# Dietary fat knowledge and intake of mid-adolescents attending public schools in the Bellville/Durbanville area of the city of Cape Town

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## Abstract

**Objectives:** This survey primarily investigated the dietary fat knowledge and intake of 17-year-olds.

**Design:** Cross-sectional descriptive survey.

**Setting and subjects:** A random sample of 168 learners (89% response rate) attending public schools in the Bellville/Durbanville area participated with parental consent after the area manager of the Department of Education and the school headmasters granted approval to conduct the survey.

**Outcome measures:** Both the test and the food frequency screener selected to assess learner dietary fat knowledge and intake respectively was pilot tested.

**Results:** The learners mostly obtained average (46%) as well as below average (52%) dietary fat knowledge scores and mostly (61%) followed diets that were categorised as typically Western, quite high in fat. The learners' interest in nutrition and their source of nutritional information, which was a subject presented at school, were positively associated with their dietary fat knowledge ($p < 0.05$) and intake ($p < 0.05$) and their dietary fat knowledge was positively associated with their fat intake ($p < 0.05$).

**Conclusions:** These mid-adolescents lack knowledge of dietary fat and are not consuming fats sparingly. However, their interest in nutrition, reliable nutritional information and dietary fat knowledge positively affected their fat intake. Interest in nutrition through nutrition and health education intervention initiatives should be cultivated among adolescents as it was identified as positively affecting both the dietary fat knowledge and intake of these adolescents.

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## Introduction

Youths aged 12 to 17 frequently practise unhealthy dietary behaviour that place them at risk for the onset of chronic disease.[1] According to the National Risk Behaviour Survey, a high proportion of South African Grade 8 to 11 learners frequently consume food items high in fat, such as fast foods, cakes and biscuits.[2] Regardless of their unhealthy dietary behaviour, adolescents are expected to live longer due to the biomedical advances in public health. However, as their life expectancy increases so will their incidence of chronic diseases as they age.[3,4] Unhealthy dietary behaviours learned in childhood and adolescence are also carried over into adulthood,[5–9] when they are more resistant to change.[1,5,9] It is important that young people be encouraged to make healthier food choices.[10] Adolescence represents a window of opportunity to prepare for a nutritionally healthy adult life, and is thus an ideal period to shape and secure healthy eating habits.[11] This is not only important for adolescent growth and development,[12] but also for preventing or postponing the onset of diet-related chronic disease in adulthood.[7,8,11]

Nutritional knowledge is one of the factors that influence the dietary behaviour of adolescents.[13] The reduction of fat intake tends to dominate nutrition strategies for the prevention of chronic disease.[10] Most Western populations have been exposed to decades of information about fat in relation to cardiovascular disease prevention and weight control. However, adolescents in general are not interested in nutrition or in the long-term benefits of healthy dietary habits.[13] As poor dietary habits are linked to the development of most chronic diseases and the lack of knowledge is a possible barrier to healthy eating, [14,15,16] the primary objectives of this study were to determine the dietary fat knowledge and intake of South African mid-adolescents and to ascertain biographic factors associated with their dietary fat knowledge and intake.

It has been proposed that eating behaviour, particularly in children, is largely characterised by affective, non-cognitive factors that cannot be influenced by information.[17] Merron and Lock[18] also questioned the value of teaching dietary knowledge to pupils, as it does not necessarily influence eating behaviour. Sherratt,[5] Kaur et al[11] and Gracey et al,[19] however, deem that nutritional education can be used to increase nutritional knowledge of adolescents in order for them to improve their dietary habits. A final subsidiary study objective therefore was to determine if the dietary fat knowledge of mid-adolescents positively influenced their fat intake.

## Research design and methodology

### Approval to conduct study

Approval for the survey was granted by the Research Committee of the Faculty of Applied Sciences of the institution and the area manager of the Western Cape Department of Education under whose administration the participating schools operate. The area manager provided an approval letter to the headmasters of these schools to facilitate their participation. The parents and legal guardians of the participating learners were informed of the survey and signed consent forms for their child's voluntary and anonymous participation.

### Learner sample selection and sampling method

Adolescents aged 17 years, representing middle to upper socioeconomic groups, were chosen as the study population for a number of reasons. The Canadian dietary fat guidelines for children indicate that although transition to a lower fat intake should begin from the age of two the adult recommended fat intake is appropriate once the linear growth spurt is completed.[20] Stature growth ceases at a median age of 17.3 years in girls and 21.2 years in boys. During the time of peak growth velocity, adolescents usually need to eat often and in large amounts. However, when the rapid growth slows they need to be careful of the amounts and frequency of eating.[21] Furthermore, adolescents do not have substantial control over their food choices until the age of 13 years and older,[22] with 15 to 17-year-olds feeling they have the freedom to make their own choices.[10] Sweeting et al[23] found that dietary habits appeared to be established by the age of 15 years with slight overall changes between the ages of 15 to 18 years. Food choice behaviours acquired during this period as a result of becoming more autonomous are likely to influence long-term behaviours.[6] Respondents in a study conducted by Lake et al[24] also indicated that in early adolescence they lacked interest in or were unaware of the importance of dietary intake. In a survey conducted by Smalley et al[9] only the older-aged adolescents (17 to 18-year-olds) were able to identify obesity and a high-fat diet as contributors to coronary heart disease, which suggests that the impact of obesity and poor diet are not learned until an older age.[9] Little is known about dietary habits between the teenage years and young adulthood.[25] Mid-adolescents from middle to upper socioeconomic formal urban areas were furthermore sought as such South African groups commonly have high fat intakes[26] and a higher prevalence of overweight and obese children.[27]

Both cluster and convenience sampling were used to determine the participating schools from relevant areas within the City of Cape Town. A discussion with the area manager of the Western Cape Education Department led to the selection of four of the largest high schools in the Bellville/Durbanville area for participation. Random sampling was used to determine the learners for participation. Class lists of the Grade 11 learners from each school were received and random samples of approximately 50 learners drawn to represent about a quarter of the Grade 11 learners in each school. The consent forms were delivered to the sampled learners (n = 205) via each school. One hundred and eighty three consent forms were returned affirmatively (89% response rate). The learners were instructed and supervised by a teacher when completing the questionnaire at a time convenient for the school. Fifteen questionnaires were not answered completely, providing for a sample of 168 learners.

### Instrument selection, questionnaire construction and pilot testing

The questionnaire consisted of three sections. The first section assessed the learners' dietary fat knowledge and the next section their dietary fat intake. The last section of the questionnaire included biographic information regarding learner age, gender, interest in nutrition, perceived nutritional knowledge, source of nutritional information, perceived food and beverage consumption and perception of body weight status. Twenty-four Grade 12 learners of the largest participating school took part in pilot testing the questionnaire as approval was also granted to conduct the questionnaire pilot testing at the participating schools.

