

## Consumption of nutritional supplements among adolescents: usage and perceived benefits

Jennifer A. O’Dea

### Abstract

The aim of the study was to obtain rich qualitative data about the type of nutritional supplements and drinks consumed by adolescents, and the reasons for their consumption, with particular emphasis on the perceived benefits of nutritional supplementation. Semi-structured focus group interviews ( $n = 16$ ) were conducted among 78 adolescents aged 11–18 years from a co-educational government high school. Participants reported consuming sports drinks, vitamin and mineral supplements, energy drinks, herbal supplements, guarana, creatine, high protein milk supplements, and coenzyme Q<sub>10</sub>. Reasons for supplement use included perceived short-term health benefits, prevention of illness, improved immunity, parental supply of supplements, taste, energy boost, better sports performance and to rectify a poor diet. Results suggest that some adolescents consume nutritional supplements, sports drinks and energy drinks for their perceived physiological benefits, and that they may not be aware of any potential risks. Health educators should be aware that adolescents seek specific health benefits from nutritional supplements and drinks, which may be better achieved through appropriate consumption of a nutritious diet. Health education programmes should incorporate the perceptions, aspirations and motivations of young

people into the planning of interventions and activities in order to make them most relevant and effective.

### Introduction

Previous studies of nutritional supplementation (Kovar, 1985; Bowering and Clancy, 1986; Park *et al.*, 1991; Dickinson *et al.*, 1994; Ervin *et al.*, 1999) have estimated that 40% of people take nutritional supplements and that children aged 1–5 years of age are the major consumers of supplements. Studies to date show that the major type of nutritional supplement appears to be combination vitamin/mineral supplements, which are consumed by 46% of users. Other studies report nutritional supplementation with various types of products such as herbal supplements (Planta *et al.*, 2000), iron (Yu *et al.*, 1997), vitamin C (Park *et al.*, 1991), amino acids (Applegate and Grivetti, 1997) and creatine (O’Dea and Rawstorne, 2001). In a large study of adolescent athletes, Sobal and Marquart (Sobal and Marquart, 1994), found 38% used vitamin and mineral supplements which mainly included vitamin C, multivitamins, iron, calcium, and vitamins A and B.

The reasons for nutritional supplementation in children and adolescents have been studied very little. The results of a large American study (Ervin *et al.*, 1999) found that nutritional supplementation was more likely to occur among females, children aged 1–5 years, whites, and those with a higher income, higher educational status and greater self-reported health status. The study did not report the reasons for supplementation. Studies of adolescent athletes (Douglas and Douglas, 1984; Krowchuk

School of Development and Learning, Faculty of Education, A35, Education Building, University of Sydney, NSW 2006, Australia. E-mail: j.o’dea@edfac.usyd.edu.au

*et al.*, 1989; Haymes, 1991; Sobal and Marquart, 1994) show that a better sports performance is expected by nutritional supplement users.

The use of health education theory can help us to improve our understanding of the nutritional supplementation practices of adolescents. Health education theory states that a person's behavior and cognitions affect future behavior, and that in order to improve adolescents' health behaviors, we need to understand the many factors which influence behavior and the complex interactions between such variables (Glanz *et al.*, 1997; Bandura, 1986). Social Cognitive Theory (Bandura, 1986) posits that many factors interact to affect behavior, including actual behavior, personal factors (including cognitions) and environmental influences. An understanding of the many factors which affect adolescents' nutritional supplementation practices will help us to educate young people better about the risks and benefits of such behaviors. For example, in order to prevent health-damaging outcomes of nutritional supplementation such as the side effects of high caffeine intake from guarana or energy drinks, we need to understand the perceived benefits, risks, individual perceptions, self-efficacy and environmental factors which drive the consumption of such products among adolescents.

The current study was designed to gain rich qualitative data about the following:

- (1) The types of nutritional supplements and drinks consumed by adolescents?
- (2) The reasons for consumption of nutritional supplements in adolescents, including perceived benefits.

The study was designed to answer these initial questions in order to inform future nutrition education programmes and health promotion activities.

