FACTORS ASSOCIATED WITH CALCIUM INTAKE IN ADOLESCENT ATHLETES

by

BRENDA LEA WEBSTER

B.S.H.Ec., The University of Saskatchewan, 1986

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

in

THE FACULTY OF GRADUATE STUDIES

(School of Family and Nutritional Sciences)

We accept this thesis as conforming

to the required standards

THE UNIVERSITY OF BRITISH COLUMBIA

December 1992

ABSTRACT

This study investigated dietary calcium intakes, and factors potentially affecting them, in adolescent athletes of both genders competing in either an aesthetic sport (gymnastics) or non-aesthetic sport (speed skating). For all athletes, data collection was conducted using a self-administered questionnaire which assessed the following: estimated calcium intake using a validated food frequency questionnaire, pubertal status, demographics (age, gender, racial origin, use of vitamin/mineral supplements, employment, allergies to milk or dairy products, parental socioeconomic status), training volume, competitive level, and social environmental factors (differential association (ie. family, friends, health experts, media), lifestyle, dieting behaviour, modelling behaviour and social and non-social reinforcement). Body composition was assessed using skinfold measurements.

The athletes competed at a minimum of a provincial level in either gymnastics (males = 25, females = 32) or speed skating (males = 32, females = 25). The mean ages of the male athletes were similar for the two sports (14.4 ± 1.8 yrs, $\bar{x} \pm SD$ vs 14.7 ± 1.9 yrs for skaters and gymnasts respectively); however, the skaters were taller (170.2 ± 10.3 cm vs 158.5 ± 13.0 cm, $p<0.05$), heavier (60.5 ± 11.9 kg vs 50.1 ± 12.5 kg, $p<0.05$) and had higher estimated percent body fat (%BF) (8.0 ± 3.4% vs 3.7 ± 2.1%, $p<0.001$) and sum of skinfold measurements (S4SF) (35.8 ± 9.8 mm vs 23.9 ± 3.6 mm, $p<0.001$). Similar to the males, the mean ages of the female athletes were similar for skaters and gymnasts (14.3 ± 1.6 yrs vs 14.1 ± 1.6 yrs); however, the skaters were taller (162.2 ± 8.2 cm vs 153.6 ± 4.9 cm, $p<0.001$), heavier (58.5 ± 9.5 kg vs 45.2 ± 7.9 kg, $p<0.001$) and had higher

estimated %BF ($21.0 \pm 7.7\%$ vs $9.4 \pm 5.7\%$, $p<0.001$) and S4SF (65.5 ± 18.9 mm vs 38.5 ± 12.3 mm, $p<0.001$). A 2X2 ANOVA (gender X sport) was used to assess differences in total dietary calcium intake. The analysis showed that there was a significant main effect of sport ($F_{1,100} = 6.63$, $p = 0.01$), indicating that averaged over gender, the skaters had significantly higher calcium intakes than the gymnasts. There was no main effect of gender ($F_{1,100} = 2.90$, $p = 0.09$) and no interaction between gender and sport ($F_{1,100} = 0.52$, $p = 0.47$), meaning that the difference in calcium intake between the two sports was similar for both genders. Additionally, all groups of athletes exceeded the recommended nutrient intake for calcium.

Among the independent variables, 2X2 ANOVA (gender by sport) revealed significant main effects for scores on the dieting sub-scale and for social reinforcement score. A significant main effect of gender was detected for scores on the dieting sub-scales ($F_{1,105} = 21.86$, $p<0.001$), meaning that averaged over the two sports, the female athletes scored significantly higher than the male athletes. No significant effect of sport was detected, nor was an interaction effect detected. Although a gender difference existed for the dieting sub-scale scores, neither the mean scores of the male nor the female athletes suggested tendencies towards disturbed eating behaviours. ANOVA of the social reinforcement variable showed that there was a significant main effect of sport ($F_{1,107} = 5.78$, $p = 0.02$), indicating that while athletes in both sports disagreed that consuming milk evoked positive feelings and a sense of belonging to a group, the gymnasts exhibited stronger disagreement to the statements. No significant effect of gender was detected, nor was there an interaction effect.

Stepwise forward entry multiple regression analysis (MRA) was used to determine the variable(s) which best predicted total dietary calcium intake. Two models were analyzed using MRA, a Traditional Model which included age, gender, %BF, weight and sport, and a Social Model which included dieting sub-scale score, differential association score, social and non-social reinforcement scores, modelling behaviour score, and a lifestyle score. The analysis showed that for all athletes combined, only one variable from the Social Model (social reinforcement) and one variable from the Traditional Model (sport) significantly explained variance in total dietary calcium. Each variable explained 6% and 10% of the variance in the dependent variable respectively. When the athletes were divided by sport and gender, different relationships emerged. For the male athletes, only differential association could significantly predict total dietary calcium intake, explaining 9% of the variance in the dependent variable. For female athletes combined, only one variable from the Social Model (modelling behaviour) and one variable from the Traditional Model (sport) entered the predictive equations, explaining only 9% and 15% of the variance in calcium intake, respectively. For the female skaters, differential association explained 21% of the variance in the dependent variable, while for the female gymnasts, non-social reinforcement explained 18% of the variance in total dietary calcium intake.

The results from this study show that for all athletes combined, variables from neither the Social nor Traditional Models were strong predictors of total dietary calcium intake. The social variables explained more variance in the dependent variable than the traditional variables only when the athletes were divided by gender and sport, and still approximately 80% of the variance was left unexplained. Therefore, the variables studied were not predictors of total dietary calcium intake in these athletes.

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGMENTS

I would like to express my sincere appreciation to my thesis supervisor, Dr. Susan Barr, for her excellent guidance and encouragement throughout my project. I would also like to acknowledge my committee members, Dr. Susan Crawford and Dr. Gwen Chapman, for their valuable contributions to my project at all stages. I would like to extent a special thank you to Dr. Joseph Leichter for chairing my thesis defense.

I thank the athletes who participated in this study, their coaches, and also Sport B.C. and Sask Sport for facilitating their participation. I gratefully acknowledge my family for their support through out the project.

This project was supported by a grant from the Dairy Bureau of Canada (5-56801).

CHAPTER I

I. INTRODUCTION:

Nutritional requirements are increased during adolescence due to the natural course of growth and development (Guenther, 1986; Moffatt, 1986; Perron and Endres, 1985). In addition to this increased need for growth and development, exercise and training may further escalate nutrient requirements during this time (Perron and Endres, 1985; Rucinski, 1989; Chen et al., 1989). It is well recognized that poor nutrition may impede athletic performance (Moffatt, 1986; Clark et al., 1988; Benson et al., 1990). For this reason, a nutritionally adequate diet may play an important role in both the athletic performance and the future health of adolescents (Moffatt, 1986; Perron and Endres, 1985; Chen et al., 1989).

Relatively few studies, to date, have examined dietary patterns or nutrition practices in adolescent athletes. The available literature, however, describes nutrient inadequacies, including inadequate calcium intake, in adolescent gymnasts, volleyball players, figure skaters and swimmers (Moffatt, 1986; Perron and Endres, 1986; Rucinski, 1989; Chen et al., 1989; Benson et al., 1990). Some research also indicates that participants in certain types of sports appear to be at greater risk for inadequate nutrient intake. In aesthetic sports such as gymnastics and figure skating, for example, excess body weight, especially body fat, is detrimental in competition (Moffatt, 1986; Rucinski, 1989; Highet, 1989). Therefore, this emphasis on body image may predispose the athlete to chronic caloric restriction, inadequate nutrient intake and potential pathogenic weight control behaviour (Moffatt, 1986; Rucinski, 1989; Committee on Sports Medicine, 1989).

Calcium is one of the nutrients of concern for adolescent athletes. Some literature suggests that adequate calcium intake during childhood and adolescence may contribute to peak bone mass (Matkovic et al., 1979; Matkovic et al., 1990; Matkovic, 1991) thereby reducing the risk of osteoporosis in later life. A recent study (Johnston et al., 1992) demonstrated that increasing calcium intake above the Recommended Dietary Allowance (RDA) significantly increased bone mineral density of prepubertal subjects even when dietary calcium intake appeared to be adequate. This study supports earlier studies (Matkovic et al., 1979; Matkovic et al., 1990; Matkovic, 1991) that calcium intake during childhood and adolescence contributes to peak bone mass. Therefore, adequate calcium intake during their adolescent years is important for the future health of this population.

