.1%)		1325	(74.8%)	
Yes	141	(17.3%)				305	(31.9%)		446	(25.2%)	
	814	(100.0%)				957	(100.0%)		1771	(100.0%)	
Ethnicity											
Non-white	328	(40.3%)				371	(38.8%)		699	(39.5%)	
White	486	(59.7%)				586	(61.2%)		1072	(60.5%)	
	814	(100.0%)				957	(100.0%)		1771	(100.0%)	
Child in receipt of school meals											
No	655	(80.6%)				789	(82.5%)		1444	(81.6%)	
Yes	158	(19.4%)				167	(17.5%)		325	(18.4%)	
	813	(100.0%)				956	(100.0%)		1769	(100.0%)	
Optimal Fruit/vegetable intake of 5 or more portions of fruit/vegetables per day											
No, not optimal	403	(49.7%)				413	(43.2%)		816	(46.2%)	
Yes, optimal	408	(50.3%)				544	(56.8%)		952	(53.8%)	
	811	(100.0%)				957	(100.0%)		1768	(100.0%)	
Optimal Fat intake of < 35% of calary intake											
No, not optimal	624	(77.1%)				751	(78.5%)		1375	(77.9%)	
Yes, optimal	185	(22.9%)				206	(21.5%)		391	(22.1%)	
	809	(100.0%)				957	(100.0%)		1766	(100.0%)	

Table 2 continued

						N	%
BMI of pupils grouped by normal or overweight/obese according to UK BMI cut points							
Overweight/obese	173	(25.1%)	89	(21.0%)		262	(23.5%)
Normal	517	(74.9%)	334	(79.0%)		851	(76.5%)
	690	(100.0%)	423	(100.0%)		1113	(100.0%)

Table 3 Correlations between physical activity, BMI and quality of life

	BMI (kg/m^2)	Physical activity (min/day)	PedsQL PF	PedsQL EF	PedsQL SF	PedsQL SchF	PedsQL PHSS	PedsQL total	EQ-5D VAS	EQ-5D utility
BMI (kg/m^2)										
Correlation	1									
P-value										
N	1114									
Physical activity (min) per day										
Correlation	−0.14	1								
P-value	<0.001									
N	1114	1770								
PedsQL PF										
Correlation	−0.08	−0.01	1							
P-value	0.009	0.677								
N	1114	1770	1771							
PedsQL EF										
Correlation	−0.07	0.03	0.57	1						
P-value	0.026	0.276	<0.001							
N	1114	1770	1771	1771						
PedsQL SF										
Correlation	−0.09	−0.02	0.61	0.60	1					
P-value	0.003	0.378	<0.001	<0.001						
N	1114	1770	1771	1771	1771					
PedsQL SchF										
Correlation	−0.04	0.03	0.54	0.57	0.50	1				
P-value	0.154	0.147	<0.001	<0.001	<0.001					
N	1114	1770	1771	1771	1771	1771				
PedsQL PHSS										
Correlation	−0.08	0.02	0.68	0.87	0.82	0.83	1			
P-value	0.009	0.471	<0.001	<0.001	<0.001	<0.001				
N	1114	1770	1771	1771	1771	1771	1771			
PedsQL total										
Correlation	−0.08	0.01	0.80	0.85	0.82	0.81	0.98	1		
P-value	0.006	0.626	<0.001	<0.001	<0.001	<0.001	<0.001			
N	1114	1770	1771	1771	1771	1771	1771	1771		
EQ-5D VAS										
Correlation	−0.19	0.14	0.33	0.28	0.28	0.25	0.33	0.35	1	
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
N	1047	1590	1591	1591	1591	1591	1591	1591	1591	
EQ-5D utility										
Correlation	−0.05	0.04	0.42	0.42	0.33	0.29	0.42	0.45	0.26	1
P-value	0.135	0.076	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	

Table 3 continued

	BMI (kg/m^2)	Physical activity (min/day)	PedsQL PF	PedsQL EF	PedsQL SF	PedsQL SchF	PedsQL PHSS	PedsQL total	EQ-5D VAS	EQ-5D utility
N	1077	1674	1675	1675	1675	1675	1675	1675	1583	1675