---

## Methods

---

The study population included 78 male and female students in Grades 7–11 from a co-educational government high school. The student's ages ranged from 11 to 18 years. A total of 16 semi-structured,

in-depth focus groups were conducted which included an average of three in each school grade from years 7 to 11. The school drew students from a lower-middle class background (determined by the school Principal using parental income) with a varied ethnic mix. The ethnic/cultural background of participants was 60.7% Anglo-Saxon/Caucasian, 20.6% Asian, 11.7% Southern European (Greek, Italian), 3.2% Middle Eastern, 2.3% Pacific Islander and 1.5% Aboriginal. Participants were randomly selected from their mandatory grade English classes and each participant provided written parental consent. A total of 97.5% of students participated in the study ( $n = 78/80$ ) with the two non-participants failing to provide a signed parental consent form. Participants in each school grade were in Grades 7 ( $n = 12$ ), 8 ( $n = 11$ ), 9 ( $n = 10$ ), 10 ( $n = 21$ ) and 11 ( $n = 24$ ), with approximately four or five students in each focus group. A mix of males and females were included in each focus group. In-depth focus group discussions were conducted at the school in a private classroom. Each focus group lasted approximately 30 min with a total of 480 min of interview time for the whole study. The University of Sydney, Human Ethics Committee, approved the study design and protocol.

## Research design

Focus groups were conducted by the author and a research assistant recorded detailed notes in shorthand. The notes were recorded verbatim where possible in order to record accurate quotations from participants. The research assistant also counted the number of participants in each focus group who raised their hand in response to the question 'In the last 2 weeks, have you consumed any of the following: vitamin and mineral supplements, high protein milk supplements, etc.' (Table I). Focus groups were conducted according to methods described by Miles and Huberman (Miles and Huberman, 1994).

The questions discussed in the focus group interviews are outlined in Table I. A semi-structured set of questions was used in order to ensure a systematic structure for the conduct of

**Table I.** *Semi-structured focus group questions asked of 78 male and female adolescents aged 11–18 years*

---

Raise your hand if, in the past 2 weeks, you consumed any of the following:

- vitamin and mineral supplements
- high protein milk formulas such as Sustagen
- herbal supplements
- guarana
- creatine
- coenzyme Q<sub>10</sub>
- sports drinks such as Gatorade
- energy drinks such as Red Bull, 'V' or Lift Plus
- any other supplement?

What type of supplement was it? (e.g. tablet, powder)

What was the brand name of the supplement?

Where did you obtain the supplement?

How much of the supplement did you consume?

Why did you consume the supplement?

---

the focus groups and consistency in the delivery and discussion of questions (Britten, 1995). The focus group questions were pilot-tested for content validity among five school students (two from Grade 7 and three from Grade 10) in order to test whether the students understood the questions, and whether they could easily answer and discuss the questions. The pilot test was also conducted in order to measure the required time frame for the interviews. The wording of the questions was subsequently modified and simplified after the pilot testing and the time frame was expanded from a 20 to 30 min minimum.

### Data analysis

The recorded notes of the focus group interviews ( $n = 16$ ) were typed to produce a manuscript. The data were then analyzed using content analysis (Miles and Huberman, 1994; Britten, 1995; Pope and Mays, 1995), which involved the systematic examination of the transcripts by identifying and grouping themes, and coding, classifying and developing categories. The final result was the development of major and minor themes from the focus group discussions. Two researchers undertook the content analysis—the author and a research assistant trained in content analysis. Each person analyzed the data independently in order to reduce bias (Mays and Pope, 1995; Pope and

Mays, 1995). After the content analysis of the data was completed, the two researchers came together to form agreement about the major and minor themes to emerge from the data, gender or age differences in any of the themes, and any information which the researchers had found difficult to categorize. After discussion about each of the relevant themes and agreement was reached between the two researchers, the themes were put into a table format. The number of responses counted by the research assistant in the focus groups in response to the question 'In the past 2' weeks, have you consumed any of the following?' (Table I) were tallied to produce frequencies. A brief questionnaire was administered to the participants prior to the focus group discussions in order to record gender, age, ethnic background and school grade.