It is well accepted that nutritional practices during adolescence are important for growth and development, athletic performance and future health, however, the most effective method of influencing food selection behaviour in this population has not been directly addressed. Krondl and Lau (1982) suggest that the main obstacle for changing food selection behaviour in an affluent society is lack of knowledge of the motives behind food selection behaviour. Therefore, Lewis et al. (1989) developed a framework based on cognitive and social factors to examine behaviours and to structure the relationship between measurable factors important to the frequency of selection of four beverages in college students and middle-aged adults. The researchers found that the social factors were better predictors of beverage consumption than the traditional variables such as nutrition knowledge. The authors also reported that the factors that influenced beverage consumption varied between the two groups (Lewis et al., 1989) suggesting that motives behind food selection may vary between populations.

Some studies suggest that participation in sports, particularly aesthetic sports, predisposes the athlete to chronic calorie restriction, nutrient inadequacies and pathogenic weight control behaviours. It has also been reported that some groups of athletes do not meet the recommended intakes for calcium which is an important nutrient during adolescence . Understanding the motive for food selection appears to be necessary to facilitate behaviour change. In the framework developed by Lewis et al. (1989), social factors were shown to be useful in predicting beverage selection behaviours in adults. Therefore, the purpose of this study was to assess the calcium intakes of adolescent athletes and to examine factors that may influence milk and dairy product intake, and therefore calcium intake in adolescent athletes of both genders. To assess whether sport is an influence, two sports were studied, an aesthetic sport (gymnastics) and a non-aesthetic sport (speed skating). Identifying and understanding the motives behind food selection in adolescent athletes may aid the development of effective nutrition education strategies to improve the health and performance of these young athletes. To clarify the terminology used in this study, definitions of terms can be found in Appendix A.

CHAPTER II

II. LITERATURE REVIEW

1. Introduction

In a study such as this, it is important to review the literature to gain an understanding of the nutrition practices of adolescent athletes, methods used to assess these practices, and the model used for predicting food selection behaviour. Therefore, this chapter first addresses the issue of calcium intake in adolescent athletes. This is followed by a review of methods for assessing calcium intake together with a description of the rationale for selecting a food frequency questionnaire for use in the study.

The next section of the review deals with the issue of disturbed eating behaviours in athletes. This section also addresses methods of assessing disturbed eating behaviours. It is followed by a description of a framework developed by Lewis et al. (1989) which was used to predict food selection behaviours in adults. This framework is reviewed in terms of the researchers' findings and its potential use for predicting food selection behaviours in adolescent athletes. Finally, a review of an appropriate field technique for assessing body composition of adolescent athletes is provided.

2. Calcium Intake

There is increasing concern about the composition and nutrient value of adolescent diets (Guenther, 1986). Calcium is one of the nutrients of concern. Differences of opinion among countries as to the recommended intake for calcium during adolescence complicate interpretation of the extent of concern about the intake of this nutrient. For example, in Canada, the recommended nutrient intake (RNI) for calcium for females 16 years of age is 700 mg/day (Health and Welfare Canada, 1990) in contrast to the recommended dietary allowance (RDA) in the United States of 1200 mg/day (Food and Nutrition Board, 1989). Therefore, intakes that meet the recommendations for one country may not be sufficient to meet the recommendations of another country. There is inconclusive evidence to date as to which values are more appropriate.

Research suggests that in general, adolescents may be replacing their milk intake with soft drinks (Guenther, 1986). Guenther demonstrated that soft drink consumption was inversely related to milk and calcium intake in American teenagers. This was most apparent with females. Those who consumed soft drinks achieved an average of only 59 percent of their RDA for calcium. Females not consuming soft drinks, however, still consumed an average of only 75 percent of the RDA for calcium. Studies on adolescent gymnasts, volleyball players, figure skaters and swimmers describe nutrient inadequacies, including inadequate calcium intake, when compared to the RDA (Moffatt, 1986; Perron and Endres, 1986; Rucinski, 1989; Chen et al., 1989; Benson et al, 1990).

Since adequate calcium consumption during childhood and adolescence may contribute to optimal peak bone mass (Matkovic et al., 1979; Matkovic et al., 1990; Matkovic, 1991), sub-optimal calcium intake is an important problem. Peak bone mass attained in early adulthood is one of the recognized variables contributing to the risk (or reduced risk) of osteoporosis in later life (Matkovic et al., 1979; Sandler et al, 1985; Bailey et al., 1986; Kreipe and Forbes, 1990). In 1979 Matkovic et al. studied two Yugoslavian populations that differed in calcium intake. The authors reported a higher mean peak bone mass at age 30 in the population that consumed higher amounts of calcium, but the males were significantly heavier and the females were significantly taller compared to the group with lower calcium intakes. Matkovic et al. (1990) assessed the effect of calcium supplementation on calcium balance and then used a two-year intervention trial to investigate the effects of calcium supplementation on bone mass in adolescent females. Results from the calcium balance studies showed that the main determinant of calcium balance was calcium intake. An increased calcium intake from 807 mg/day to 1242 mg/day resulted in a net calcium absorption with no change in urinary calcium excretion. Net calcium absorption was highly correlated with calcium retention ($r=0.93$, $p<0.001$). The results of the two-year intervention study showed a general increase in the bone mass measurements for the adolescents on the high calcium intake, however, these differences were not significant ($p>0.05$). The researchers felt that their small sample size may have resulted in a Type II error. In view of the results from the calcium balance and bone mass studies, the authors suggested that their data support the hypothesis that inadequate calcium intake may translate into inadequate calcium retention and decreased peak bone mass.

Further evidence in support of the importance of calcium intake in young people was provided by a three year, double blinded, placebo-controlled clinical trial (Johnston et al., 1992). This study was conducted to assess the effects of calcium supplementation on bone density of adolescents. Forty-five pairs of identical twins of both genders, initially age 10 ± 2 years completed the study. In each pair of twins, one twin served as the control. Bone density was measured using photon absorptiometry at three sites, radius, hip and spine, at baseline and three years later. The mean dietary intake of the placebo group was 908 mg calcium per day while the supplemented group consumed 1612 mg (894 mg from diet and 718 mg from supplements). After three years, those subjects who received supplements and were prepubescent throughout the study had significantly greater bone mineral densities in the radius and lumbar spine sites compared to their controls. However, in those subjects who went through puberty or were post-pubertal, no significant effects of supplementation were observed. The researchers concluded that in prepubertal children whose dietary intake of calcium approximated the RDA, calcium supplementation enhanced the rate of increase in bone mineral density. At present, it is unknown whether the gain in bone mineral density will persist, however, these data lend support to a higher recommended calcium intake during childhood and early adolescence.

3. Assessing Calcium Intake

There is a need for a method of estimating calcium intake that is practical with a large sample size (Cummings et al., 1987; Gibson, 1990). There are two general methods for assessing dietary intakes. The first method is quantitative, for example diet recalls or food records (Gibson, 1990; Angus et al., 1989). These measures, however, are not typically indicative of usual intakes unless diet records are kept for an extended period of time (Gibson, 1990; Angus et al., 1989). The second method is qualitative and gathers retrospective information on food patterns or usual intakes of foods or nutrients (Gibson, 1990; Angus et al., 1989). This method includes diet histories and food frequency questionnaires (FFQ)(Gibson, 1990). The most appropriate method for assessing dietary intake depends on the desired accuracy and type of diet information required as well as the resources available to the researchers (Angus et al., 1989).

There is no "gold standard" for assessing dietary intake (Cummings et al., 1987; Angus et al., 1989; Block, 1982). However, both the 7 day weighed food record (Cummings et al., 1987; Angus et al., 1989) and the multiple, non-consecutive diet record have been reported to be the most accurate tools for assessing dietary intake (Block and Hartman, 1989). Both of these methods provide information on "usual" intakes, however, they are labour intensive and not practical for large diet surveys (Angus et al., 1989). Alternatively, a 24 hour recall is faster, but does not provide information regarding usual dietary intake of an individual (Cummings et al., 1987; Block, 1982). The FFQ on the other hand is a useful tool designed to assess usual dietary intakes in large numbers of subjects (Angus et al., 1989). The advantages of the FFQ are: 1. it is easy to administer; 2. it requires minimal coding of the data, therefore, it is less expensive and faster than other methods (ie. 24 hour recall); 3. it provides a better approximation of the usual diet compared to a 24 hour recall (Margetts et al., 1989); 4. it is easier to complete (Gibson, 1990; Angus et al., 1989; Margetts et al, 1989).