The learners' dietary fat knowledge was assessed using a questionnaire consisting of 18 multiple-choice questions with four alternative answers and constructed in the format of a test. The test was developed for use in a study that determined the sensory acceptability of bakery products with a reduced fat content. The participant sample consisted of young adults represented by higher-education students. The construction of the fat knowledge test and its validity and reliability evaluation are described in a previous publication.[28] A test focusing on practical knowledge was sought, as practical knowledge is needed to consume low-fat foods.[29] This dietary fat knowledge test largely examines knowledge of the food sources of fat and to a limited extent the dietary fat-disease relationship.[28]

In the pilot testing of the dietary fat knowledge test some learners had difficulty answering four of the questions. One learner had difficulty answering the question related to omega-3 fatty acids (see Table I, question 4) and 12 learners respectively had difficulty answering questions related to trans fatty acids (Table I, question 5), monounsaturated fat (Table I, question 14) and saturated fat (Table I, question 17). The test was constructed using first-year and second-year university students.[28] Peltzer[30] did find that South African university students have significantly greater nutritional knowledge than secondary school learners. Since none of these terms could be changed, the answer option '(e) don't know' was added to all the questions in the test to assist the learners to answer the questions and to reduce guessing. In the test development, standard scores were calculated with a score of seven or below representing an average or poor score, a score of eight to twelve an average score and a score of 13 or above an above average or good score. The total test score equalled 18 marks.[28] These scores were used in this study to assess learners' knowledge of dietary fat as the added answer option would not impact the dichotomous marking of the test. In conducting the study, it was emphasised that the learners should use this answer option only if they really were not familiar with a word in a question.

A screening questionnaire was used to provide an indication of learners' fat intake. This screening questionnaire (Block)[31] was adapted for use to evaluate the fat intake of South Africans. It is included as part of the material for the dietary management of dyslipidaemia to evaluate the dietary fat intake of individuals at the first and subsequent consultation(s) to determine their fat intake and dietary compliance.[31] The screening questionnaire was not tested for validity and reliability after it was adapted. The foods included in the screening questionnaire[31] were compared to the foods commonly

consumed by children in the Western Cape as determined through the National Food Consumption Survey (NFCS).[32] Only the consumed foods that are sources of fat were considered. The comparison was done to ascertain the representation of these consumed food sources of fat in the screening questionnaire and the appropriateness of the screening questionnaire for use in this learner group. The screening questionnaire included nearly all the commonly consumed foods that are sources of fat (i.e. nine of the 10 and 10 of the 13 consumed foods that are sources of fat as was respectively determined through the 24-hour-recall and the quantified food frequency questionnaire as the NFCS dietary intake methodologies). The foods included in the screening questionnaire[31] also represented the foods that are sources of fat found to be consumed in the largest amounts (grams) per day by children in the Western Cape.[32]

This screening questionnaire (adapted from Block)[31] was also pilot tested among Grade 12 learners to determine its face-related evidence of validity for use with this learner group. The questionnaire[31] did not require any modifications. A points system is used in the screening questionnaire according to which points are allocated to each food item per frequency of intake, i.e. nil, one, two, three and four point(s) respectively for the intake frequencies of once or less than once per month, two to three times per month, one to two times per week, three to four times per week and lastly five or more times per week. The point(s) obtained for each food item is summed with the total reflecting a meat/snack score. Scores of more than 27 represent a diet high in fat (indicating that there are many areas/ways through which the fat content of the eating pattern could be lowered), scores of 25 to 27 a diet quite high in fat (indicating that there are areas/ways through which the fat content of the eating pattern could be lowered), scores of 22 to 24 the typical Western diet (indicating that the eating pattern could be lower in fat as represented below), scores of 18 to 21 a diet with low-fat food choices (but could be improved to obtain the desirable score) and scores of 17 or less a desirable fat intake (through a diet having the best low-fat food choices).[31] The learners took 15 to 20 minutes to complete the questionnaire.

## Data analysis

The data was imported into the STATISTICA data analysis software system, version 7.1 (Statsoft Inc., 2005) from an Excel spreadsheet for analysis. The Pearson's chi-square test was used to determine associations between the categorical variables (learner gender, interest in nutrition, perceived nutritional knowledge relative to learners of similar age, major source of nutritional information, etc.) and the outcome variables (learner dietary fat knowledge and intake) with a value of $p < 0.05$ considered statistically significant.

## Results

### Learner demographic profile

Sixty-one per cent of the sample was girls and 39% boys. The median age was 17 years, with 70% of the learners being 17 years old, 29% being 18 years old and one learner being older. The white population group was predominantly represented by the learners.

### Learner dietary fat knowledge

Questions in the knowledge test were ranked according to their difficulty levels (determined in the development of the test) with the easiest items placed first.[28] About two-thirds of the learners (63% to 69%) could answer the first three questions correctly. These three questions were also answered the best by the learners. Only 18% to 45% of the learners answered the remaining questions correctly (see Table I).

**Table I: Number and percentage of learners (n = 168) who answered the dietary fat knowledge questions* correctly**

| Question | Question description | n | % |
|---|---|---|---|
| 1 | Lowest to highest fat listed foods | 116 | 69.0 |
| 2 | Highest fat containing food | 106 | 63.1 |
| 3 | Food not containing cholesterol | 112 | 66.7 |
| 4 | Omega-3 fatty acid rich food | 36 | 21.4 |
| 5 | Trans fatty acid containing food | 63 | 37.5 |
| 6 | Cholesterol containing food | 70 | 41.7 |
| 7 | Lowest fat containing food | 73 | 43.5 |
| 8 | True fact of cholesterol | 75 | 44.6 |
| 9 | 'Good' fat in the diet | 39 | 23.2 |
| 10 | Foods usually containing cholesterol | 39 | 23.2 |
| 11 | Dietary factor associated with high blood cholesterol level | 30 | 17.9 |
| 12 | Energy content of fat compared to starch | 48 | 28.6 |
| 13 | Margarine to protect against heart disease | 34 | 20.2 |
| 14 | Monounsaturated fat containing oil | 67 | 39.9 |
| 15 | Oils not suited for dietary management of coronary heart disease | 35 | 20.8 |
| 16 | Lowest fat containing food | 42 | 25.0 |
| 17 | High saturated fat containing food | 54 | 32.1 |
| 18 | Highest energy containing food | 44 | 26.2 |

* Dietary fat knowledge test obtained from Venter[28] and adapted for use in this learner group by adding an additional answer option '(e) don't know' to all the test questions

The knowledge scores achieved (indicated in Table II) reflected poor scores. The median and mean scores were below the cut-off score of seven, reflecting below average or poor scores (and the poor answering of most of the questions that can be seen in Table I). The majority (98%) of the learners obtained an average (46%) or poor (52%) knowledge score (see Table II).

### Learner dietary fat knowledge and biographic factors

**Gender:** More females than males achieved average scores (58% versus 26%), while more males than females achieved poor scores (72% versus 39%) ($p < 0.001$) (see Table III).