---

## Results

---

In the 2 weeks prior to the focus groups, the following percentage of participants consumed: sports drinks, 56.4% ( $n = 44$ ); vitamin and mineral tablets, 48.7 % ( $n = 38$ ); energy drinks, 42.3% ( $n = 33$ ); herbal supplements, 17.9% ( $n = 14$ ); guarana 5.2% ( $n = 4$ ); creatine, 5.2% ( $n = 4$ ); high protein milk supplements 3.9% ( $n = 3$ ); and coenzyme Q<sub>10</sub>, 1.3% ( $n = 1$ ). The participants who indicated that they had consumed an herbal supplement ( $n = 14$ ) reported the supplement to be unknown ( $n = 6$ ), ginseng ( $n = 3$ ), echinacea ( $n = 3$ ), lysine ( $n = 1$ ) and an infusion of 'slimming' herbal tealeaves ( $n = 1$ ). Several participants reported the consumption of herbal teas, but these were considered to be common beverages and were not included in the analysis as herbal supplements.

The results of focus group interviews are presented in Table II. As the list of nutritional supplements consumed by the adolescents was specified in the semi-structured focus group questions, they are presented in the same order in Table II. The themes related to participants' reasons for taking each supplement are listed in descending order of importance after each specific supplement. For

## Consumption of nutritional supplements among adolescents

**Table II.** *Reasons given by adolescents for their consumption of nutritional supplements and drinks*

Category of supplement	Type of supplement	Reasons for consumption	Typical responses from adolescents
Vitamins and minerals	multivitamin tablets, vitamin c, iron tablets	health; prevention of illness; sports performance; parental control; energy; poor diet; to do something positive for self	<p>'Keeps me healthy'</p> <p>'I don't know'</p> <p>'Iron because I'm vegetarian'</p> <p>'Keeps me fit for sports'</p> <p>'Vitamin C to prevent colds'</p> <p>'Keeps your sugar levels up'</p> <p>'They taste yummy'</p> <p>'Mum gives them to me'</p> <p>'They are good for you'</p> <p>'Feel like you are doing something good for yourself'</p> <p>'I don't get enough fresh foods'</p> <p>'Vitamin C for the immune system'</p> <p>'Helps me to grow'</p>
High protein milk formulas	Sustagen (pre-prepared drink; powder mix)	taste; thirst; energy; parental control; to gain weight/bulk up	<p>'Quench thirst'</p> <p>'Give me more energy for sports'</p> <p>'Mum gives it to me'</p> <p>'Stops my cold sores'</p>
Herbal supplements	lysine (tablets)	prevention of illness (cold sores)	
	echinacea (tablets)	health; prevention of illness; boost immunity	'To not get sick'
	ginseng (tablets)	energy boost; sports performance; prevention of illness/colds	<p>'Helps me do better at sports'</p> <p>'For colds'</p> <p>'To stop me from getting sick'</p>
	herbal tea infusion	slimming/weight loss	'To help with my obesity— Mum gives it to me'
Guarana Coenzyme Q <sub>10</sub> (one female only)	'herbs' (unidentified tablets)	'Don't know – Mum gives it to me'	
	tablets; drinks	energy; parental control	'Gives me energy'
Creatine (males only)	tablets	energy; parental control	'Mum takes it for energy— she gives me one sometimes'
		powder	<p>'To build muscle tissue when working with weights'</p> <p>muscle gain; sports performance</p> <p>'Helps with weight training'</p> <p>'My brother gives it to me in a milkshake to build my muscles'</p>

**Table II.** *Continued*

Category of supplement	Type of supplement	Reasons for consumption	Typical responses from adolescents
Sports drinks	drinks	thirst; taste; soft drink substitute; energy; sports performance; coaches preference; to prevent cramps	'Had it because I was thirsty' 'Tastes nice' 'The energy gives you a lift' 'There are lots of vitamins in it' 'It was the only drink available' 'Stops me getting cramps at sport' 'It's just like a soft drink' 'Cools you down' 'Coach makes us drink it' 'Gives you energy' 'Makes your muscles relax'
Energy drinks	drinks	energy; taste; sports performance; soft drink substitute; peer group pressure; attractive packaging	'Makes me feel more energetic' 'Other guys in the team take it' 'I don't think it does anything for me' 'I had it because I was thirsty' 'Wakes you up, makes you feel alert and it tastes nice' 'I only bought it because there was no water' 'It makes me go hyper' 'The caffeine gives me a buzz' 'I drink it before soccer and I don't lose energy as fast' 'I like the can—it looked cool so I bought it' 'They're like a soft drink'

example, the major theme is listed first and the minor themes are listed last. Similar responses were given by male and female adolescents of various ages except where indicated. Creatine supplementation was undertaken only by males ( $n = 4$ ) and coenzyme Q<sub>10</sub> tablets were consumed by one female only.