The FFQ can be used to assess the frequency with which certain foods are consumed during a specified time period (ie. daily, weekly, or monthly)(Gibson, 1990) or it can be designed to act as a predictor of intakes of specific nutrients including calcium (Gibson, 1990; Margetts et al., 1989)). The latter method is used to assess calcium intake. In addition, FFQ can be semi-quantitative. This is an attempt to quantify usual portions of food items in order to provide quantitative data about usual dietary intake (Gibson, 1990).

A number of studies have compared intakes determined by FFQ and weighed diet records and have shown good agreement between the two methods for calcium intake (Cummings et al., 1987; Angus et al., 1989; Margetts et al, 1989; Willett, 1987). Cummings et al. (1987) studied the intakes of free-living women over 65 years of age comparing calcium estimated by FFQ to 7 day weighed food records. They reported a correlation coefficient of r=0.76. Similar results were reported by Angus et al. (1989) in a study of women between the ages of 29 and 72 years. The researchers compared calcium estimated by FFQ to a 4 day weighed food record. The correlation coefficient was r=0.79. These results suggest that a FFQ designed to estimate calcium is capable of assessing calcium intake.

Other studies do not demonstrate the same ability of a FFQ to estimate calcium intake when compared to a food record (Willett et al., 1987; Stuff et al., 1983; Bergman et al., 1990). However, these studies all used a FFQ to assess the usual intakes for a number of nutrients simultaneously. The questionnaires were large and involved, containing over 100 food items. In contrast, for the assessment of a specific nutrient, the FFQ can be simplified and still include a sufficient number of items to ensure reasonable accuracy. A semi-quantitative FFQ is, therefore, a practical and efficient method for assessing calcium intake (Cummings et al., 1987; Angus et al, 1989).

Barr and Pare (1992) developed and validated a FFQ to assess calcium intake in adolescents. The FFQ included foods that were high in calcium content and/or consumed frequently by adolescents. One hundred and thirty-eight students completed the FFQ and provided a 24-hour recall. The validity of the FFQ was examined in two ways.

To assess the ability of the FFQ to quantify calcium intake, each participant's 24-hour recall was coded onto a blank FFQ. Then, the 24-hour recall and the FFQ from the same day's intake were analyzed for calcium intake. The analysis showed that the mean calcium intake from the 24-hour recall was 878 mg and the mean calcium intake from the FFQ for the same day's intake was 715 mg. Therefore, on average, the FFQ was able to quantify 81 percent of the calcium intake from the 24-hour recall. These two values were highly correlated ($r=0.98$, $p<0.0001$).

Next, the mean calcium intake analyzed from the students' completion of the FFQ was 954 mg. This value was correlated with the mean calcium intake from the 24-hour recall. While these two values were significantly correlated, the correlation coefficient was not extremely high ($r=0.59$, $p<0.0001$). These values, however, are reasonably similar since calcium intake is highly variable from day to day. Overall, these results demonstrate that the FFQ is a valid tool for estimating calcium intake in this age group.

4. Dieting Behaviour

Participation in competitive sports typically requires a certain degree of leanness for optimal performance. The potential concern is that those athletes who restrict food intake or "diet" to achieve leanness, will also be limiting calcium intake and therefore possibly jeopardizing their calcium status. Some sports place an even greater emphasis on leanness for aesthetic reasons. In addition, sports such as gymnastics and figure skating require the athletes to support their body weight while moving gracefully through various routines (Moffatt, 1986; Rucinski, 1989; Highet, 1989). Thus, the need for leanness is also of practical importance (Moffatt, 1986; Rucinski, 1989). Studies in both male (Faria and Faria, 1989) and female (Falls and Humphrey, 1978) gymnasts have shown that, in top level athletes generally, percent body fat is inversely related to national ranking.

As a group, athletes who participate in sports which place a greater emphasis on leanness have been considered to be at greater risk for developing disturbed eating habits (Borgen and Corbin, 1987; Rosen and Hough, 1988; Davis and Cowles, 1989). Tendencies toward eating disturbances have been reported in a number of female college athletes who participate in sports with a greater emphasis on leanness such as gymnastics, body building, ballet, synchronized swimming, diving, figure skating and long distance running (Borgen and Corbin, 1987; Rosen and Hough, 1988; Davis and Cowles, 1989). Similar tendencies toward eating disturbances have been found in male college wrestlers (Enns et al., 1987). A study in adolescent figure skaters suggested that a gender difference may exist regarding tendencies toward eating disturbances with males feeling less pressure to strive for thinness compared to females (Rucinski, 1989).

It has been suggested that poor nutrition and tendencies toward disturbed eating behaviours were primarily a problem for weight control sports (Borgen and Corbin, 1987). However, this was not the case in a study on pathogenic weight control behaviours in female varsity athletes (Rosen et al, 1986). These female varsity athletes were participants in sports with varying degrees of emphasis on leanness. At both extremes a high prevalence of pathogenic weight control behaviours was revealed, with field hockey having the second highest prevalence next to gymnastics (Rosen et al., 1986). In a study on female collegiate swimmers, although tendencies toward eating disturbances were not pathogenic, there was a positive correlation ($r = 0.72$, $p < .01$) between tendencies toward eating disturbances and being heavier for a given height (Barr, 1991). Similarly, in a recent study in female adolescent athletes (Benson et al., 1990), although the gymnasts had a lower percent body fat compared to swimmers and the control group, the swimmers exhibited greater tendencies toward eating disturbances compared to both the gymnasts and the control group. This study supports the premise that participants in sports which place less emphasis on leanness may not be exempt from eating behaviour disturbances, especially during adolescence.

Eating disorders are primarily found in late adolescence and early adulthood (Wilmore, 1991; Wardle and Marsland, 1990). However, some data suggest that girls as young as 11 years of age are already weight conscious (Wardle and Marsland, 1990). There is increasing evidence that participation in athletic events further emphasizes the need for thinness and leanness, thus predisposing the adolescent to eating disorders (Wilmore, 1991). In addition to the demands to be lean for optimal performance in a sport, adolescent athletes are subject to the same socio-cultural influences that affect the non-athlete (Wilmore, 1991). These influences combined with the psychological make up of the elite athlete, who is both goal oriented and a perfectionist, make this type of adolescent particularly vulnerable to eating disorders (Wilmore, 1991).

5. Evaluating Eating Disturbances

The two measures most frequently used to assess eating disorders are the Eating Attitudes Test (EAT) and the Eating Disorders Inventory (EDI)(Wilmore, 1991).

The EDI is a 64 item questionnaire containing sub-scales of: drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interceptive awareness and maturity fears (Wilmore, 1991). The EAT originally consisted of a 40 item questionnaire that was proposed to measure symptoms of anorexia nervosa (Garner and Garfinkel, 1979). The most recent version of the EAT contains 26 of the original 40 items (Garner et al.,1982). It contains sub-scales of: 1. dieting (related to avoidance of fattening food and a preoccupation with being thinner); 2. bulimia and food preoccupation (items reflecting thoughts about food as well as those indicating bulimia); 3. oral control (related to self control of eating and the perceived pressure from others to gain weight)(Garner et al., 1982) The higher a subject scores on the EAT, the more suggestive it is of a disordered attitude toward eating.

The EAT has been validated with anorexia nervosa patients in clinical settings. However, it should not be used as a diagnostic criterion for anorexia nervosa in non-clinical groups (Garner et al., 1982). It has been shown that in a non-clinical setting, individuals with high EAT scores do not satisfy the diagnostic criteria for anorexia nervosa. However, the majority were found to experience abnormal eating patterns which interfered with normal psychosocial functioning (Button and Whitehouse, 1981). This suggests the EAT would be a suitable screening tool for abnormal eating patterns.