Table 4 Mean scores of QoL dimensions by physical activity status and season

	Achieving 60 min of moderate/vigorous physical activity per day															
	No			Yes			Mean difference	95% CI			Adjusted difference	95% CI		
	N	Mean	SD	N	Mean	SD		Lower	Upper	P-value*		Lower	Upper	P-value#
Winter														
PedsQL PF	673	89.9	14.0	141	87.8	20.1	−2.1	−4.8	0.7	0.144	−0.7	−3.6	2.3	0.659
PedsQL EF	673	81.7	20.6	141	80.9	22.6	−0.8	−4.6	3.0	0.672	−1.1	−5.1	2.8	0.572
PedsQL SF	673	88.8	17.3	141	85.2	23.3	−3.6	−6.9	−0.2	0.036	−1.9	−5.5	1.6	0.287
PedsQL SchF	673	80.2	19.4	141	77.9	24.1	−2.3	−6.0	1.4	0.219	−2.5	−6.4	1.4	0.216
PedsQL PHSS	673	83.6	16.1	141	81.3	20.9	−2.2	−5.3	0.9	0.157	−1.8	−5.1	1.4	0.268
PedsQL Total	673	85.1	14.7	141	83.0	20.1	−2.2	−5.1	0.7	0.133	−1.5	−4.6	1.5	0.315
EQ-5D VAS	685	78.2	17.4	141	82.5	13.5	4.3	1.3	7.4	0.006	1.7	−1.5	4.8	0.293
EQ-5D utility	693	0.90	0.17	141	0.92	0.11	0.02	−0.01	0.05	0.200	0.02	−0.01	0.05	0.153
Summer														
PedsQL PF	652	90.6	14.3	305	91.2	13.2	0.6	−1.3	2.5	0.541	0.4	−1.8	2.6	0.702
PedsQL EF	652	82.8	20.0	305	85.0	18.4	2.2	−0.4	4.9	0.099	1.5	−1.6	4.6	0.342
PedsQL SF	652	88.7	17.6	305	89.8	16.9	1.1	−1.3	3.4	0.384	0.8	−2.0	3.5	0.574
PedsQL SchF	652	80.8	20.3	305	81.6	18.7	0.8	−1.9	3.5	0.553	−0.3	−3.4	2.8	0.864
PedsQL PHSS	652	84.1	15.9	305	85.5	15.0	1.4	−0.8	3.5	0.207	0.7	−1.8	3.1	0.594
PedsQL total	652	85.7	14.5	305	86.9	13.5	1.2	−0.8	3.1	0.233	0.6	−1.6	2.8	0.594
EQ-5D VAS	583	76.8	17.0	279	81.7	17.0	4.9	2.5	7.4	0.0001	3.8	1.0	6.6	0.008
EQ-5D utility	646	0.89	0.21	293	0.91	0.20	0.02	−0.01	0.05	0.163	0.02	−0.03	0.04	0.707

* *P*-value from two independent samples *t*-test

\# Difference adjusted for age, sex (male/female), ethnicity (white/non-white), free school meals (yes/no), area (NW/SW)

PedsQL PF physical functioning; *SF* social functioning; *EF* emotional functioning; *SchF* school functioning; *PHSS* psychosocial health summary score; *Total* total scale score; *EQ-5D VAS* visual analogue scale; *Utility* utility score

For both the PedsQL and EQ-5D dimensions, a higher score indicates better QoL

the MID of 4.5 points for the PedsQL, suggesting that these differences are potentially of some clinical or practical importance.

Table 6 shows the mean QoL scores by dietary fat consumption status. Statistically significant differences were observed between the optimal (< 35% of daily calorie intake in fats) and fat intake too high groups only for the EF dimension of the PedsQL in the winter survey and this difference remained after adjustment for covariates, with the optimal fat intake group reporting better QoL. However, the observed difference in EF scores between the two groups was 3.9 points, less than the MID of 4.5 points for the PedsQL, suggesting that this difference is small in magnitude and may not be of any clinical or practical importance.

Table 7 shows the mean QoL scores by dietary consumption of fruit and vegetables. Statistically significant differences were observed between the optimal consumption (5 or more portions of fruit and vegetables per day) and not optimal consumption groups for the EF, SF, PHSS and Total dimensions of the PedsQL in the winter survey. Those who achieved the optimal consumption reported poorer QoL and these differences remained after adjustment for covariates. In the summer survey, the pattern was less clear with the only statistically significant differences being observed between the optimal consumption (5 or more portions of fruit and vegetables per day) and not optimal consumption groups for the PedsQL SF and EQ-5D VAS dimension. Those who achieved the optimal consumption reported poorer QoL. However, all of these