The reasons for nutritional supplementation varied according to the type of supplement being consumed. Vitamin and mineral supplements and herbal supplements were taken by adolescents to

promote better health, to prevent illnesses such as the common cold and because they were given to participants by their mother. Several participants reported that they did not know why their mother gave them the supplements.

I don't know why she gives them to us. She was just handing them around and all the kids had one. I don't know what type they were, but they were nice.

A minor theme related to consumption of vitamin

and mineral supplements was the participants' perception that they liked doing something positive for themselves.

I just like to, you know, feel like I'm doing something good for myself...better than just junk food... I like to feel proud that I've done something good for myself.

High protein milk formulas (Sustagen) were consumed very little by the study group, with those who did consume them, mainly drinking for taste, thirst and better sports performance.

I drink vanilla Sustagen every day... I like the taste and it gives me lots of energy for softball and stuff. Mum gives it to me too, but I just like the taste of it. Its yummy...nicer than the chocolate.

Sports drinks were consumed by more than half of the study group as thirst quenchers and drinks that taste good. The majority of participants talked about sports drinks being substitutes for soft drinks.

They're nice and they're good when you're hot and thirsty. I just get them out of the fridge...I like the color.

Some participants talked extensively about the relationship between sports drinks and perceived improvements in sports performance.

It makes your muscles relax after dancing and it stops you getting cramps.

I have it at softball for extra energy.

Some participants indicated that their sports coach promotes the consumption of sports drinks.

The coach gets them for the team [football] and he makes us have it all the time.

None of the participants identified the rehydrating properties of sports drinks as reasons for their consumption.

The energy drinks were very popular among participants of all ages and they talked enthusiastically about the perceived beneficial effects that

energy drinks have on their bodies and their sports performance.

They really energize you and they give you a bit of a buzz.

I felt refreshed and hyper.

People drink it for the energy and the cool packaging.

Other participants referred to enjoying the taste of the energy drinks and a theme emerged that they were consumed as soft drink substitutes, but only when participants had enough money to buy them, as they were perceived to be more expensive than soft drinks.

...I get them when I've got money left over—like soft drinks and they taste good.

Participants involved in sports, particularly males, talked about deliberately using the energy drinks as stimulants and ergogenic aids.

...I wanted an energy boost so I had five cans of Red Bull before playing soccer.

I had it before soccer. It's probably a psychological theory, but it made me feel more energetic. Other guys in the team take it.

I had a can of 'V' for soccer. I don't think it does anything for me. I take it just before playing, but it might make a difference if I take five cans.

Supplements including guarana, ginseng, and coenzyme Q<sub>10</sub> were consumed for the 'energy' they were perceived to provide. Herbal supplements were generally taken by adolescents for their perceived benefits to general health and prevention of illness.

I take it [ginseng] for immunity and to not get sick.

---

## Discussion

---

The results of the focus groups provide rich qualitative data about the reasons behind the consump-

tion of nutritional supplements, sports drinks and energy drinks in adolescents. Adolescents of all ages could clearly articulate the perceived benefits of various forms of supplementation, with the vast majority of supplements considered to be beneficial to the adolescents' health and for the prevention of illness. The theme of immunity became interchangeable with the theme of prevention of illness, particularly in relation to vitamins and minerals, and herbal supplements such as echinacea. It was interesting that no participants discussed the potential of supplements to prevent lifestyle diseases such as coronary heart disease or cancer, but they focused on more short-term benefits such as prevention of colds, flu and cold sores. The common cold was the type of illness most expected to be prevented among the adolescents by nutritional supplementation. The idea that immunity can be 'boosted' by dietary factors was a very strong theme to emerge. These results support the findings of Nowak and Crawford (Nowak and Crawford, 1998) who found that adolescents recognize the importance of food in the long-term prevention of future illness, but attach more importance on short-term issues such as their current looks, energy and fitness.

Many adolescents reported that they obtained supplements such as vitamins and minerals, herbal supplements, and guarana from their mother. It was interesting to note that several of the adolescents reported being unaware of the benefits of the supplements supplied by their mother, other than a vague idea that they would somehow make them healthier. The theme of improving health status was very common and reinforced the minor theme that simply taking some nutritional supplements could improve a poor diet by 'making up' for poor dietary choices. This phenomenon has been termed 'dietary insurance' or 'health insurance' (Whitney and Rolfes, 1999) for people who feel unsure about the nutritional adequacy of their diet. It is clear from the results of the current study that this phenomenon exists among adolescents as well as adults.