**Table II: Dietary fat knowledge scores of learners (n = 168)**

| Descriptive statistics | Score | Norm scores† | Learner score achievement | |
|---|---|---|---|---|
| Mean ± SD* | 6.45 ± 2.65 | | n | % |
| Median | 6 | Good (≥ 13) | 4 | 2.4 |
| Minimum | 1 | Average (8–12) | 77 | 45.8 |
| Maximum | 16 | Poor (≤ 7) | 87 | 51.8 |

* SD = Standard deviation; † Obtained from dietary fat knowledge test[28]

**Table III: Associations between learner dietary fat knowledge and their biographic factors (n = 168)**

| Biographic factors | Total | | Dietary fat knowledge score* | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Poor (n = 87) | | Average (n = 77) | | Good (n = 4) | |
| | N | % | n | % | n | % | n | % |
| **Gender†** | | | | | | | | |
| Female | 103 | 61.3 | 40 | 23.8 | 60 | 35.7 | 3 | 1.8 |
| Male | 65 | 38.7 | 47 | 28.0 | 17 | 10.1 | 1 | 0.6 |
| **Own interest in nutrition‡** | | | | | | | | |
| Very[1] | 29 | 17.3 | 7 | 4.2 | 19 | 11.3 | 3 | 1.8 |
| Somewhat[2] | 104 | 61.9 | 58 | 34.5 | 45 | 26.8 | 1 | 0.6 |
| Not[3] | 35 | 20.8 | 22 | 13.1 | 13 | 7.7 | 0 | 0 |
| **Perception of own nutritional knowledge relative to learners of similar age§** | | | | | | | | |
| Much less | 13 | 7.7 | 9 | 5.4 | 4 | 2.4 | 0 | 0 |
| Somewhat less | 18 | 10.7 | 12 | 7.1 | 6 | 3.6 | 0 | 0 |
| About similar | 83 | 49.4 | 45 | 26.8 | 38 | 22.6 | 0 | 0 |
| Somewhat more | 41 | 24.4 | 17 | 10.1 | 21 | 12.5 | 3 | 1.8 |
| Much more | 13 | 7.7 | 4 | 2.4 | 8 | 4.8 | 1 | 0.6 |
| **Major source of nutritional information¤** | | | | | | | | |
| School subject (Home Economics)[4] | 54 | 32.1 | 17 | 10.1 | 35 | 20.8 | 2 | 1.2 |
| Media (visual, oral and written) and advertising | 23 | 13.7 | 13 | 7.7 | 10 | 6 | 0 | 0 |
| Health personnel | 6 | 3.6 | 1 | 0.6 | 5 | 3 | 0 | 0 |
| Family and friends | 74 | 44.1 | 48 | 28.6 | 24 | 14.3 | 2 | 1.2 |
| None | 11 | 6.6 | 8 | 4.8 | 3 | 1.8 | 0 | 0 |
| **Perception of own body weight status¤¤** | | | | | | | | |
| Underweight | 13 | 7.7 | 7 | 4.2 | 6 | 3.6 | 0 | 0 |
| Optimal weight | 113 | 67.3 | 62 | 36.9 | 48 | 28.6 | 3 | 1.8 |
| Somewhat overweight | 31 | 18.5 | 14 | 8.3 | 16 | 9.5 | 1 | 0.6 |
| Overweight | 5 | 3 | 2 | 1.2 | 3 | 1.8 | 0 | 0 |
| Obese | 6 | 3.6 | 2 | 1.2 | 4 | 2.4 | 0 | 0 |

*† Significant difference ($p < 0.001$); ‡,¤,¤¤Significant difference/association ($p < 0.05$); §,*,** Non-significant ($p > 0.05$)

[1] Very interested in nutrition, described as 'will regularly obtain/read nutritional information'

[2] Somewhat interested in nutrition, described as 'will occasionally read nutritional information'

[3] Not interested in nutrition, described as 'will not obtain/read nutritional information'

[4] At the time of the study (2005), the school subject referred to was Home Economics. In the new school curriculum, introduced into Grades 10 to 12, since 2006 the subject was renamed Consumer Studies[33]

**Own interest in nutrition:** Among those learners who achieved poor scores most indicated being somewhat interested (67%) or not interested (25%) in nutrition. However, among those learners who achieved good scores most indicated being very interested (75%) or somewhat interested (25%) in nutrition ($p < 0.05$) (see Table III).

**Perception of own nutritional knowledge relative to learners of similar age:** The learners who obtained poor and average scores mostly perceived their nutritional knowledge as about similar (52% and 49% respectively) or somewhat higher (20% and 27% respectively) relative to other learners of their age. Learners who achieved good scores mostly perceived their nutritional knowledge as somewhat higher (75%) or much higher (25%) than other learners of their age. The difference, however, was not significant ($p > 0.05$) (see Table III).

**Major source of nutritional information:** The learners indicated family and friends and nutritional education incorporated in a school subject (at the time of the study Home Economics, now renamed Consumer Studies)[32] as their major sources of nutritional information (44% and 32% respectively). A significant association ($p < 0.05$) was found between the dietary fat knowledge scores of the learners and their source of nutritional information. While only 20% of those learners who achieved poor scores indicated nutrition incorporation in a school subject as their nutritional information source, 46% and 50% respectively of those learners who achieved average and good scores did so (see Table III).

**Perception of own body weight status:** Most of the learners who achieved poor, average or good scores perceived themselves to be either of an optimal body weight (71%, 62% and 75% respectively) or to be somewhat overweight (16%, 21% and 25% respectively) ($p > 0.05$) (see Table III).

### Learner dietary fat intake and fat food sources

The meat and snack intake frequency of the learners was used to ascertain their dietary fat intake as explained in the methodology. Nearly two-thirds of the learners (61%) either followed a diet high in fat (36%), quite high in fat (14%) or the typical Western diet (12%). Just over a third (39%) of the learners followed a diet that included low-fat choices or with a desirable fat content.

The typical food intake of many adolescents consists of high-fat products:[10] pizza, fries, popcorn, potato chips, confectionary, etc.[13] The popularity of these food items was evident in this study, as can be extracted from Table IV. Thirty-seven per cent of the learners consumed hot dogs, frankfurters, salami, russians, sausage, etc. once or less than once per month, but 30% consumed these items two to three times per month. Approximately 40% of the learners also consumed hamburgers and cheeseburgers (45%), bacon or pork sausage (41%), potato chips (41%) and ice cream (43%) and about 30% potato crisps, corn chips, popcorn (32%) and doughnuts, cake, cookies, puddings (29%) two to three times per month.