Table 5 Mean scores of QoL dimensions by weight status by season

| | BMI of pupils grouped by Normal or overweight/obese according to UK cut points | | | | | | | | | | | | | |
| | Overweight/obese | | | Normal weight | | | Mean difference | 95% CI | | | Adjusted difference | 95% CI | | |
	N	Mean	SD	N	Mean	SD		Lower	Upper	P-value*		Lower	Upper	P-value#
Winter														
PedsQL PF	173	85.6	18.1	517	90.8	14.0	5.2	2.6	7.8	0.001	4.8	2.2	7.4	0.001
PedsQL EF	173	78.6	21.5	517	82.6	20.6	4.0	0.4	7.6	0.031	4.3	0.7	7.8	0.018
PedsQL SF	173	83.8	21.8	517	90.2	16.6	6.3	3.2	9.4	<0.001	5.8	2.7	8.9	<0.001
PedsQL SchF	173	77.7	20.9	517	80.3	20.1	2.6	−0.9	6.1	0.145	2.6	−0.9	6.1	0.150
PedsQL PHSS	173	80.0	18.6	517	84.3	16.2	4.3	1.4	7.2	0.004	4.2	1.4	7.1	0.004
PedsQL total	173	81.4	17.7	517	85.9	14.7	4.5	1.8	7.2	0.001	4.4	1.7	7.0	0.001
EQ-5D VAS	177	75.5	18.0	522	80.6	16.1	5.1	2.3	8.0	<0.001	5.8	3.1	8.6	0.001
EQ-5D utility	176	0.89	0.15	526	0.90	0.18	0.01	−0.02	0.04	0.651	0.01	−0.02	0.04	0.557
Summer														
PedsQL PF	89	88.1	15.0	334	91.4	12.8	3.2	0.1	6.4	0.041	3.3	0.1	6.4	0.042
PedsQL EF	89	78.7	23.8	334	83.8	17.8	5.1	0.6	9.6	0.026	5.6	1.1	10.1	0.016
PedsQL SF	89	85.4	20.0	334	90.1	14.9	4.8	1.0	8.5	0.014	4.3	0.4	8.1	0.029
PedsQL SchF	89	79.7	21.2	334	80.8	19.3	1.0	−3.6	5.7	0.657	1.1	−3.5	5.8	0.631
PedsQL PHSS	89	81.3	16.8	334	84.9	13.7	3.6	0.2	7.0	0.035	3.7	0.2	7.1	0.036
PedsQL total	89	83.0	15.5	334	86.5	12.5	3.5	0.4	6.6	0.025	3.6	0.4	6.7	0.025
EQ-5D VAS	85	74.6	17.4	312	80.0	16.0	5.3	1.4	9.2	0.008	6.3	2.3	10.3	0.002
EQ-5D utility	90	0.84	0.30	335	0.93	0.14	0.08	0.04	0.13	0.001	0.08	0.04	0.13	0.001

* *P*-value from two independent samples *t*-test

Difference adjusted for age, sex (male/female), ethnicity (white/non-white), free school meals (yes/no), season (winter/summer), area (NW/SW)

PedsQL PF physical functioning; *SF* social functioning; *EF* emotional functioning; *SchF* school functioning; *PHSS* psychosocial health summary score; *Total* total scale score; *EQ-5D VAS* visual analogue scale; *Utility* utility score

For both the PedsQL and EQ-5D dimensions, a higher score indicates better QoL

observed differences were small, less than the MID of 4.5 points for the PedsQL suggesting that these differences are small in magnitude and may not be of any clinical or practical importance.

Discussion

The correlations observed in this study indicate little or no relationship between self-reported QoL, BMI and moderate to vigorous PA. We also found no statistically significant differences between the two groups of children, who achieved the recommended PA guidelines and those who did not, on any of the dimensions of the PedsQL and the EQ-5D utility score. Only on the EQ-5D VAS score was there a statistically significant difference between the groups.

This difference on the EQ-5D VAS dimension is the only evidence from this study which agrees with several reports on adult physical activity and QoL [28–32] and studies on children examining obesity, QoL and PA [9, 10]. It may be that our measures of QoL (the PedsQL and the EQ-5D) in this relatively healthy group were not sensitive enough to detect differences between the more active and less active children. Or it could be that at this younger age, the differences of being active or not may not yet have impacted on the pupils' health [33]. Wendel-Vos and colleagues [33] found some cross-sectional associations between leisure time activity and physical components of QoL, whereas longitudinal associations were predominantly observed for mental components of QoL. This shows that there is possibly a beneficial effect of PA on QoL over a longer sustained period of time.