The major theme of 'energy production' was related to nearly all of the nutritional supplements.

Participants referred to obtaining an 'energy boost' from supplements, and a conservation of energy and endurance—'you don't lose energy as fast'. The adolescents appear to be incorrectly attributing the 'creation' of energy to these supplements when the actual effect is a stimulant effect caused by caffeine, and other stimulants in products such as energy drinks, guarana and ginseng. Guarana, for example, contains a very high concentration of caffeine and the potential for toxicity of guarana in humans has been suggested (Santa Maria *et al.*, 1998). It is possible that many of the misguided 'energy creation' beliefs among adolescents may be attributable to information provided to consumers in the advertising and marketing of these 'health food' products, and this should be studied in further research. It is important to note, however, that many of the adolescents in the current study clearly articulated that they had recently experienced the physiologic effects of caffeine and that was the major motivating factor behind their consumption. The adolescents had deliberately sought an 'energy boost', and had received it in the form of a stimulant effect from the caffeine-containing supplements and drinks. Some participants indicated that the desired energy boost might have been dependent on the dosage of the energy drink—'I don't think it does anything for me...but it might make a difference if I take five cans'. In this regard, the adolescents were using the nutritional supplements and drinks as stimulant drugs whose effects were clearly dose related. There were no other themes related to the use of stimulants or other drugs in conjunction with energy drinks, but the future investigation of this possibility would be useful in determining whether there is a link between substance abuse and the use of nutritional stimulants in adolescents.

None of the participants discussed any negative or potentially dangerous effects of nutritional supplementation. Many previous studies have reported various hazards of nutritional supplementation in children and adolescents, including the potential toxicity from large doses of vitamins and minerals (DiPalma and Ritchie, 1977; Fumich and Essig, 1983), side effects of

caffeine-containing products (Bernstein *et al.*, 1994), allergic reactions (Greenberger and Flais, 2001), and the largely unknown side effects of substances such as creatine (Juhn *et al.*, 1999; Rooney *et al.*, 1999) and coenzyme Q<sub>10</sub>. The fact that the young people in the current study appear to be unaware of the potential risks associated with nutritional supplementation may reflect a poor knowledge of these issues among adolescents. It is also possible that the adolescents in the current study have simply ignored the perceived risks and side effects of nutritional supplementation in favor of the perceived benefits.

These results can be partially explained in the context of changes that occur during adolescence which is characterized by large changes in physical, cognitive and social development (Tanner, 1972). Adolescents experience the development of self-identity, self-perceptions, independence and increased responsibilities (Harter, 1990). They also tend to be involved in experimentation with new behaviors, and increased conformity to peers and peer influences (Crockett and Petersen, 1993). The use of nutritional supplementation is therefore not surprising in this context of adolescent development, peer influence and experimental behaviors, especially in an environment where physical prowess and sports performance is highly valued among males.

These results have important implications for the use of health education theory in the planning of nutrition education and health promotion activities. The results of the current study suggest that it is important to warn young people and their parents about the risks and undesirable side effects of some caffeine-containing nutritional supplements, such as sleep disturbances, diuresis, raised diastolic blood pressure, increased anxiety and tremors (Bernstein *et al.*, 1994; Australia New Zealand Food Authority, 2000). However, the study results also suggest that warnings about potential dangers may not necessarily deter some adolescents who may have already weighed up the perceived benefits of consumption and decided that the energy 'buzz' is desirable. Health education theories such as Health Belief Models (Strecher and Rosenstock,

1997) and the Theory of Reasoned Action (Fishbein and Ajzen, 1975) suggest that encouraging adolescents to participate in an informed risk/benefit analysis may be beneficial in helping them to choose healthful behaviors. In addition, addressing issues of self-efficacy (Bandura, 1986) may help adolescents choose more healthful behaviors. This could be achieved by providing sports nutrition advice and skills development about a high carbohydrate diet and fluid balance may help young people to improve their sports performance (Probart *et al.*, 1993), and thereby achieve their desired goals via nutritional means which are known to be risk free.