Approximately 40% of the learners consumed eggs (46%), fried chicken with skin (45%) and red meat, e.g. beef and mutton (41%), once or twice per week, while 27% each consumed cold cuts, lunch meats, ham with fat, etc. and salad dressings, mayonnaise, etc. once or twice per week. A quarter of the learners (25%) consumed cheese or cheese spread three to four times per week. As many learners consumed it once or twice per week and five or more times per week (24% each). The food items that contributed most to the fat intake of the learners were margarine or butter, followed by full-cream milk and cheese or cheese spread. Margarine or butter was consumed by about half (53%) of the learners and full-cream milk and cheese or cheese spread by respectively 30% and 24% of the learners five or more times per week.

### Learner dietary fat intake and biographic factors

**Gender:** Most learners of both genders followed a diet either high in fat (27% for females and 49% for males) or with a desirable fat content (28% for females and 17% for males). A near equal percentage of males (11%, 9% and 14% respectively) and females (16%, 14% and 16% respectively) also followed diets quite high in fat, typically Western or including low-fat choices ($p > 0.05$) (see Table V).

**Table IV: Frequency of meat and snack intake* of learners (n = 168)**

| Meat and snack intake | ≤ 1 time per month | | 2–3 times per month | | 1–2 times per week | | 3–4 times per week | | 5+ times per week | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n | % |
| Hamburgers or cheeseburgers | 51 | 30.4 | 75 | 44.6 | 37 | 22.0 | 5 | 3.0 | 0 | 0 |
| Red meat, e.g. beef and mutton | 17 | 10.1 | 29 | 17.3 | 68 | 40.5 | 41 | 24.4 | 13 | 7.7 |
| Fried chicken (with skin) | 30 | 17.9 | 37 | 22.0 | 75 | 44.6 | 24 | 14.3 | 2 | 1.2 |
| Hot dogs, frankfurters, salami, russians, sausage | 63 | 37.5 | 50 | 29.8 | 35 | 20.8 | 15 | 8.9 | 5 | 3.0 |
| Cold cuts, lunch meats, ham (with fat), etc. | 36 | 21.4 | 37 | 22.0 | 46 | 27.4 | 32 | 19.1 | 17 | 10.1 |
| Salad dressings, mayonnaise, etc. | 40 | 23.8 | 34 | 20.2 | 45 | 26.8 | 19 | 11.3 | 30 | 17.9 |
| Margarine or butter | 22 | 13.1 | 19 | 11.3 | 16 | 9.5 | 21 | 12.5 | 90 | 53.4 |
| Eggs | 28 | 16.7 | 43 | 25.6 | 78 | 46.4 | 13 | 7.7 | 6 | 3.6 |
| Bacon or pork sausage | 49 | 29.2 | 68 | 40.5 | 41 | 24.4 | 5 | 3.0 | 5 | 3.0 |
| Cheese or cheese spread | 17 | 10.1 | 28 | 16.7 | 41 | 24.4 | 42 | 25.0 | 40 | 23.8 |
| Full-cream milk | 66 | 39.3 | 13 | 7.7 | 18 | 10.7 | 21 | 12.5 | 50 | 29.8 |
| Potato chips ('slap chips') | 36 | 21.4 | 68 | 40.5 | 45 | 26.8 | 12 | 7.1 | 7 | 4.2 |
| Potato crisps, corn chips, popcorn, etc. | 33 | 19.6 | 53 | 31.5 | 48 | 28.6 | 20 | 11.9 | 14 | 8.3 |
| Ice cream | 55 | 32.7 | 72 | 42.9 | 29 | 17.3 | 4 | 2.4 | 8 | 4.8 |
| Doughnuts, cake, cookies, puddings, etc. | 42 | 25.0 | 49 | 29.2 | 44 | 26.2 | 20 | 11.9 | 13 | 7.7 |

* Screening questionnaire (adapted from Block) obtained from the South African Medical Association Dyslipidemia Nutrition Working Group[31]

**Own interest in nutrition:** Of the learners who followed a diet with a desirable fat content, a near equal percentage indicated that they were somewhat or very interested (45% and 38% respectively) in nutrition. Those learners who followed diets high in fat, quite high in fat and typically Western, however, mostly indicated to be only somewhat interested (70%, 70% and 80% respectively) or not interested (20%, 22% and 15% respectively) in nutrition ($p < 0.05$) (see Table V).

**Perception of own nutritional knowledge relative to learners of similar age:** About half of the learners (49%) indicated a nutritional knowledge similar to that of other learners of the same age. This nutritional knowledge perception was also represented across all the levels of dietary fat intake, i.e. 53% for the high, 52% for the quite high, 55% for the typically Western, 40% for diets including low-fat food choices and 45% for a desirable intake ($p > 0.05$) (see Table V).

**Major source of nutritional information:** Parents are the first educators to their children and adolescent decisions about food take place in the context of family life and family resources.[4] Family and friends were a major source of information among those learners who followed diets high in fat (62%) or typically Western (60%). Among those learners who followed diets that included low-fat food choices or with a desirable fat content a subject presented at school (Home Economics) (44% and 48% respectively) and family and friends (36% and 25% respectively) were the major sources of nutritional information ($p < 0.05$) (see Table V).

**Perception of own food and beverage intake relative to learners of similar age:** Friends influence the food choices and eating habits of young people. The primary reason indicated for this relates to being accepted and to feel included.[10] About half (54%) of nine- to 17-year-olds in a Northern Ireland study admitted that their friends influence their food choices and eating habits.[10] This possibly could be applicable to this study too. About half of the learners (54%) indicated that they consumed foods and beverages similar to their counterparts. The other half (46%) indicated that they made healthier food and beverage choices. This perception was also found among the learners in each of the dietary fat intake levels whether high, quite high, typically Western, including low-fat food choices or with a desirable fat content (62%, 52%, 55%, 48% and 45% compared to 38%, 48%, 45%, 52% and 55% respectively) ($p > 0.05$) (see Table V).

**Perception of own body weight status:** According to Pirouznia,[13] body image is one of the factors that could play a role in eating behaviour. It was not evident in this study. The majority of the learners in each of the dietary fat intake levels perceived their body weight status as optimal, i.e. 67% in the high, 65% in the quite high, 85% in the typically Western, 64% in the group that include low-fat food choices and 63% of those with a diet with a desirable fat content ($p > 0.05$) (see Table V).

### Learner dietary fat intake and knowledge

The association between the fat knowledge score and intake of the learners was significant ($p < 0.05$) (see Table V). The learners who followed a diet high in fat mostly obtained a poor knowledge test score (68%), while the learners who followed a diet desirable in fat content mostly obtained average fat knowledge test scores (63%). Those learners following diets quite high in fat, typically Western and including low-fat food choices either obtained poor (48%, 60% and 44% respectively) or average (52%, 40% and 52% respectively) fat knowledge test scores.