While physical activity showed little relationship to QoL and diet showed some relationships; children who self-reported a BMI of overweight to obese (according to UK cut-points [18]) had significantly lower QoL on both dimensions of the EQ-5D and every dimension of the PedsQL apart from the School Functioning dimension. These findings lend further support to an existing evidence base of overweight/obese children reporting lower quality of life. De Beer and colleagues found in their study of 31 obese adolescents to 62 normal weight 12- to 18-year-olds that the obese subjects reported significantly lower PedsQL

Table 6 Mean scores of QoL dimensions by fat dietary consumption status by season

| | Fat intake grouped by optimal ≤ 35% of calorie intake or not optimal > 35% of calorie intake | | | | | | | | | | | | | | |
| | Fat intake too high | | | Optimal fat intake | | | Mean difference | 95% CI | | | Adjusted difference | 95% CI | | |
	N	Mean	SD	N	Mean	SD		Lower	Upper	P-value*		Lower	Upper	P-value#
Winter														
PedsQL PF	624	89.5	14.6	185	91.1	13.2	1.6	−0.8	3.9	0.187	1.7	−0.7	4.0	0.167
PedsQL EF	624	80.9	20.5	185	84.9	19.9	3.9	0.6	7.3	0.021	3.9	0.6	7.2	0.021
PedsQL SF	624	88.4	17.9	185	89.0	17.3	0.6	−2.3	3.5	0.691	0.4	−2.5	3.3	0.774
PedsQL SchF	624	79.7	19.9	185	81.5	19.4	1.9	−1.4	5.1	0.263	1.7	−1.6	4.9	0.313
PedsQL PHSS	624	83.0	16.5	185	85.1	15.9	2.1	−0.6	4.8	0.120	2.0	−0.7	4.6	0.143
PedsQL total	624	84.6	15.1	185	86.6	14.3	2.0	−0.5	4.4	0.111	1.9	−0.5	4.3	0.125
EQ-5D VAS	639	79.4	16.5	185	77.0	18.1	−2.4	−5.2	0.3	0.084	−2.0	−4.7	0.8	0.159
EQ-5D utility	646	0.90	0.17	186	0.91	0.15	0.01	−0.02	0.04	0.452	0.01	−0.02	0.04	0.433
Summer														
PedsQL PF	751	90.8	14.1	206	90.8	13.6	0.0	−2.2	2.2	0.998	0.1	−2.1	2.2	0.955
PedsQL EF	751	83.1	19.8	206	85.0	18.4	1.9	−1.2	4.9	0.227	2.1	−0.9	5.1	0.169
PedsQL SF	751	88.8	17.6	206	90.0	16.5	1.1	−1.6	3.8	0.412	1.3	−1.4	4.0	0.361
PedsQL SchF	751	80.5	20.2	206	83.0	18.0	2.6	−0.5	5.6	0.099	2.3	−0.7	5.4	0.133
PedsQL PHSS	751	84.1	15.9	206	86.0	14.3	1.8	−0.6	4.3	0.132	1.9	−0.5	4.3	0.122
PedsQL total	751	85.8	14.5	206	87.2	12.9	1.4	−0.8	3.6	0.214	1.4	−0.8	3.6	0.198
EQ-5D VAS	671	78.7	16.9	191	77.1	18.0	−1.6	−4.4	1.1	0.252	−1.4	−4.2	1.4	0.318
EQ-5D utility	737	0.90	0.20	202	0.89	0.24	−0.01	−0.04	0.03	0.747	0.00	−0.03	0.03	0.906

* *P*-value from two independent samples *t*-test

\# Difference adjusted for age, sex (male/female), ethnicity (white/non-white), free school meals (yes/no), season (winter/summer), area (NW/SW)

PedsQL PF physical functioning; *SF* social functioning; *EF* emotional functioning; *SchF* school functioning; *PHSS* psychosocial health summary score; *Total* total scale score; *EQ-5D VAS* visual analogue scale; *Utility* Utility score

For both the PedsQL and EQ-5D dimensions, a higher score indicates better QoL

dimension scores compared to the normal weight subjects [34]. Friedlander's study, using a different measure of QoL in a younger (8–11 years) group of children also found similar results [12]. Of the 371 children involved in this study, the overweight children had increased odds of lower scores on various health-related quality of life dimensions. Similarly, Schwimmer and colleagues found that overweight children were five times more likely to report low QoL scores when compared to healthy weight children [11]. Several other studies have similarly shown that overweight or obese children and adolescents report lower QoL scores in at least some if not all dimensions compared to healthy weight subjects [13, 35–38].