The 'dieting' sub-scale (13 items) of the EAT questionnaire reflects a pathogenic avoidance of fattening foods and shape preoccupation. It is not related to bulimia (Garner et al., 1982). Subjects who score high on this sub-scale can be described as over estimators of their body size, dissatisfied with their body shape, and having a desire to be smaller (Garner et al. 1982). Therefore, if calcium intake is being investigated, the dieting sub-scale would appear to be the most appropriate scale to use since restricting intake will logically restrict calcium intake. In addition, the 'dieting' sub-scale has the highest correlation with the total 26 item EAT ($r = 0.93$) compared to the other sub-scales. It has also been suggested as an economical substitute for assessing dieting behaviours in circumstances where brevity is important (Garner et al.,1982). A score of 8 or greater suggests pathological tendencies towards shape preoccupation and avoidance of fattening foods (Garner and Garfinkel, 1982).

6. Factors Influencing Eating Behaviour

Nutrition education can be defined as "a process that assists the public in applying knowledge from the nutrition sciences and the relationship between diet and health to their food practices. It is a deliberate effort to improve the nutritional well-being of people by assessing the multiple factors that affect food choices, tailoring educational methodologies and messages to the public being reached, and evaluating results." (ADA Reports, 1990).

Nutrition education programs have served to provide knowledge and a change to more positive attitudes. However, their ability to produce changes in eating behaviour is somewhat less established (Johnson and Johnson, 1985). The desired outcome of a nutrition education program is to achieve a positive change in food practices (Johnson and Johnson, 1985). Since nutritionists desire a behavioral change for the success of their education programs, it is suggested that they integrate the principles of the behavioral sciences into their education strategies to facilitate this change (Olson and Gillespie, 1981). For this reason, the nutrition education message should be based in the nutritional sciences, however, the foundation for communicating this message should be found in the social and behavioral sciences (ADA, 1990).

The process of food selection is part of an intricate behaviour system influenced by many factors (Krondl and Lau, 1982). It is recognized as more than a function of physiological need in that both social and environmental influences play a strong role (Krondl and Lau, 1982). Inadequate knowledge of the motives behind food selection is a major obstacle for modifying food selection behaviour (Lewis et al. 1989). Therefore, when studying food selection, there appears to be a need to include a range of cognitive and environmental influences (Lewis et al., 1989).

Lewis et al. (1989) developed a framework which allowed the inclusion of cognitive and environmental influences in an attempt to predict beverage selection behaviour in young and middle age adults. In addition, the researchers compared the predictive power of their cognitive and environmental model to the predictive power of a traditional model more commonly used in food and health behaviour studies. In view of the relevance to the present study, the framework developed by Lewis et al. (1989) is reviewed in greater detail below.

To facilitate their study of cognitive and environmental influences, the investigators (Lewis et al., 1989) developed and validated a number of scales which measured various traditional and social factors which have been identified as influencing food selection behaviour and were relevant to a social model. To test the framework, the researchers used the frequency of consumption of milk and soda as the food selection behaviour. The factors that were included in the model were:

differential association, social and non-social reinforcement, modelling behaviour, general nutrition knowledge, commitment, and attitudes relative to the frequency of consuming the beverages.

The first factor included in the model was the social environment factor. This factor was termed differential association and included five elements of the social environment that the researchers identified as influencing food selection behaviour: 1. Family, 2. Friends, 3. Health Experts, 4. Media and 5. Lifestyle. A scale was developed to measure the impact of these social environmental elements on food selection. The scale contained statements reflecting a) family members' use of the beverage and perception of their feelings about it, b) friends' use of the beverage and their perception of their feelings about it, c) perception of health experts' recommendations concerning the beverage, and d) perception of media advertising for the beverage. The participants were to respond by marking the extent of their agreement with the statement on a Likert-type scale. Lifestyle was defined as the frequency with which breakfast, lunch and supper were eaten away from home. Participants responded to questions about how often they consumed meals away from home and a "Lifestyle " score was computed.

The next factor was social reinforcement. To operationalize social reinforcement, a scale was developed which contained questions reflecting positive feelings, a sense of belonging to a group and pleasing others as a function of drinking the beverages. Separate scales were constructed for milk and soda. An attitude scale was also constructed. This scale required the participants to respond by marking their extent of agreement with statements such as "It is important to drink milk for good nutrition." and "Drinking soda is an acceptable dietary practice.".

Behaviour modelling was evaluated since the researchers felt that eating is a social behaviour and it has been documented that many other social behaviours can be influenced by modelling behaviour (Bandura, 1977). To assess modelling behaviour, a scale was constructed to measure how often the participants saw or had seen certain models drinking milk or soda. The models were: mother, father, another adult in the family liked/admired by participant, husband/wife or boy/girlfriend, friend admired by participant and favourite media star.

Non-social reinforcement was defined by taste enjoyment of the beverage. The investigators felt that the function of taste was a critical component of food selection and that there is a clear association between food choice and taste. Therefore, the participants were asked to score how they enjoyed the taste of the beverages.

Measures for the traditional model were also collected. The researchers developed a true/false scale to assess general nutrition knowledge. Demographic data such as age, gender, education and socioeconomic index were also collected.

Data were collected through the use of self-administered questionnaires distributed by mail. Six hundred and ninety-three students (approximately half were women) and 422 middle-aged adults (58% women) responded to the questionnaire. The data were analyzed first by comparing a general regression analysis of the social model and for the traditional model (age, sex, education, socioeconomic status, attitude, nutrition knowledge) in both groups. Since food consumption is highly variable, the authors decided that the social model must be able to explain 35% of the variance in beverage consumption to be acceptable. The results indicated that all versions of the social model explained at least 35% of the variance in beverage consumption in both groups whereas the traditional model did not meet the *a priori* criteria for explained variance for any of the beverages in either of the groups. The authors also employed path analysis which allowed the development of models which structured the relationships between the measurable variables important to food consumption.

The results of the path analysis indicated that behaviour modelling, social reinforcement and nutrition knowledge may influence beverage consumption indirectly through attitudes and behaviour commitment. However, the factors that influenced beverage consumption varied between the two groups of adults. Nutrition knowledge was related to attitude in adult soda-drinking models but not in the student soda-drinking models. The influencing factors for consumption also varied with type of beverage since for the students, nutrition knowledge was related to taste enjoyment for low-fat milk but not for whole milk. This suggests that the factors influencing food selection may vary between populations and between the foods being consumed.

The overall finding of the study was that the social model constructed by Lewis et al. (1989) explained more variance in food selection than the traditional model (age, gender, education, socioeconomic index, nutrition knowledge and attitude). Therefore, researchers concluded that the social model was appropriate for predicting food selection behaviour in adults. To date, this is the only reported use of this framework for predicting food selection.

7. Body Composition

Human body composition has been a topic of interest for decades due to its relevance to health and physical performance. Excess fat is associated with increased morbidity and mortality (Durnin and Womersley, 1974; Bandini and Dietz, 1987) and there is a high negative correlation between percent body fat and physical performance in activities that require vertical or horizontal movement of body weight through space (Wilmore, 1983). Therefore, the assessment of body composition is necessary to provide better estimates of minimal and optimal weights for physical performance and health (Lohman, 1986).

There are an array of methods available for assessing body composition ranging from simple measurements of body size, such as body weight used in conjunction with height and frame size to evaluate "ideal weight", to precise laboratory-based techniques that are not practical for field studies (Hergenroeder and Klish, 1990). The former type of measurement does not address the issue of dividing body compartments into fat or fat free body (FFB). It therefore, provides limited insight into the actual composition of the body. In addition, it may incorrectly classify lean muscular individuals (ie. athletes) as obese (Lohman et al., 1984). Other methods of body composition analysis are thus required to obtain this information in the field.

Skinfold measurement is a simple and non-invasive method for assessing body composition in the field. Percent body fat can be estimated from the data obtained by measuring skinfold thicknesses at various sites on the body. Although there are many equations published in the literature for first predicting body density, and then, body fat from skinfolds, few of these equations have been developed using an adolescent population.