## Discussion

In a study conducted by Kaur et al,[11] the majority of adolescent Indian girls aged 13 to 19 obtained nutritional knowledge scores of 10 to 15 (46%), followed by five to ten (40%) (30 mark total). The mean score was 11.72 ± 1.42, reflecting a below average nutritional knowledge score, also found in this study for dietary fat

**Table V: Associations between learner dietary fat intake and their biographic factors (n = 168)**

| Biographic factors | Total | | Dietary fat intake* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | High (n = 60) | | Quite high (n = 23) | | Typically Western (n = 20) | | Low-fat choices (n = 25) | | Desirable (n = 40) | |
| | N | % | n | % | n | % | n | % | n | % | n | % |
| **Gender†** | | | | | | | | | | | | |
| Female | 103 | 61.3 | 28 | 16.7 | 16 | 9.5 | 14 | 8.3 | 16 | 9.5 | 29 | 17.3 |
| Male | 65 | 38.7 | 32 | 19.1 | 17 | 4.2 | 6 | 3.6 | 9 | 5.4 | 11 | 6.6 |
| **Own interest in nutrition‡** | | | | | | | | | | | | |
| Very[1] | 29 | 17.26 | 6 | 3.57 | 2 | 1.19 | 1 | 0.6 | 5 | 2.98 | 15 | 8.93 |
| Somewhat[2] | 104 | 61.9 | 42 | 25 | 16 | 9.52 | 16 | 9.52 | 12 | 7.14 | 18 | 10.71 |
| Not[3] | 35 | 20.83 | 12 | 7.14 | 5 | 2.98 | 3 | 1.79 | 8 | 4.76 | 7 | 4.17 |
| **Perception of own nutritional knowledge relative to learners of similar age§** | | | | | | | | | | | | |
| Much less | 13 | 7.74 | 5 | 2.98 | 1 | 0.60 | 2 | 1.19 | 3 | 1.79 | 2 | 1.19 |
| Somewhat less | 18 | 10.71 | 7 | 4.17 | 3 | 1.79 | 3 | 1.79 | 2 | 1.19 | 3 | 1.79 |
| About similar | 83 | 49.4 | 32 | 19.05 | 12 | 7.14 | 11 | 6.55 | 10 | 5.95 | 18 | 10.71 |
| Somewhat more | 41 | 24.4 | 12 | 7.14 | 6 | 3.57 | 4 | 2.38 | 9 | 5.36 | 10 | 5.95 |
| Much more | 13 | 7.74 | 4 | 2.38 | 1 | 0.60 | 0 | 0.00 | 1 | 0.60 | 7 | 4.17 |
| **Major source of nutritional information‖** | | | | | | | | | | | | |
| School subject (Home Economics)[4] | 54 | 32.14 | 11 | 6.55 | 9 | 5.36 | 4 | 2.38 | 11 | 6.55 | 19 | 11.31 |
| Media (visual, oral and written) and advertising | 23 | 13.69 | 8 | 4.76 | 4 | 2.38 | 2 | 1.19 | 3 | 1.79 | 6 | 3.57 |
| Health personnel | 6 | 3.57 | 1 | 0.60 | 2 | 1.19 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Family and friends | 74 | 44.05 | 37 | 22.02 | 6 | 3.57 | 12 | 7.14 | 9 | 5.36 | 10 | 5.95 |
| None | 11 | 6.55 | 3 | 1.79 | 2 | 1.19 | 2 | 1.19 | 2 | 1.19 | 2 | 1.19 |
| **Perception of own food and beverage intake relative to learners of similar age**** | | | | | | | | | | | | |
| Similar choices | 90 | 53.57 | 37 | 22.02 | 12 | 7.14 | 11 | 6.55 | 12 | 7.14 | 18 | 10.71 |
| Healthier choices | 78 | 46.43 | 23 | 13.69 | 11 | 6.55 | 9 | 5.36 | 13 | 7.74 | 22 | 13.10 |
| **Perception of own body weight status††** | | | | | | | | | | | | |
| Underweight | 13 | 7.74 | 6 | 3.57 | 3 | 1.79 | 0 | 0.00 | 2 | 1.19 | 2 | 1.19 |
| Optimal weight | 113 | 67.26 | 40 | 23.81 | 15 | 8.93 | 17 | 10.12 | 16 | 9.52 | 25 | 14.88 |
| Somewhat overweight | 31 | 18.45 | 11 | 6.55 | 4 | 2.38 | 1 | 0.60 | 7 | 4.17 | 8 | 4.76 |
| Overweight | 5 | 2.98 | 2 | 1.19 | 0 | 0.00 | 1 | 0.60 | 0 | 0.00 | 2 | 1.19 |
| Obese | 6 | 3.57 | 1 | 0.60 | 1 | 0.60 | 1 | 0.60 | 0 | 0.00 | 0 | 0.00 |
| **Fat knowledge scores‡‡** | | | | | | | | | | | | |
| Poor | 87 | 51.79 | 41 | 24.4 | 11 | 6.55 | 12 | 7.14 | 11 | 6.55 | 12 | 7.14 |
| Average | 77 | 45.83 | 19 | 11.31 | 12 | 7.14 | 8 | 4.76 | 13 | 7.74 | 25 | 14.88 |
| Good | 4 | 2.38 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 1 | 0.60 | 3 | 1.79 |

*†, *§, * **, * †† Non-significant ($p > 0.05$); *‡, *‖, * ‡‡ Significant difference/association ($p < 0.05$)

[1] Very interested in nutrition, described as 'will regularly obtain/read nutritional information'

[2] Somewhat interested in nutrition, described as 'will occasionally read nutritional information'

[3] Not interested in nutrition, described as 'will not obtain/read nutritional information'

[4] At the time of the study (2005), the school subject referred to was Home Economics. In the new school curriculum, introduced into Grades 10 to 12 since 2006, the subject was renamed Consumer Studies[33]

knowledge per se. Although little is known regarding the general and specific nutritional knowledge of South African learners, two studies investigating general nutritional knowledge found it to be poor.[30,34] The fat knowledge questions that were answered poorly relate to food sources of fatty acids and cholesterol and the relationship between fat and disease (see Table I). The overall knowledge of the fat types in food among 12 to 15-year-olds in a national United Kingdom survey was also not impressive; for example, only 20% and 52% respectively could answer two questions correctly that related to polyunsaturated fat food sources and 23% to 52% could not select the lower-fat option correctly in pairs of food.[5] The weakest knowledge area among Latin American adolescents was the relationship between fat/obesity and health.[35]

Research indicates that the dietary patterns of nine to 17-year-olds in Northern Ireland,[10] 16 to 17-year-olds in Britain[25] and 16 to 18-year-old South African Indian adolescents[36] are characterised by a high consumption of fat. The typical food intake of many adolescents

consists of high-fat products[10] and the use of fast foods for meals or snacks is especially popular with adolescents. Most such foods provide more than 50% of their energy from fat.[21] Popularity of the food items typically associated with the teenage diet was evident in this study and the South African National Youth Risk Behaviour Survey.[2]