In terms of diet and QoL, this study found that those eating more fat reported a significantly worse emotional functioning than healthy eaters although conversely those whose fruit intake was optimal reported that their QoL was significantly worse than those eating less fruit and vegetables. However, both effects were small in magnitude and may not be of any clinical or practical importance. There are several studies which would also support the idea of a 'healthy' diet supplementing a higher QoL. However, most

of these studies have been conducted in populations with specific diseases or conditions. In a trial investigating diet and its implications on hypertension, a controlled diet of the recommended intakes of vegetables and fat improved participant's perception of their quality of life [39]. Hassan and colleagues in the examination of the BRFSS (Behavioural Risk Factor Surveillance System) data, in which 182,372 US adults participated, also reported that better diet supported by exercise in the overweight and obese participants was associated with better QoL [40].

The study has several strengths and limitations. We had a large sample of over 1,700 children self-reporting QoL and physical activity. We believe that the participants in this study represented an ethnically diverse cross section of the secondary school population that is broadly similar to many comprehensive secondary schools in England. The data were collected over the same period of time in all schools which should account for any differences in activity due to holiday periods or seasonality.

The generalisability of this study, to other schools and areas in England, is likely to have been affected by the low response rate of 33% (1869/5716). This study involved

Table 7 Mean scores of QoL dimensions by fruit and vegetable dietary consumption status and season

| | Fruit intake either optimal (5 or more portions of fruit/vegetables per day) or not optimal | | | | | | | | | | | | | |
| | Not optimal | | | Yes optimal | | | Mean difference | 95% CI | | | Adjusted difference | 95% CI | | |
	N	Mean	SD	N	Mean	SD		Lower	Upper	P-value*		Lower	Upper	P-value#
Winter														
PedsQL PF	403	91.0	12.2	408	88.7	16.0	−2.3	−4.3	−0.3	0.022	−2.4	−4.3	−0.4	0.018
PedsQL EF	403	83.7	19.7	408	80.0	20.8	−3.7	−6.5	−0.9	0.010	−3.7	−6.4	−0.9	0.009
PedsQL SF	403	89.9	16.9	408	87.1	18.4	−2.7	−5.2	−0.3	0.028	−2.8	−5.2	−0.4	0.023
PedsQL SchF	403	80.6	19.8	408	79.6	19.7	−1.1	−3.8	1.7	0.444	−1.2	−3.9	1.5	0.394
PedsQL PHSS	403	84.7	16.0	408	82.3	16.6	−2.5	−4.7	−0.2	0.030	−2.5	−4.8	−0.3	0.024
PedsQL total	403	86.3	14.3	408	83.9	15.5	−2.4	−4.5	−0.4	0.020	−2.5	−4.5	−0.5	0.016
EQ-5D VAS	411	78.0	18.2	414	79.9	15.5	1.9	−0.4	4.2	0.107	1.9	−0.3	4.2	0.093
EQ-5D utility	418	0.91	0.17	415	0.90	0.16	−0.01	−0.03	0.01	0.374	−0.01	−0.03	0.01	0.385
Summer														
PedsQL PF	413	91.1	13.6	544	90.6	14.3	−0.5	−2.3	1.3	0.587	−0.7	−2.5	1.1	0.452
PedsQL EF	413	84.8	19.1	544	82.5	19.8	−2.3	−4.8	0.2	0.068	−2.6	−5.1	−0.1	0.044
PedsQL SF	413	90.8	15.1	544	87.7	18.9	−3.1	−5.3	−0.9	0.007	−2.9	−5.2	−0.7	0.011
PedsQL SchF	413	81.1	20.6	544	81.0	19.2	−0.1	−2.6	2.5	0.949	0.0	−2.5	2.6	0.981
PedsQL PHSS	413	85.6	15.0	544	83.7	16.0	−1.8	−3.8	0.2	0.072	−1.8	−3.9	0.2	0.076
PedsQL total	413	86.9	13.6	544	85.5	14.6	−1.5	−3.3	0.3	0.106	−1.6	−3.4	0.3	0.099
EQ-5D VAS	372	76.3	17.6	490	79.9	16.7	3.6	1.3	5.9	0.002	2.8	0.5	5.2	0.018
EQ-5D utility	407	0.89	0.21	532	0.90	0.21	0.00	−0.02	0.03	0.729	0.01	−0.02	0.03	0.707

* P-value from two independent samples t-test

Difference adjusted for age, sex (male/female), ethnicity (white/non-white), free school meals (yes/no), season (winter/summer), area (NW/SW)

PedsQL PF physical functioning; SF social functioning; EF emotional functioning; SchF school functioning; PHSS psychosocial health summary score; Total total scale score; EQ-5D VAS visual analogue scale; Utility Utility score