Determination of body composition in adolescents is a complex problem. Changes in body shape, fat proportion and fat patterning during adolescence may invalidate the assumptions underlying the skinfold thickness technique (SF)

(Deurenberg et al., 1990b). Furthermore, it is well accepted that the water and mineral content of fat free body (FFB) changes with maturation (Deurenberg et al., 1990a; Forbes, 1987; Lohman et al., 1984; Lohman, 1986), invalidating the assumptions of constant composition of fat and FFB in the two-compartment model. Therefore, use of adult regression equations (which assume a constant composition of FFB) to estimate percent body fat (%BF) from SF in adolescents can result in significant errors (Slaughter et al., 1984; Slaughter et al., 1988). Accordingly, some researchers have developed equations based on a multi-compartment model that attempt to adjust for the changes in body composition during maturation (Deurenberg et al., 1990b; Lohman, 1986; Weststrate and Deurenberg, 1989). From the available data in the literature, Lohman (1986) has developed age and sex specific constants for the density of FFB (and its constituents) based on the multi-compartment model. Unfortunately, to date, neither these equations nor constants have been cross-validated on an athletic adolescent population.

Thorland et al. (1984) conducted a cross-validation study between body density by underwater weighing and selected anthropometric regression equations in both male (age range 14-19 years) and female (age range 11-19 years) adolescent athletes. In males, equations of either a linear or quadratic form demonstrated acceptable accuracy in predicting body density. In females, only the quadratic equations displayed the same degree of accuracy. For use in an adolescent athletic population Thorland et al. (1984) suggested the quadratic equations of Jackson and Pollock for females (1980) and the linear equation of Forsyth and Sinning for males (1973). To calculate %BF from body density, Lohman's formula (1986) and his age and sex specific constants for body density appear to be the most acceptable method which addresses the chemical immaturity of youths.

8. Summary

The review of the literature has suggested that adequate calcium intake during childhood and adolescence appears to make a positive contribution to bone mineral density. There is documentation, however, that some groups of adolescent athletes have had inadequate calcium intakes according to their country's recommendations for the nutrient. The literature also provides support for the use of a food frequency questionnaire for estimating calcium intake in this age group. Thus, the assessment of calcium intake in adolescent athletes using a FFQ warrants investigation.

There is inconclusive evidence to date as to whether adolescent athletes competing in aesthetic sports are more prone to disturbed eating behaviours and nutrient inadequacies than those who participate in non-aesthetic sports. The dieting sub-scale of the Eating Attitudes Test has been identified as a useful indicator of pathogenic tendencies towards shape preoccupation and avoidance of fattening foods. Since calcium intake is affected by dieting behaviour, the dieting sub-scale of the Eating Attitudes Test appears to be a good choice for investigating disturbed eating behaviours in this study.

Factors influencing food selection behaviour seem to vary between age groups. However, it is not known whether the framework developed by Lewis et al. (1989) is useful in predicting food selection behaviour in adolescents. Understanding the motives behind food selection appears to be important for developing strategies to modify food selection behaviour. Therefore, there is support for applying the framework developed by Lewis et al. (1989) in attempt to identify factors which may predict calcium intake in adolescent athletes. If the framework is useful, it will facilitate the development of nutrition intervention strategies to improve calcium intake in this population.

9. Hypotheses

To study the influence of various factors on calcium intake in adolescent athletes, the following null hypotheses were investigated:

1. There will be no difference in the mean calcium intake of athletes participating in aesthetic or non-aesthetic sports.
2. There will be no relationship between the mean daily calcium intake and:
    a) differential association score;
    b) lifestyle score;
    c) modelling behaviour score;
    d) social reinforcement score;
    e) non-social reinforcement score;
    f) demography;
    g) dieting behaviour score;
    h) percent body fat.

CHAPTER III

III. METHODOLOGY

1. Subjects

Through contacts with two provincial gymnastic and speed skating organizations, athletes competing at a minimum of a provincial level in either of these sports were asked to take part in the study. One-hundred and fourteen adolescent athletes of both genders between 12 and 18 years of age volunteered for this study. Fifty seven males (gymnasts = 25, speed skaters = 32) and fifty seven females (gymnasts = 32, speed skaters = 25) participated in the study. Participants from Vancouver and surrounding area were registered with Sport B.C. while participants from Saskatchewan were registered with Sask Sport. Written informed consent was obtained from all athletes, and parental consent was also obtained when the athletes were younger than 18 years of age (see Appendix B for copy of consent form). The study was approved by the University of British Columbia Behavioral Sciences Screening Committee for Research and Other Studies involving Human Subjects.

2. Data Collection

There were two components to the data collection, body composition analysis and a self-administered questionnaire. All data collection was conducted at the athletes' training sites.

A) Body Composition

All body composition determinations (height, weight, SF) were performed prior to training to minimize the effects of fluid changes on estimation of body composition. Height was measured using a wall scale to the nearest 0.1 cm. Body weight was measured using an electronic scale to the nearest 0.5 kg. Hip circumference was measured in triplicate to the nearest 0.1 cm using a flexible cloth tape, and a mean value calculated.

Triplicate skinfold measurements were taken, using Lange Calipers (Cambridge Scientific Industries, Cambridge MA) on the right side of the body, by the same individual to reduce technical variability. Separate regression equations were used for males and females. These equations were previously cross validated in an adolescent athletic population (Thorland et al., 1984). For females, the quadratic equation of Jackson and Pollock (1980) was used to predict body density as suggested by Thorland et al. (1984). This equation required the measurement of the following sites: triceps, supra-iliac, abdomen, thigh, and hip circumference (Harrison et al, 1989). For males, the linear equation of Forsyth and Sinning (1973) was used to predict body density as suggested by Thorland et al. (1984). This equation required the measurement of the following sites: subscapular, abdomen, triceps, and midaxillary (Harrison et al, 1988). Both regression equations included age. Percent body fat was calculated using Lohman's age and sex specific constants for density of FFB and the corresponding formula to calculate percent body fat (Lohman, 1986). See Appendix C for the equations used to estimate %BF and the age and sex specific constants for FFB. The sum of the four skinfold sites (S4SF) was also calculated.

B) Questionnaire

All athletes completed a questionnaire that contained several parts which assessed the following factors: pubertal status, demographics (age, sex, racial origin, use of vitamin/mineral supplements, employment, allergies to milk or dairy products), training volume, competitive level, total calcium intake, differential association (ie. family, friends, experts, media), lifestyle, dieting behaviour, modelling behaviour, social and non-social reinforcement and parental socioeconomic status (see appendix B for sample of the questionnaire completed by the participants). Each part of the questionnaire will be addressed separately.

i) Maturation Status

Maturation status was assessed differently for each gender. For females, maturation status was assessed by the self-reported presence or absence of menarche. For males, it was assessed by the self-reported presence or absence of facial hair and a change in the pitch of their voice. If the males responded "Yes" to either question, they were considered to have reached puberty.

ii) Employment

The athletes responded to the employment question by marking "Yes" or "No" indicating whether or not they were employed. If the athletes answered "Yes", they were to mark or specify what type of work they did, fast food restaurant, retail sales, paper route or babysitting or 'other' and to specify the type of job. Next the employed athletes were to report the number of hours they worked per week.

iii) Supplement Usage

The participants were asked to report whether or not they used supplements by marking a response of either "Yes" or "No". If the athlete used supplements they were to respond by marking which supplements they used from the following supplement list, multivitamin/mineral, vitamin C, Iron, Calcium, Other (and specify).

iv) Racial Origin

The participants were asked to mark one or two categories which describes their racial origin since race may influence consumption of milk and dairy products and therefore calcium intake. A list of various racial origins was provided, "Caucasian" (white), "Oriental", "East Indian", "Black", "Native Canadian" (Indian or Inuit), "Other" (please specify), and "Don't Know". The athletes' responses were then divided into three categories: 1) "Caucasian"; 2) "Oriental"; 3) "Other and Mixed". Therefore, if an athletes responded that their racial origin was only Caucasian, they were coded as Caucasian. If an athlete selected Oriental as their only response, they were coded Oriental. If the athletes marked other racial origins such as Black, East Indian, Native Canadian or Other, or if they marked more than one choice for racial origin, they were coded as "Other or Mixed".

v) Allergies

The participants were to respond by marking either "Yes" or "No" to the question "Are you allergic to milk or dairy products?". The intent of this question was that the participant would be excluded from further analysis if they marked "Yes" to the question as it could have a substantial impact on their daily calcium intake. However, if the athlete marked "Yes" and consumed milk, they were not excluded.

vi) Training Volume and Competitive Level

Training volume and competitive level was also self-reported. The athletes responded to questions about their training status, number of hours per session they trained, number of sessions per week and number of months per year of training for their sport.