Health education theories such as those mentioned above, as well as the Social Cognitive Theory (Bandura, 1986), also suggest that other factors need to be considered in order to encourage healthy food habits in adolescents. Factors other than perceived benefits and risks of nutritional supplementation need to be considered to help adolescents make healthful and sensible food selections. Other factors could include the significant influence of 'others' such as peers, mothers and sports coaches in the supplementation practices of adolescents, the availability of healthful drinks such as water, juices and milk instead of energy drinks, adolescents' self-efficacy in improving physical performance via sports nutrition, and more effective marketing and promotion of healthful foods and drinks (e.g. in schools). Perhaps the larger environmental issue of food regulation ought to be considered in relation to the availability, sale and supply to adolescents of caffeine-containing energy drinks, and largely untested nutritional supplements such as coenzyme Q<sub>10</sub> and creatine.

It is clear from the results of the current study that nutritional supplementation and consumption of sports drinks and energy drinks is popular among adolescent sports people, but also those not involved in sport, who simply desire the perceived benefits of better health, avoidance of certain illnesses and more 'energy'.

Limitations of the current study include the use of set questions, which limited the discussion to certain types of nutritional supplements and issues

related to perceived benefits rather than risks. This study was conducted in only one school, which makes the results of limited generalizability. Future studies should explore adolescents' perceptions of a greater variety of nutritional supplements, and should also include younger children and their parents, as previous research has indicated that supplementation occurs in this younger age group (Ervin *et al.*, 1999; O'Dea and Rawstorne, 2000).

Health educators may apply these findings to inform the educational models designed to improve the food habits of adolescents by incorporating the motivating factors behind adolescent nutrition behaviors. Health professionals could apply these results in the clinical examination of adolescents as well as in school and community nutrition education. Adolescents in the current study were clearly interested in bettering their physical performance and sports performance, and this is an avenue of interest among adolescents which may be exploited by health educators. Health education programmes can incorporate the perceptions and motivations of young people into the planning of educational activities in order to make them most relevant and effective.