The data implies that at least a third of the learners may be consuming one or more high-fat fast and snack food(s), such as hot dogs, frankfurters, salami, russians, sausage, pork sausage, hamburgers, cheeseburgers, bacon, potato chips, potato crisps, corn chips, popcorn, ice cream and bakery products, on a weekly basis. In a large Minnesota metropolitan area about 75% of adolescents in Grades 7 to 12 reported eating at a fast food restaurant during the previous week.[7] Dietary intakes of adolescents who frequently consume fast food are poorer in nutritional quality than those of adolescents who less frequently consume fast food.[7] Bakery products, also consumed by the learners, were found to provide large amounts of fat to the diets of American 15-year-olds.[37]

The major sources of fat in the diets of this learner group was margarine or butter, along with full-cream milk and cheese or cheese spread, followed by meat and meat products, such as cold cuts and lunch meats. Spreading fats, milk and milk products were also main contributors to the high fat intake of a national sample of British 16 to 17-year-olds,[25] while dairy foods were a major source of fat in the diets of American 15-year-olds.[37] The percentage of total fat consumption by 10-year-olds in the Bogalusa Heart Study coming from cheese furthermore increased from 1973–1974 to 1992–1994.[38] Meat and meat products were also a major source of fat in the diets of a national sample of British 16 to 17-year-olds[25] and American 10-[39] and 15-year-olds.[37] Most South Africans prefer brick margarine and full-cream milk. However, when advised to make lower-fat dairy choices there is a tendency to exclude milk from the diet.[40] This should be avoided because there is an indication in this study that if only consuming full-cream milk many adolescents may not consume enough milk. As much as 39% of the learners in this study indicated consuming milk only once or less than once per month (see Table IV).

Although learner gender had a significant impact on dietary fat knowledge it did not influence the dietary fat intake. South African adolescent girls aged 16 to 18 also obtained higher scores than the boys on the nutritional composition of common foods in a study by Walker and Walker.[34] The mean nutritional knowledge score was also higher for Western Australian teenage girls than for boys.[19] In addition, Australian adolescent girls had better knowledge of which foods to reduce when slimming than did adolescent boys.[41] Grade 7 girls in New Mexico also answered more cancer-related nutritional knowledge questions correctly than Grade 7 boys (62% and 54% respectively).[15] Although boys are more likely to have a higher fat consumption than girls,[19] Crawley[25] found a similar fat intake for males and females in a national sample of British 16 to 17-year-olds. The percentage energy from fat obtained from nationally representative dietary data of American youths also varied little by gender.[42]

Most learners indicated to be somewhat interested in nutrition (described as 'will occasionally read nutritional information'), which suggests that these young adults are not particularly interested in nutrition – a phenomenon which is generally acknowledged.[13] However, learner interest in nutrition and the major source of nutritional information, which was the school subject Home Economics, was significantly associated with their dietary fat knowledge and intake as was their dietary fat knowledge with their fat intake. Worsley[43] indicated the association between interest in nutrition and nutritional knowledge to be a potential key mediator influencing food behaviour. Nutritional knowledge is found to be better among adolescents who study Home Economics.[44] More eighth and tenth grade adolescents in the National Adolescent Student Health Survey who attended a nutrition course also scored high on knowledge of fat items compared to those who did not attend such a course (65% versus 51%).[45] Home Economics teaching also contributes to better food choices made by adolescents and their diets representing the recommended intakes more closely of among others the percentage dietary energy derived from fat.[44] This study, in finding that dietary fat knowledge supports consuming a lower-fat diet, upholds the hypothesis, along with other studies,[13,16,45] that having dietary knowledge is associated with healthier eating.

## Conclusions

Although the sample location limits the generalisation of the results, the study suggests that mid-adolescents from urban middle to upper socioeconomic areas lack knowledge on dietary fat, and are consuming diets that do not represent the South African food-based dietary guideline of eating fats sparingly.[40] A lack of knowledge of dietary fat and high fat intakes among the youth are universal findings. A study by Resnikow and Reinhardt[46] suggested that American primary and secondary school pupils are lacking essential information required to make positive nutritional choices. This knowledge gap may ultimately have major public health implications for increased risk of chronic disease.[46] A quarter of the adolescents in this study already perceived themselves to be overweight or obese. If the diet followed by these mid-adolescents is continued into adulthood, the high intake of fat is a concern, which can be justified by the looming health consequences. The rising prevalence of obesity among the youth worldwide[8] and in South Africa[26,47] is already a major concern. Reports of disordered eating and unsafe weight-loss practices and the increase in type 2 diabetes among youths further highlight the importance of a healthy adolescent diet.[8]

The study furthermore suggests that interest in nutrition, reliable nutritional information and dietary fat knowledge can positively impact fat intake. This interest indicates that nutritional knowledge is an important target for nutrition and health intervention strategies, as it has the potential to improve dietary quality. The results therefore support the hypothesis that dietary awareness and knowledge are associated with healthy dietary behaviours that facilitate the selection of healthy foods.[16] Youths may not merely alter dietary behaviour by being informed, however.[13,15,16] Accurate knowledge that motivates the individual to make healthy food choices is as important,[16] since the learners who indicated obtaining their nutritional information through a school subject obtained higher dietary fat knowledge scores and also followed diets with either a lower or more acceptable fat content. Cultivating interest in nutrition is also important as it was identified as influencing both the dietary fat knowledge and intake of this mid-adolescent group. This is of particular importance as adolescents in general are not interested in nutrition.[13]

Research on nutritional knowledge and dietary intake has yielded inconsistent associations.[13,16,43] This led researchers to question the relevance of nutritional knowledge related to food choice and the value of nutritional education campaigns. One of the reasons for the discrepancy may be weaknesses in the instruments used to determine nutritional knowledge.[14,48] According to Berg et al,[16] studies involving children and adolescents found positive, nil and even negative relationships between nutritional knowledge and behaviour, suggesting that the connection may be weak in these age groups. However, with the use of validated measures of nutritional knowledge, strong evidence emerges for an association between nutritional knowledge and intake, including fat intake.[14]

The assessment of dietary fat knowledge[28] by means of an inherently valid and reliable instrument pilot tested and adapted for use in this mid-adolescent age group can thus be considered a strength of this study. The association found between learner dietary fat knowledge and obtaining nutritional information through a school subject can confer construct-related evidence of validity to the nutritional knowledge test as adapted for this study. Worsley[43] and Axelson and Brinberg[48] furthermore emphasise that knowledge will be a good predictor of behaviour, only if the measure represents aspects of knowledge required to make a particular food choice that corresponds with that specific required dietary behaviour. The absence of such studies mentioned by Berg et al[16] was also overcome in this study. The study also provided research information about South African adolescents. This information, however, is limited.[49]

A limitation of the study is the use of the screening questionnaire[31] to assess the learner dietary fat intake, because it was never evaluated after it was adapted. A further limitation is the comparison of the foods included in the screening questionnaire[31] with that commonly consumed by younger children (one to nine-year-olds)[32] and not mid-adolescents. However, the nutritional considerations related to South African adolescents are often based on that found for younger South African children.[49] A limitation that may reduce the generalisation of the results is the participation of mostly white mid-adolescents, attending schools representative of broad middle to upper socioeconomic areas in the City of Cape Town. On the other hand, Kennedy and Goldberg[39] found that the average dietary fat levels do not vary dramatically between the diets of children from different income and racial/ethnic status groups. Other limitations may include the male learners being younger than the median age when the adult recommended diet is appropriate[20] and the self-reported body weight status.