Next, the athletes were asked to respond to questions about their competitive level. They were asked to respond to whether they competed in City, Provincial, National and International competitions by circling either "Yes" or "No" to each question. A criteria for participating in the study was that the athletes competed at a minimum of a provincial level, however, due to the structure of the athletes' competitive season, some athletes may not have competed in a city or provincial championship, however had competed in a national competition and were therefore included in the study.

vii) Socioeconomic Status

Since socioeconomic status (SES) can influence nutrition practices, the athletes were asked to specify the occupation of their mother and father. Socioeconomic status was then calculated using the 1981 socioeconomic index for occupations in Canada which reflects income and education level (Blishen et al. 1987). If only one parent worked, that parent's occupation was used to represent the household's SES. However, if both parents worked, a mean of the two values was used to represent the SES of the household.

viii) Calcium Intake

A previously validated food frequency questionnaire (Barr and Pare, 1992) was used to assess daily calcium intake, the dependent variable. The athletes were asked to respond to how often they consumed the various foods, "Per Day", "Per Week", "Per Month", or "Don't Eat" by recording the number of times that they would consume the specified quantity of the food during that period. All values were converted to a per month basis. If the respondent stated that he/she consumed the food daily, the number of times the food was eaten per day was multiplied by 30, if weekly, the number of servings was multiplied by four and if monthly, the value was not adjusted. For each food, the adjusted values were recorded and used to estimate calcium intake. The calcium content of the foods was analyzed using a computer program PC Nutricom (Smart Engineering LTD., Vancouver, B.C.) based on the Canadian Nutrient File (Health and Welfare Canada, 1982). The number of servings of the food the athlete would consume per month was multiplied by the calcium content of the food. These values were calculated for all food items and a monthly calcium intake computed. To calculate daily calcium intake, the monthly calcium intake was divided by thirty. Table 1 shows the instrument used to quantify calcium intake. In addition, since it has been suggested that teenagers may be replacing their milk intake with soda (Guenther, 1986), the frequency of consumption of regular and diet soda was included in the FFQ.

The athletes were also asked to indicate which type of milk they usually drank, "whole milk" (coded 1), "two percent milk" (coded 2), "one percent milk" (coded 3), "skim milk" (coded 4), "chocolate milk" (coded 5) or "no milk" (coded 6).

Table 1: Calcium Food Frequency Questionnaire

Food	Per Day[1]	Per Week[2]	Per Month[3]	Don't Eat
Bread or Toast, 1 slice or 1 roll				
white	____	____	____	____
brown	____	____	____	____
Muffin, 1 large	____	____	____	____
Pizza, 1 medium slice	____	____	____	____
Cheeseburger	____	____	____	____
Cheese - 1 slice processed OR 1 piece hard cheese (plain or in sandwich)	____	____	____	____
Broccoli, 1/2 cup (125 ml)	____	____	____	____
Gai-lan (Chinese Broccoli), 1/2 cup	____	____	____	____
Bok-choi (Chinese Cabbage), 1/2 cup	____	____	____	____
Ice Cream (large scoop)	____	____	____	____
Frozen Yogurt (large scoop)	____	____	____	____
Fast Food Milkshake	____	____	____	____
Cottage Cheese, 1/2 cup	____	____	____	____
Yogurt, small (175 ml) carton or equivalent	____	____	____	____

Table 1: Calcium Food Frequency Questionnaire (continued)

Food	Per Day[1]	Per Week[2]	Per Month[3]	Don't Eat
Canned Salmon or Sardines with bones 1/2 small can	____	____	____	____
Soft Drink, regular, 1 can or large glass	____	____	____	____
Soft Drink, diet, 1 can or large glass	____	____	____	____
Coffee or Tea, 1 cup	____	____	____	____
Tofu, 2 oz (60 gm)	____	____	____	____
Milk on Cereal	____	____	____	____
Orange Juice, 1 cup	____	____	____	____
Milk (any type including chocolate) 1 cup	____	____	____	____
Macaroni & Cheese, 1 cup (250 ml)	____	____	____	____

[1]Values were multiplied by 30 to transform them to a per month basis.
[2]Values were multiplied by four to transform them to a per month basis.
[3]Values were not transformed.

ix) Dieting Behaviour

This scale contained the thirteen items of the dieting sub-scale from the Eating Attitudes Test (Garner et al., 1982) used to measure dissatisfaction with body shape and a desire to be thinner. The athletes responded to the questions indicating how frequently they had certain feelings about each statement by marking the response which matched how often they experienced those feelings, "Always" (scored 3) "Very Often" (scored 2), "Often" (scored 1) "Sometimes" (scored 0),"Rarely" (scored 0), "Never" (scored 0) (Garner and Garfinkel, 1979). A dieting behaviour score was calculated by adding the scores from all 13 questions after reversing the scoring for question number 13. A score of eight or greater suggests pathological tendencies of shape preoccupation and a desire to be thinner (Garner and Garfinkel, 1982). The dieting behaviour instrument is shown in Table 2. The reliability of the instrument was assessed using the Cronbach's alpha reliability coefficient calculated using all thirteen responses after reversing the scoring for question 13.

x) Differential Association

A previously validated questionnaire was used to assess differential association (family, friends, health experts, media)(Lewis et al., 1989). Table 3 shows the questions the athletes answered about their: 1) family members' use of milk and their perception of their feelings about it, 2) friends' use of milk and their perception of their feelings about it, 3) perception of health experts' recommendations concerning milk, and 4) perception of entertainment/persuasive quality of television advertising of milk (Lewis et al., 1986). The athletes responded by marking their

Table 2: Dieting Behaviour Questions from the Dieting Sub-Scale of the Eating Attitudes Test

Question	Always	Very Often	Often	Some-times	Rarely	Never
1. Am terrified about being overweight	____	____	____	____	____	____
2. Aware of the calorie content of foods that I eat	____	____	____	____	____	____
3. Particularly avoid foods with high carbohydrate content (eg. bread, rice, potatoes, etc)	____	____	____	____	____	____
4. Feel extremely guilty after eating	____	____	____	____	____	____
5. Am preoccupied (think a lot about) with a desire to be thinner	____	____	____	____	____	____
6. Think about burning up calories when I exercise	____	____	____	____	____	____
7. Am preoccupied with (think a lot about) with the thought of having fat on my body	____	____	____	____	____	____
8. Avoid foods with sugar in them	____	____	____	____	____	____
9. Eat diet foods or drinks	____	____	____	____	____	____
10. Feel uncomfortable after eating sweets	____	____	____	____	____	____
11. Go on diets to lose weight	____	____	____	____	____	____
12. Like my stomach to be empty	____	____	____	____	____	____
13. Enjoy trying rich new foods[1]	____	____	____	____	____	____

[1]Reversed scoring prior to analysis

Table 3: Items Used to Determine Differential Association

Category	Item
FRIENDS[1]	1) I have a lot of friends who drink milk 2) A meal with my friends usually doesn't include milk[2] 3) My friends seem to feel that it's important to drink milk 4) My friends think milk is drunk only by young children and not by teens or adults[2]
EXPERTS[1]	1) My doctor recommends that I drink milk of some kind 2) I often hear health experts recommend drinking milk 3) I have heard nutritionists recommend that people of my age drink milk 4) My doctor has shown no concern about whether I drink milk[2]
MEDIA[1]	1) Advertisements for milk catch my attention 2) The advertisements I see for milk make me want to drink it 3) I hardly ever pay attention to advertisements for milk[2] 4) I think advertisements for milk and dairy products are entertaining
FAMILY[1]	1) Most teens and adults in my family drink milk as part of a snack or with meals 2) Very few adults in my family use milk on a regular basis[2] 3) It is unusual for adults in my family to drink milk[2] 4) My family feels that drinking milk is an important part of the diet for teens

[1]Athletes responded to the statements by marking their extent of agreement with the statements on a five point scale, Strongly Disagree, Disagree, Unsure, Agree, Strongly Agree.
[2]Scores on these statements were reversed prior to analysis due to negative wording.