For both the PedsQL and EQ-5D dimensions, a higher score indicates better QoL

only four schools in two regions and is not a random sample of pupils or schools; so therefore, the results must be interpreted cautiously and cannot be wholly representative of other schools in the NW and SW or indeed England. The low response rate may have potentially caused a bias in the estimated differences in QoL between the various groups. Unfortunately, as this was an anonymous survey, no information was collected on the characteristics of the non-respondents to the questionnaire; therefore, a comparison of respondents to non-respondents cannot be made. Also, since this was an anonymous survey, we have no information on how many children completed the survey twice once in the winter and again in the summer. So, we cannot rule out that some bias may have been introduced into the sample. However, 23.5% of our survey participants were classified as obese which is similar to previous estimates for English school children aged 11–15 of 21%; although only 25% of our sample met the physical activity guidelines compared to around 52% reported nationally [41]. Our sample appeared to have similar levels for receipt of free school meals (18 vs. 16.5%) compared to school roll information [42].

We believe that the responders, to our survey, are more likely to be a well-motivated group of students, who are more likely to report higher levels of QoL, physical activity and better levels of diet and lower levels of BMI (due to overestimating their height and underestimating their weight). If this is so, then we believe that the results and observed differences between the groups are potentially likely to be smaller than the true differences as we have a self-selected sample of students who eat and exercise well and generally have a good QoL.

The cross-sectional design is less robust than a longitudinal study. So, it must be clearly acknowledged that the data represent a snap shot of information on physical activity and QoL. The diet questionnaire although validated and piloted by the authors has mainly been used in an adult non-UK population, which again may have an effect.

Pragmatically, we used self-report methods rather than objective measures such as pedometers or accelerometers to estimate physical activity. This may have resulted in an overestimate of activity particularly if this was a well-motivated group of students. However, the use of objective measures, such as pedometers, is not without problems as

the use of these tools tends to alter the behaviour of people being observed and again may result in an over estimate of activity [43]. In general, the potential 'bias' of self-reporting survey methods for diet or PA is of concern to any researcher and the over-reporting in activity or under-reporting fat intake maybe a particular worry in studies of children [43]. However, in previous studies of children and PA, the self-report survey shows some promise of being a quality research instrument with a young population [44] and remains the most widely used measurement tool [45]. For practical reasons (since we had a large sample), we used the self-reported CAPANS instrument to assess PA, which has been shown to be a reliable and valid measure in children [16]. In several studies, self-reported BMI in children has shown that students tend to underestimate their BMI. Those students who are overweight or obese tend to underestimate their BMI to a greater extent than normal weight students. However, further studies have found that differences between self-reported and measured height and weight in young people were not statistically significant and there was reasonable agreement between actual and self-reported measurements [14, 46]. In other studies, which found differences, they reported that over 90% of adolescent participants estimated weight and height were in the correct BMI (Overweight/obese or Normal) classification group [47, 48].

Conclusion

Those children aged 11–15 achieving the recommended 60 min of moderate to vigorous physical activity per day had similar QoL (as assessed by the PedsQL) to those who did not achieve the recommended physical activity guidelines. In this sample, those reporting a normal BMI had better QoL outcomes on both the EQ-5D and PedsQL measures (apart from the School Functioning dimension) than overweight/obese children, thus confirming previous studies. Overall, this study showed mixed results for pupils achieving the recommended targets for physical activity and diet and their relationship with QoL. Hence, further study into PA and diet and their effects on QoL is needed.