## Recommendations

Although the generalisation of the results should be cautioned against, the study supports the need for nutritional and health education intervention initiatives targeted at South African mid-adolescents so that they may consume diets lower in fat and follow healthier eating habits. There are many positive health implications for those adolescents who become more attentive eaters.[50] Population data on total cholesterol show that modification of dietary habits of the youth has been able to change lipid profiles in developing nations and even third-world countries.[29]

Children's dietary behaviour can be examined by looking at individual, behavioural and environmental factors. To change dietary behaviour successfully, interventions should aim to modify all three these factors[46] and include strategies at the population level that will benefit the youth in general and strategies at the individual level to help youths with health conditions.[8] This study supports the implementation of such strategies from a nutritional perspective, the foremost strategy being the provision of school-based nutritional education. In this study the subject Home Economics (Consumer Studies), which incorporates nutrition as a substantial component of the subject content,[33] made a positive impact on the learner's dietary (fat) behaviour. However, such an outcome will only be obtained by the portion of the learner population that chooses the subject. The subject Life Orientation in the new school curriculum includes a small component on nutrition.[33] The inclusion of nutrition in this mandatory subject[33] is crucial as it will impact the youth in general. However, due to nutrition only being a small component of the subject, it will need to be evaluated to be acknowledged as contributing positively to the well-being of the learner population. Further nutritional activities, such as provided by the School Health Services, along with other activities such as school and mass communication programmes,[2] may therefore be crucial to support the health and well-being of young people in South Africa. Although the media was not indicated as a major source of nutritional information by the learners in this study, it is believed that this technology can be effectively utilised in the provision of nutritional education and information. Interest in nutrition was identified as being positively associated with dietary fat knowledge and intake. Interest in nutrition must therefore be cultivated in the provision of nutritional education and information and also be used to overcome the barriers to healthier eating indicated by adolescents. One such barrier includes the lack of youths' personal concern and urgency regarding healthy eating and personal health,[6,7] and specifically regarding future adverse health effects.[10] Setting up a Youth Development Programme[2] and Health Promoting Schools[51] in South Africa, as advocated, may ultimately hold the promise for developing healthy behaviour and dietary practices among the youth, including eating fats sparingly.

The school setting has several features that make it advantageous for offering educational and information programmes aimed at the youth.[15,35] The school environment should support the change to healthy dietary practices,[19,52] with the home environment reinforcing these practices.[19,22,52] Parents and friends were found to be a major source of nutritional information in this study. The home environment should therefore be included in intervention initiatives aimed at the mid-adolescent group to support the nutrition and health practices as advocated through the school setting.

Nutritional education and information interventions should be appropriate and consider the need for a moderation in fat intake along with the need for a high energy intake.[20] A quarter of the learners perceived themselves to be overweight or obese. Although a higher percentage reported themselves as overweight in other adolescent studies,[19,53] it is still a concern as South African adolescents are attempting to lose weight and are using inappropriate methods to do so.[54] Nutritional education and information should therefore include information about sensible weight loss and the detrimental effects of inappropriate weight-loss methods[41,55] at the population and the individual level.[8] Adolescents should also be discouraged from 'dieting', which tends to be short term, and rather be encouraged to adopt more healthy eating behaviours that can be integrated

into their lifestyle.[50] The way healthy eating is portrayed to the youth should perhaps be reviewed,[10] as it needs to be accepted as normal.[41] In practice, learners should be encouraged to apply the guideline 'eat fats sparingly'. This will entail consuming less fat and oils[40] by substituting bread spread or spreading fats,[25] milk[15] and meat[40] with lower-fat choices. Fried foods and bakery products should be eaten sparingly and higher-fat snacks substituted with fruit and vegetables.[5]