response according to their feelings with the statements. They answered using a five point scale, "Strongly Disagree" (scoring 1), "Disagree" (scoring 2), "Unsure" (scoring 3), "Agree" (scoring 4), and "Strongly Agree" (scoring 5). After reversing the scores for negatively worded items, the internal consistency of the instrument was assessed using the Cronbach's alpha reliability coefficient by first calculating coefficients for each of the sub-scales, family, friends, experts and media and then calculating the coefficient for the entire scale. A mean score was calculated for each question, each sub-scale and an overall differential association score was computed by averaging the responses to all sixteen questions.

xi) Lifestyle

The questionnaire also contained a section to assess lifestyle (as shown in Table 4). In this section, the athletes answered questions about the frequency of consumption of meals and snacks away from home. The athletes were asked to respond to the number of times per week that they would consume breakfast, morning snack, lunch, afternoon snack, dinner and an evening snack. Then, they were to record the number of times that they would eat those meals and snacks "out" per week. Eating "out" was defined as not consuming food at home or brought from home. The number of meals and snacks eaten away from home per week was calculated, and the percentage of meals and snacks eaten away from home was termed the lifestyle variable.

xii) Social Reinforcement

Table 5 shows the four questions which comprised the social reinforcement

Table 4: Items Used to Determine Lifestyle

Meals and Snacks	Times Eaten per week	Times eaten "out " per week
Breakfast	____	____
Morning Snack	____	____
Lunch	____	____
Afternoon Snack	____	____
Dinner	____	____
Evening Snack	____	____

Table 5: Items Used to Determine Social Reinforcement Score

1) Drinking milk makes me feel part of a special group of people Strongly Agree Agree Unsure Disagree Strongly Disagree
2) When I drink milk I feel I get approval from the people who matter to me Strongly Agree Agree Unsure Disagree Strongly Disagree
3) It gives me a nice feeling to have a glass of milk with friends Strongly Agree Agree Unsure Disagree Strongly Disagree
4) When I drink milk, I please people who are important to me Strongly Agree Agree Unsure Disagree Strongly Disagree

instrument. The athletes were asked to respond to questions about their perceptions concerning positive feelings, a sense of belonging to a group, and pleasing others as a function of consuming milk (Lewis 1986). The respondents were asked to indicate the extent of their agreement with the statement by marking their answer on a five point scale, "Strongly Disagree" (scoring 1), "Disagree" (scoring 2), "Unsure" (scoring 3), "Agree" (scoring 4), "Strongly Agree" (scoring 5). An overall score was calculated to represent the social reinforcement score by averaging the responses to all four questions. A Cronbach's alpha reliability coefficient was calculated using all four of the questions. In accordance with the questionnaire developed by Lewis (1986), the social reinforcement questions were interspersed with the differential association questions in the questionnaire compiled for the athletes.

xiii) Modelling Behaviour

Table 6 illustrates the questions which have been used as a measure of modelling behaviour. Modelling behaviour was assessed by determining the frequency in which the athletes saw or had seen certain models consume milk. The participants indicated how often they had observed the model (mother, father, another adult in their family admired or liked by the athlete, a friend of the opposite sex and a friend they admire) drinking milk by circling, "Never or Almost Never" (scored 1), "Not Very Often" (scored 2), "Fairly Often" (scored 3), "Very Often" (scored 4). The original modelling behaviour scale developed by Lewis (1986) included 'a favourite movie star' as one of the models. However, when the scale was pre-tested using an adolescent population, the youths were either unable to answer the question because they either commented that they never saw their favourite movie star so how would they know

Table 6: Items Used to Determine Modelling Behaviour Score

Your Mother...				
	VERY OFTEN	FAIRLY OFTEN	NOT VERY OFTEN	NEVER OR ALMOST NEVER
Your Father...				
	VERY OFTEN	FAIRLY OFTEN	NOT VERY OFTEN	NEVER OR ALMOST NEVER
Another adult in your family whom you admire (for example, aunt or grandparent)...				
	VERY OFTEN	FAIRLY OFTEN	NOT VERY OFTEN	NEVER OR ALMOST NEVER
A friend of the opposite sex...				
	VERY OFTEN	FAIRLY OFTEN	NOT VERY OFTEN	NEVER OR ALMOST NEVER
A friend you admire...				
	VERY OFTEN	FAIRLY OFTEN	NOT VERY OFTEN	NEVER OR ALMOST NEVER

if they drank milk or not or they left the question blank. Therefore, it was decided to drop the question from the modelling behaviour scale for the adolescents.

The internal consistency of the revised scale was assessed using Cronbach's alpha reliability coefficient using all five questions. A modelling behaviour score was computed by averaging the scores from all five questions.

xiv) Non-Social Reinforcement (Taste)

The instrument developed to measure non-social reinforcement is shown in Table 7. Using a six point scale, participants were asked to indicate how much they enjoyed the taste of certain dairy products. The athletes responded by circling, "Don't Know" (scored 1), "Not At All" (scored 2), "Not Very Much" (scored 3), "Just So-So" (scored 4), "It's O.K." (scored 5), "Very Much" (scored 6). Cronbach's alpha reliability coefficient was calculated using all eight questions. A non-social reinforcement (taste) score was calculated by averaging the scores from all eight questions.

3. Data Analysis

The Statistical Package for the Social Sciences (SPSSX Inc., Chicago, IL) was used for all data analysis. In this study the dependent variable was daily calcium intake. The independent variables were: 1) sport; 2) percent body fat; 3) age; 4) sex; 5) weight; 6) dieting behaviour; 7) social reinforcement; 8) non-social reinforcement (taste); 9) behaviour modelling; 10) lifestyle; 11) differential association. A significance level of alpha = 0.05 was established for all statistical analyses except where otherwise specified.

Table 7: Items Used to Determine Taste Enjoyment

1. How much do you enjoy the taste of whole milk?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
2. How much do you enjoy the taste of low-fat (2% or 1%) milk?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
3. How much do you enjoy the taste of skim milk?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
4. How much do you enjoy the taste of fruit-flavoured yogurt?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
5. How much do you enjoy the taste of plain yogurt?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
6. How much do you enjoy the taste of cottage cheese?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
7. How much do you enjoy the taste of hard cheese (such as cheddar)?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW
8. How much do you enjoy the taste of ice cream?					
VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

To analyze the descriptive data, the athletes were divided into 2 groups according to gender and the two sports were compared. Descriptive statistics, including means, ranges and frequencies were used to describe the athletes within the sports. T-tests were used to evaluate the differences between the means of the two sports for the continuous descriptive data. Chi-Square was used to test differences between the two sports when the data was categorical, for example presence of menarche.

Analysis of variance was used to compare gender and sport differences for the following variables: daily dietary calcium intake (and contributions to calcium intake from fluid milk, other dairy foods and non-dairy food sources), dieting behaviour score, differential association variable, modelling behaviour variable, lifestyle variable, non-social reinforcement (taste) variable and the social reinforcement variable. The homogeneity of the dependent variable was examined, and resulted in a significant Bartlett-Box F, therefore, total dietary calcium intake was transformed by using the natural log for all statistical tests. The Mann-Whitney U test was used to compare the consumption of regular and diet soda between the sports.

Then, the athletes who reported allergies to milk or dairy products and therefore did not consume milk were excluded from further analysis. Next, the relationship between daily calcium intake and the following independent variables: dieting behaviour score, modelling behaviour score, differential association score, lifestyle score, non-social reinforcement score, social reinforcement score, age, weight, percent body fat and consumption of soda (regular and diet) was examined for all athletes using a Pearson Correlation Coefficient. Then, the athletes were divided by gender and sport and the correlations re-examined.

Stepwise forward entry multiple regression analysis was used to find the independent variable(s) that best predicted daily calcium intake as the dependent variable. Two different multiple regression tests were conducted for all athletes combined, one to test the traditional variables including age, sport, gender, weight and %BF, and the second to test the independent variables from a modified version of the social model used by Lewis et al. (1989) (modelling behaviour variable, differential association variable, lifestyle variable, non-social reinforcement variable, and social reinforcement variable) and the dieting sub-scale score from the Eating Attitudes Test (Garner et al., 1982). Then the athletes were divided by gender and sport and the multiple regression analysis computed again. Equations to predict calcium intake were generated where possible.