References

1. Biddle, S., Sallis, J. F., & Cavill, N. (Eds.). (1998). *Young and active? Young people and health-enhancing physical activity–evidence and implications*. London: Health Education Authority.
2. U.S. Department of Health and Human Services. (1996). Physical Activity and Health: A Report of the Surgeon General. Atlanta, GA: Centres for Disease Control.
3. Bouchard, C., Shephard, R. J., & Stephens, T. (Eds.). (1994). *Physical activity fitness and health. International proceedings and consensus statement*. Champaign, IL: Human Kinetics.
4. Paffenbarger, R., & Olsen, E. (1996). *Lifefit: An effective exercise programme for optimal health and a longer life*. Champaign IL: Human Kinetics.
5. Trembley, M. S., & Willms, J. D. (2003). Is the Canadian childhood obesity epidemic related to physical inactivity? *International Journal of Obesity, 27*(9), 1100–1105.
6. Haskel, W. L., Lee, I., Pate, R. R., Powell, K. E., Blair, S. N., Frankiln, B. A., et al. (2007). Physical activity and public health updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*, 1081–1093.
7. Department of Health. (2004). At least five a week: Evidence on the impact of physical activity and its relationship to health. A Report from the Chief Medical Officer. London: Department of Health Publications.
8. Bize, R., Johnson, J. A., & Plotnikof, R. (2007). The association between health-related quality of life and physical activity level among the general adult population: A systematic review. *Preventive Medicine, 10*, 1016.
9. Chen, X., Sekine, M., Hamanishi, S., Yamagami, T., & Kagamimori, S. (2005). Associations of lifestyle factors with quality of life (QOL) in Japanese children: A 3-year follow-up of the Toyama Birth Cohort Study. Child: Care. *Health & Development, 31*(4), 433–439.
10. Shoup, J. A., Gattshall, M., Dandamudi, P., & Estabrooks, P. (2008). Physical activity, quality of life and weight status in overweight children. *Quality of Life Research, 17*, 407–412.
11. Schwimmer, J. B., Burwinkle, T. M., & Varni, J. W. (2003). Health-related quality of life of severely obese children and adolescents. *Journal of the American Medical Association, 289*, 1813–1819.
12. Friedlander, S. L., Larkin, E. K., Rosen, C. L., Palermo, T. L., & Redline, S. (2003). Decreased quality of life associated with obesity in school-aged children. *Archives of Pediatrics and Adolescent Medicine, 157*, 1206–1211.
13. Pinhaus-Hamiel, O., Singer, S., Pilpel, N., Fradkin, A., Modan, D., & Reichman, B. (2006). HRQOL among children and adolescents: Associations with obesity. *International Journal of Obesity, 30*, 267–272.
14. Boyle, S. E. (2008). *Evaluation of physical activity levels among adolescents in the Southwest and Northwest: consideration of health issues. A PhD Study*. Sheffield, UK: The University of Sheffield.
15. McCormack G, Giles-Corti B. (2002). Report to the physical activity taskforce, evaluation and monitoring group: An assessment of self-report questionnaires and motion sensors for measuring physical activity in children. WA, Australia: Department of Public Health, The University of Western Australia.
16. Hands, B., Parker, H., Glasson, C., Brinkman, S., & Read, H. (2004). *Results of Western Australian child and adolescent physical activity and nutrition survey 2003 (CAPANS. Physical Activity Technical Report*. Australia: The University of Notre Dame.
17. Block, G., Gillespie, C., Rosenbaum, E. H., & Jenson, C. (2000). A rapid food screener to assess fat and fruit and vegetable intake. *American Journal of Preventive Medicine, 18*(4), 284–288.
18. Cole, T. J., Freeman, J. V., & Preece, M. A. (1990). Body mass index reference curves for the UK. *Archives of Disease in Childhood, 73*, 25–29.
19. DH (Central Health Monitoring Unit, Health Improvement Directorate–Public Health). Health Profile of England. London: Department of Health, 2006.

20. The EuroQol Group. (1990). EuroQol–a new facility for the measurement of health-related quality of life. *Health Policy, 16*(3), 199–208.

21. Varni, J. W., Burwinkle, T. M., & Seid, M. (2006). The PedsQL 4.0 as a school population health measure: Feasibility, reliability, and validity. *Quality of Life Research, 15*, 203–215.

22. Wille, N., & Ravens-Sieberer U. (2006). Age-appropriateness of the EQ-5D adult and child-friendly version–Testing the feasibility, reliability and validity in children and adolescents. In 23rd Scientific Plenary Meeting of the EuroQol Group in Barcelona, Spain: September 14–16. Edited by: Badía X. Barcelona: IMS Health, pp 217–229.

23. Eidt-Koch. D., Mittendorf, T., Greiner, W. (2009). Cross-sectional validity of the EQ-5D-Y as a generic health outcome instrument in children and adolescents with cystic fibrosis in Germany. *BMC Pediatrics, 9*, 55. doi: 10.1186/1471-2431-9-55.

24. Dolan, P., Gudex, C., Kind, P., & Williams, A. (1995). *A social tariff for the EuroQol: Results from a UK general population survey. Centre for Health Economics Discussion Paper No. 138.* York: University of York.

25. Walters, S. J. (2009). *Quality of life outcomes in clinical trials and health care evaluation: a practical guide to analysis and interpretation.* Chichester: Wiley.

26. Varni JW, Limbers C, Burwinckle TM. (2007). Literature review: health-related quality of life measurement in pediatric oncology: hearing the voices of the children. Journal of Pediatric Psychology, March: 1–13.

27. Walters, S. J., & Brazier, J. E. (2005). Comparison of the minimally important difference for two health state utility measures: EQ-5D and SF-6D. *Quality of Life Research, 14*, 1523–1532.

28. Vuillemin, A., Boini, S., Bertais, S., Tessier, S., Oppert, J.-M., Hercberg, S., et al. (2007). Association between leisure-time physical activity and health-related quality of life changes over time. *Preventive Medicine, 44*(3), 202–208.