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## References

1. Lowry R, Kann L, Collins JL, Kolbe LJ. The effect of socioeconomic status on chronic disease risk behaviors among US adolescents. JAMA 1996;276(10):792–7.
2. Reddy SP, Panday S, Swart D, et al. Umthenthe Uhlaba Usamila – The South African Youth Risk Behaviour Survey 2002. Cape Town: South African Medical Research Council; 2003.
3. Schneider D. International trends in adolescent nutrition. Soc Sci Med 2000;51:955–67.
4. Jenkins S, Horner SD. Barriers that influence eating behaviors in adolescents. J Pediatr Nurs 2005;20(4):258–67.
5. Sherratt E. High fat intakes are unhealthy but do children know? Educ Rev 1996;48(2):163–74.
6. Croll JK, Neumark-Sztainer D, Story M. Healthy eating: what does it mean to adolescents? J Nutr Educ 2001;33:193–8.
7. French SA, Story M, Neumark-Sztainer D, Fulkerson JA, Hannan P. Fast food restaurant use among adolescents: associations with nutrient intake, food choices and behavioral and psychosocial variables. Int J Obesity 2001;25:1823–33.
8. Lytle LA, Kubik MY. Nutritional issues for adolescents. Best Pract Res Cl En 2003;17(2):177–89.
9. Smalley SE, Wittler RR, Oliverson RH. Adolescent assessment of cardiovascular heart disease risk factor attitudes and habits. J Adolescent Health 2004;35:374–9.
10. Hamilton J, McIlveen H, Strugnell C. Educating young consumers – a food choice model. J Consum Stud Home Econ 2000;24(2):113–23.
11. Kaur TJ, Kochar GK, Agarwal T. Impact of nutrition education on nutrient adequacy of adolescent girls. Stud Home Comm Sci 2007;1(1):51–5.
12. Neumark-Sztainer D, Story M, Perry C, Casey MA. Factors influencing food choices in adolescents: findings from focus-group discussions with adolescents. J Am Diet Assoc 1999;99:929–34, 937.
13. Pirouznia M. The influence of nutrition knowledge on eating behavior – the role of grade level. Nutr Food Sci 2001;31(2):62–6.
14. Wardle J, Parmenter K, Waller J. Nutrition knowledge and food intake. Appetite 2000;34:269–75.
15. Cunningham-Sabo LD, Davis SM, Koehler KM, Fugate ML, DiTucci JA, Skipper BJ. Food preferences, practices and cancer-related food and nutrition knowledge of Southwestern American Indian youth. Cancer 1996;78(7 Suppl):1617–22.
16. Berg MC, Jonsson I, Conner MT, Lissner L. Relation between breakfast food choices and knowledge of dietary fat and fiber among Swedish schoolchildren. J Adolescent Health 2002;31:199–207.
17. Hursti UK. Factors influencing children's food choice. Ann Med 1999;31(Suppl 1):26–32.
18. Merron S, Lock R. Does knowledge about a balanced diet influence eating behaviour? School Sci Rev 1998;80(290):43–8.
19. Gracey D, Stanley N, Burke V, Corti B, Beilin LJ. Nutritional knowledge, beliefs and behaviors in teenage school students. Health Educ Res 1996;11:187–204.
20. Zlotkin SH. A review of the Canadian "Nutrition recommendations update: dietary fat and children". J Nutr 1996;126(Suppl):S1022–7.
21. Spear BA. Adolescent growth and development. J Am Diet Assoc 2002;102(3 Suppl):S23–9.
22. Zabinski MF, Daly T, Norman GJ, et al. Psychosocial correlates of fruit, vegetable, and dietary fat intake among adolescent boys and girls. J Am Diet Assoc 2006;106:814–21.
23. Sweeting H, Anderson A, West P. Socio-demographic correlates of dietary habits in mid to late adolescence. Eur J Clin Nutr 1994;48(10):736–48.
24. Lake AA, Rugg-Gunn AJ, Hyland RM, Wood CE, Mathers JC, Adamson AJ. Longitudinal dietary change from adolescence to adulthood: perceptions, attributions and evidence. Appetite 2004;42:255–63.
25. Crawley HF. The energy, nutrient and food intakes of teenagers aged 16–17 years in Britain. 1. Energy, macronutrients and non-starch polysaccharides. Brit J Nutr 1993;70:15–26.
26. Steyn NP, Bradshaw D, Norman R, et al. Dietary changes and the health transition in South Africa: implications for health policy. Cape Town: South African Medical Research Council; 2006.
27. Kruger R, Kruger HS, MacIntyre UE. The determinants of overweight and obesity among 10- to 15-year-old schoolchildren in the North West Province, South Africa – the THUSA BANA (Transition and Health during Urbanisation of South Africans; BANA, children) study. Public Health Nutr 2006;9(3):351–8.
28. Venter I. Construction of a valid and reliable test to determine knowledge on dietary fat of higher-educated young adults. S Afr J Clin Nutr 2008;21(3):133–9.
29. Kelishadi R, Pour MH, Zadegan NS, et al. Dietary fat intake and lipid profiles of Iranian adolescents: Isfahan Healthy Heart Program – heart health promotion from childhood. Prev Med 2004;39:760–6.
30. Peltzer K. Nutrition knowledge and food choice among black students in South Africa. Cent Afr J Med 2001;48(1/2):4–8.
31. South African Medical Association Dyslipidemia Nutrition Working Group. Dietary management of dyslipidemia clinical guideline. S Afr Med J 2000;90(2):179–85.
32. Labadarios D, editor. The National Food Consumption Survey (NFCS): children aged 1 – 9 years, South Africa, 1999. Pretoria: Department of Health; 2000:294, 476.
33. Western Cape Education Department. The National Curriculum Statement: Grades 10 to 12. Western Cape Education Department Further Education and Training (FET) Conference for Principals, 11 June 2005. Panorama: Northlink College. Available from http://wced.wcape.gov.za/ncs/conference05/index.html (Accessed 28/08/2009).
34. Walker ARP, Walker BF. Food composition knowledge of white, coloured and Indian adolescents: how can it be improved? S Afr J Food Sci Nutr 1993;5(4):125–8.
35. McArthur L, Peña M, Holbert D. Effects of socioeconomic status on the obesity knowledge of adolescents from six Latin American cities. Int J Obesity 2001;25:1262–8.
36. Mia FB, Vorster HH. Coronary heart disease risk factors in Indian adolescents – the role of diet. CVJSA 2000;11(2):68–75.
37. Witschi JC, Capper AL, Ellison RC. Sources of fat, fatty acids and cholesterol in the diets of adolescents. J Am Diet Assoc 1990;90(10):1429–31.
38. Niklas TA, Baranowski T, Cullen KW, Berenson G. Eating patterns, dietary quality and obesity. J Am Coll Nutr 2001;20(6):599–608.
39. Kennedy E, Goldberg J. What are American children eating? Implications for public policy. Nutr Rev 1995;53(5):111–26.
40. Wolmarans P, Oosthuizen W. Eat fats sparingly – implications for health and disease. S Afr J Clin Nutr 2001;14(3 Suppl):S48–55.
41. Nowak M. The weight-conscious adolescent: body image, food intake, and weight-related behavior. J Adolescent Health 1998;23(6):389–98.
42. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Examination Surveys. Am J Clin Nutr 2000;72(Suppl):S1343–53.
43. Worsley A. Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? Asia Pacific J Clin Nutr 2002;11(Suppl):S579–85.
44. Seaman CEA, Young D. The contribution of home economics teaching to nutrition knowledge and food choice among adolescents. Int J Consumer Stud 2007;20(3):229–34.
45. Portnoy B, Christenson GM. Cancer knowledge and related practices: results from the National Adolescent Student Health Survey. J School Health 1989;59(5):218–24.
46. Resnicow K, Reinhardt J. What do children know about fat, fiber and cholesterol? A survey of 5,116 primary and secondary school students. J Nutr Educ 1991;23:65–71.
47. Amstrong MEG, Lambert MI, Sharwood KA, Lambert EV. Obesity and overweight in South African primary school children – the Health of the Nation Study. S Afr Med J 2006;96(5):439–44.
48. Axelson ML, Brinberg D. The measurement and conceptualization of nutrition knowledge. J Nutr Educ 1992;24:239–46.
49. Whati LH, Senekal M, Steyn NP, Nel JH, Lombard C, Norris S. Development of a reliable and valid nutrition questionnaire for urban South African adolescents. Nutrition 2005;21:76–85.
50. Neumark-Sztainer D, Hannan PJ, Story M, Perry CL. Weight-control behaviors among adolescent girls and boys: implications for dietary intake. J Am Diet Assoc 2004;104(6):913–20.
51. James S, Moodley V. The health of older children in a school setting. South African Health Review. Durban: Health Systems Trust; 2006. Available from http://www.hst.org.za/uploads/files/chap17-06.pdf (Accessed 28/08/2009).
52. Stevens J, Cornell CE, Story M, et al. Development of a questionnaire to assess knowledge, attitudes and behaviors in American Indian children. Am J Clin Nutr 1999;69(Suppl):S773–81.
53. Serdula MK, Collins ME, Williamson DF, et al. Weight control practices of US adolescents and adults. Ann Intern Med 1993;199:667–71.
54. Senekal M, Steyn NP, Mashego TB, Nel JH. Evaluation of body shape, eating disorders and weight management related parameters in black female students or rural and urban origins. SAJP 2001;31(1):45–53.
55. Cilliers J, Senekal M, Kunneke E. The association between the body mass index of first-year female university students and their weight-related perceptions and practices, psychological health, physical activity and other physical health indicators. Public Health Nutr 9(2):234–43.