---

## References

---

- Applegate, E. A. and Grivetti, L. E. (1997) Search for the competitive edge: a history of dietary fads and supplements. *Journal of Nutrition*, **127**, 869S–873S.
- Australia New Zealand Food Authority (2000) *Report of the Expert Group on the Safety Aspects of Dietary Caffeine*. ANZFA, Canberra.
- Bandura, A. (1986) *Social Foundations of Thought and Action: A Social Cognitive Theory*. Prentice-Hall, Englewood Cliffs, NJ.
- Bernstein, G. A., Carroll, M. E., Crosby, R. D., Perwien, A. R., Go, F. S. and Benowitz, N. L. (1994) Caffeine effects on learning, performance and anxiety in normal school-age children. *Journal of the American Academy of Child and Adolescent Psychiatry*, **33**, 407–415.
- Bowering, J. and Clancy, K. L. (1986) Nutritional status of children and teenagers in relation to vitamin and mineral use. *Journal of the American Dietetic Association*, **86**, 1033–1038.
- Britten, N. (1995) Qualitative interviews in medical research. *British Medical Journal*, **311**, 251–253.
- Crockett, L. J. and Petersen, A. C. (1993) Adolescent development: health risks and opportunities for health promotion In Millstein, S. G., Petersen, A. C. and Nightingale, E. O. (eds), *Promoting the Health of Adolescents. New Directions for the Twenty-First Century*. Oxford University Press, Oxford, pp. 13–37.
- Dickinson, V. A., Block, G. and Russek-Cohen, E. (1994) Supplement use, other dietary and demographic variables and serum vitamin C in NHANES II. *Journal of American College Nutrition*, **13**, 22–32.
- DiPalma, J. R. and Ritchie, D. M. (1977) Vitamin toxicity. *Annual Review of Pharmacology and Toxicology*, **17**, 133–148.
- Douglas, P. D. and Douglas, J. G. (1984) Nutrition knowledge and food practices of high school athletes. *Journal of the American Dietetic Association*, **84**, 1198–1202.
- Ervin, R. B., Wright, J. D. and Kennedy-Stephenson, J. (1999) Use of dietary supplements in the United States, 1988–94. *Vital and Health Statistics—Series 11: Data from the National Health Survey*, **244**, i–iii, 1–14.
- Fishbein, M. and Ajzen, I. (1975) *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Addison-Wesley, Reading, MA.
- Fumich, R. M. and Essig, G. W. (1983) Hypervitaminosis A: a case report in an adolescent soccer player. *American Journal of Sports Medicine*, **11**, 34–37.
- Glanz, K., Lewis, F. M. and Rimer, B. K. (1997) *Health Behavior and Health Education*. Jossey-Bass, San Francisco, CA.
- Greenberger, P. A. and Flais, M. J. (2001) Bee pollen-induced anaphylactic reaction in an unknowingly sensitized subject. *Annals of Allergy, Asthma and Immunology*, **86**, 239–242.
- Harter, S. (1990) Self and identity development. In Feldman, S. S. and Elliot, G. R. (eds), *At the Threshold: The Developing Adolescent*. Harvard University Press, Cambridge, MA, pp 352–387.
- Haymes, E. M. (1991) Vitamin and mineral supplementation to athletes. *International Journal of Sports Nutrition*, **1**, 146–169.
- Kovar, M. G. (1985) Use of medications and vitamin-mineral supplements by children and youths. *Public Health Reports*, **100**, 470–473.
- Krowchuk, D. P., Anglin, T. M., Goodfellow, D. B., Stancin, T., Williams, P. and Zimet, G. D. (1989) High school athletes and the use of ergogenic aids. *American Journal of Diseases in Children*, **143**, 486–489.
- Mays, N. and Pope, N. (1995) Rigour and qualitative research. *British Medical Journal*, **311**, 109–112.
- Miles, M. B. and Huberman, A. M. (1994) *Qualitative Data Analysis: An Expanded Sourcebook*. Sage, Thousand Oaks, CA.
- Nowak, M. and Crawford, D. (1998) Getting the message across: adolescents' health concerns and views about the importance of food. *Australian Journal of Nutrition and Dietetics*, **55**, 3–8.
- O'Dea, J. A. and Rawstorne, P. R. (2000) Consumption of dietary supplements and energy drinks by schoolchildren [Letter]. *Medical Journal of Australia*, **173**, 389.
- O'Dea, J. A. and Rawstorne, P. R. (2001) Male adolescents identify their weight gain practices, reasons for desired weight gain and sources of weight gain information. *Journal of the American Dietetic Association*, **101**, 105–107.
- Park, Y. K., Kim, I. and Yetley, E. A. (1991) Characteristics of vitamin and mineral supplement products in the United States. *American Journal of Clinical Nutrition*, **54**, 750–759.

- Planta, M., Gundersen, B. and Pettitt, J. C. (2000) Prevalence of the use of herbal products in a low-income population. *Family Medicine*, **32**, 252–257.
- Pope, C. and Mays, N. (1995) Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health service research. *British Medical Journal*, **311**, 42–45.
- Probart, C. K., Bird, P. J. and Parker, K. A. (1993) Diet and athletic performance. *Medical Clinics of North America*, **77**, 757–772.
- Santa Maria, A., Lopez, A., Diaz, M. M., Munoz-Mingarro, D. and Pozuelo, J. M. (1998) Evaluation of toxicity of guarana with *in vitro* bioassays. *Ecotoxicology and Environmental Safety*, **39**, 164–167.
- Sobal, J. and Marquart, L. F. (1994) Vitamin/mineral supplement use among high school athletes. *Adolescence*, **29**, 835–843.
- Strecher, V. J. and Rosenstock, I. M. (1997) The Health Belief Model. In Glanz, K., Lewis, F. M. and Rimer, B. K. (eds), *Health Behavior and Health Education*. Jossey-Bass, San Francisco, CA, pp. 41–59.
- Tanner, J. M. (1972) Sequence, tempo, and individual variation in growth and development of boys and girls aged twelve to sixteen. In Kagan, J. and Coles, R. (eds), *Twelve to Sixteen: Early Adolescence*. Norton, New York, pp 1–24.
- Whitney, E. N. and Rolfes, S. R. (1999) *Understanding Nutrition*, 8th edn. Wadsworth, Belmont, CA.
- Yu, S. M., Kogan, M. D. and Gergen, P. (1997) Vitamin-mineral supplement use among preschool children in the United States. *Pediatrics*, **100**(5), E4.

Received on October 27, 2001; accepted on February 13, 2002