29. Shibata, A., Oka, K., Nakamura, Y., & Muraoka, I. (2007). Recommended level of physical activity and health related quality of life among Japanese adults. *Health and Quality of Life Outcomes, 5*, 64.

30. Kruger, J., Bowles, H. R., Jones, D. A., Ainsworth, B. E., & Kohl, H. W. (2007). Health-related quality of life, BMI and physical activity among US adults (≥18 years): National Physical Activity and Weight Loss Survey, 2002. *International Journal of Obesity, 31*, 321–327.

31. Malmberg, J., Miilunpalo, S., Pasanen, M., Vuori, I., & Oja, P. (2005). Characteristics of leisure time physical activity associated with a risk of decline in perceived health–a 10 year follow-up of middle-aged and elderly men and women. *Preventive Medicine, 41*(1), 141–150.

32. Brown, D. W., Balluz, L. S., Heath, G. W., Moriarity, D. G., Ford, E. S., Giles, H. W., et al. (2003). Associations between recommended levels of physical activity and health-related quality of life. Findings from the 2001 behavioural risk factor surveillance system (BRFSS) survey. *Preventive Medicine, 37*(5), 520–528.

33. Wendel-Vos, G. C. W., Shuit, A. J., Tijhuis, M. A. R., & Kromhout, D. (2004). Leisure time physical activity and health-related quality of life: Cross-sectional and longitudinal associations. *Quality of Life Research, 13*, 667–677.

34. De Beer, M., Hofsteenge, G. H., Koot, H. M., Hirasing, R. A., Delemarre-van de Waal, H. A., & Gemke, R. J. B. (2007). Health-related-quality-of-life in obese adolescents is decreased and inversely related to BMI. *Acta Paediatrica, 96*(5), 710–714.

35. Fallon, E. M., Tanofsky-Kraff, M., Norman, A. C., McDuffie, J. R., Taylor, E. D., Cohen, M. L., et al. (2005). Health-related quality of life in overweight and nonoverweight black and white adolescents. *Journal of Pediatrics, 147*(4), 443–450.

36. Amaral, O., Pereira, C., Veiga, N., Tavares, I., Sanganho, M., & Catela, N. (2005). Overweight and health related quality of life in Portuguese adolescents. *European Journal of Public Health, 15*(supp 1), 89–90.

37. Zeller, M. H., & Modi, A. C. (2006). Predictors of health-related quality of life in obese youth. *Obesity, 14*(1), 122–130.

38. Hughes, A. R., Farewell, K., Harris, D., & Reilly, J. J. (2007). Quality of life in a clinical sample of obese children. *International Journal of Obesity, 31*(1), 39–44.

39. Plaisted, C. S., Lin, P. H., Ard, J. D., McClure, M. L., & Svetkey, L. P. (1999). The effects of dietary patterns on quality of life a substudy of the dietary approaches to stop hypertension trial. *Journal of the American Dietetic Association, 99*(8 S1), S84–S89.

40. Hassan, M. K., Joshi, A. V., Madhavan, S. S., & Amonkar, M. M. (2004). Obesity and health related quality of life: A cross-sectional analysis of the US Population. *International Journal of Obesity, 27*, 1227–1232.

41. NHS Information Centre. (2006). Statistics on obesity, physical activity and diet: England, 2006. The NHS Information Centre, Lifestyles Statistics.

42. Ofsted. Inspection Reports. Published Online @ http://www.ofsted.gov.uk/reports/index on 01/11/05.

43. Welk, G. J., Corbin, C. B., & Dale, D. (2000). Measurement issues in the assessment of physical activity in children. *Research Quarterly for Exercise and Sport, 71*(2), 59–73.

44. Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the physical activity questionnaire for older children. *Medicine and Science in Sports and Exercise, 29*(10), 1344–1349.

45. Sallis, J. F., & Owen, N. (1999). *Physical activity and behavioural medicine.* London: Sage Publications.

46. Voss, L. D., & Bailey, B. J. (1994). Equipping the community to measure children's height: The reliability of portable instruments. *Archives of Disease in Childhood, 70*, 469–471.

47. Strauss, R. S. (1999). Comparison of measured and self reported weight and height in a cross sectional sample of young adolescents. *International Journal of Obesity Related Metabolic Disorders, 8*, 904–908.

48. Goodman, E., Hinden, B. R., & Khandelwal, S. (2000). Accuracy of teen and parental reports of obesity and body mass index. *Paediatrics, 106*(1), 52–58.