CHAPTER IV

IV. RESULTS

For all analysis, missing data have been treated as pairwise deletions unless otherwise specified.

1. Internal Consistency of the Questionnaire

The Cronbach's alpha reliability coefficient (1951) was used to test the internal consistency of each scale within the questionnaire. A scale was considered to be internally consistent if the alpha coefficient was 0.65 or greater (Lewis, 1986). Only data from internally consistent scales were used for statistical analysis. Table 8 shows the Cronbach's alpha reliability coefficients for all scales.

The internal consistency of each scale was assessed by using all questions within each scale. However, the reliability of the differential association scale was first assessed by assessing the reliability of the following sub-scales: family, friends, media and health experts. This analysis showed the sub-scales of family and media to be internally consistent, whereas the sub-scales of friends and health experts were not internally consistent. Next, a Cronbach's alpha reliability coefficient was calculated using all sixteen questions from the four sub-scales (family, friends, health experts, media). This calculation demonstrated internal consistency when the sub-scales were analyzed collectively with a coefficient of 0.75. Therefore, it was decided that an overall differential association score, which averaged the scores of all sixteen questions, would be used for the differential association variable and included in the statistical analysis. The other scales, dieting sub-scale, modelling behaviour, non-

Table 8: Cronbach's Alpha Reliability Coefficient for Questionnaire Scales

Scale	Cronbach's Alpha Reliability Coefficient
Dieting Sub-scale (EAT)	0.86
Differential Association	0.75
Friends	0.53
Family	0.72
Media	0.78
Experts	0.54
Modelling	0.66
Non-Social Reinforcement	0.66
Social Reinforcement	0.70

social reinforcement and social reinforcement were deemed reliable since their alpha coefficients were greater than 0.65 and therefore, their scores were included in the statistical analysis.

2. Descriptive Characteristics of Athletes

To examine the descriptive characteristics of the participants, the athletes were divided into two groups by gender and then further divided by sport for comparative purposes.

A) Males

As shown in Table 9, the two groups of athletes had similar mean ages, but the speed skaters were significantly ($p<0.05$) taller and heavier and had significantly ($p<0.001$) higher %BF and S4SF measurements than the gymnasts. For maturation, there was no significant difference in the number of speed skaters who had reached puberty (78%) compared to the gymnasts (60%), as assessed using Chi-Square.

When the two sports were compared for employment status, there was no significant difference between the number of speed skaters who were employed compared to the gymnasts (41% and 24% respectively). For the athletes who were employed, there was no significant difference between the sports for the number of hours worked per week (2.6 ± 4.7 vs 2.0 ± 3.9, skaters and gymnasts respectively) or the types of positions held (for example, paper route or fast food restaurant).

Table 10 shows that the percentage of athletes who took vitamin/mineral supplements was similar for each sport. For the two sports combined, 21% took multivitamin/mineral supplements, 18% took vitamin C, four percent took iron, nine

Table 9: Descriptive Physical Characteristics of Male Athletes (Means and standard deviations)

Variable	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
AGE (yrs)	14.4±1.8	14.7±1.9	14.5±1.8
HT (cm)	170.2±10.3*	158.5±13.0	165.1±12.9
WT (kg)	60.5±11.9*	50.1±12.5	55.9±13.1
%BF	8.0±3.4**	3.7±2.1	6.1±3.6
S4SF	35.8±9.8**	23.9±3.6	30.6±9.7

*$p<0.05$ Speed Skaters vs Gymnasts using a two-tailed t-test.
**$p<0.001$ Speed Skaters vs Gymnasts using a two-tailed t-test.

Table 10: Use of Vitamin Supplementation in Male Athletes (percentages)

Variable	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
Use Supplements	21.9%	36.0%	28.1%
Multivitamin	18.3%	24.0%	21.1%
Vitamin C	9.4%	28.0%	17.5%
Iron	0%	8%	3.5%
Calcium	3.1%	16.0%	8.8%
Other	0%	4%	1.8%

No significant difference for supplement use between speed skaters and gymnasts using Chi-Square test.

percent took calcium and two percent took a B-Complex supplement.

Racial origin can influence calcium intake, therefore, the racial origins of the athletes in the two sports were compared. Ninety-four percent of the skaters and 84% of the gymnasts were Caucasian. Other racial origins included two (6%) gymnasts who were Oriental and three (12%) gymnasts who were in the "Other or Mixed" category. For the skaters, none were Oriental and two (6%) were in the "Other or Mixed" category. None of the non-Caucasian athletes reported being allergic to milk or dairy products.

A major source of calcium for an adolescent population is milk and dairy products, therefore, an allergy to these foods may substantially affect the athlete's dietary calcium intake. For this reason, the athletes were asked to respond to whether or not they were allergic to milk or dairy products. One skater and one gymnast, both Caucasians, reported allergies to milk or dairy products, however, according to the FFQ data, only the skater avoided milk and dairy products. This athlete was therefore excluded from the Pearson Correlation and Multiple Regression Analysis.

As shown in table 11, training volume and competitive status were assessed to provide a comparison between the quality of the male athletes who participated in the two sports. For training volume, the analysis showed that the gymnasts trained significantly ($p < 0.001$) more hours per session than the speed skaters, while sessions per week and months of training per year did not differ between groups. However, both groups of athletes were considered highly conditioned since on average, they trained in excess of four sessions per week for more than nine months of the year. Since there was no difference in the competitive level of the male athletes, the

Table 11: Training Volume and Competitive Level of Male Athletes (means, standard deviations and percentages)

Variable	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
Hours/Session	1.4±0.4**	3.4±0.6**	2.3±1.1
Sessions/Week	4.4±2.2	5.9±1.6	5.1±2.1
Months/Year	9.3±2.3	11.4±1.4	10.2±2.2
City Championships[1]	84.4%$	72.0%	79.9%
Provincial Championships[1]	90.6%$	96.0%	93.0%
National Championships[1]	53.1%$	60.0%	56.1%
International Championships[1]	37.5%$	16.0%	28.1%

**$p<0.001$ Speed Skaters vs Gymnasts using two-tailed t-test.
$ = No significant difference between Speed Skaters vs Gymnasts for competitive level using a Chi-Square test.
[1]Values represent percent of athletes who competed in competitions at that level.

difference in training was likely due to the type of training required for each sport as opposed to a difference between quality of the athletes participating in the two sports (for example, speed skaters train more aerobically than gymnasts).

B) Females

As shown in Table 12, the two groups of athletes had similar ages, however, the speed skaters were significantly ($p<0.001$) taller, heavier and had higher %BF and S4SF measurements than the gymnasts. For maturation, the Chi-Square analysis showed that significantly ($p<0.05$) more speed skaters had reached menarche compared to the gymnasts (80% vs 53% respectively), suggesting that the speed skaters were more physiologically advanced.

When the two sports were compared for employment status, there was no significant difference between the number of skaters who were employed compared to the gymnasts (24% vs 31% respectively). For the athletes who were employed, both groups of athletes spent a similar number of hours at work each week (1.2 ± 3.9 hours vs 1.4 ± 2.7 hours for skaters and gymnasts respectively).

As shown in Table 13, the use of vitamin and mineral supplements was similar for both groups of female athletes. Sixty percent of the speed skaters and 38% of the gymnasts used at least one type of vitamin or mineral supplement. There was no significant difference between the sports for the type of supplement used except significantly ($p<0.05$) more speed skaters took Vitamin C than gymnasts.

As indicated previously, racial origin and allergies to milk and dairy products can influence dietary calcium intake, therefore, these factors were investigated. When the athletes in the two sports were compared for racial origin, 96% of the skaters and

Table 12: Descriptive Physical Characteristics of Female Athletes (means and standard deviations)

Variable	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
AGE (yrs)	14.3±1.6	14.1±1.6	14.2±1.6
HT (cm)	162.2±8.2**	153.6±4.9	157.4±7.8
WT (kg)	58.5±9.5**	45.2±7.9	51.0±10.8
%BF	21.0±7.7**	9.4±5.7	14.5±8.8
S4SF (mm)	65.5±18.9**	38.5±12.3	50.3±20.5

**$p<0.001$ Speed Skaters vs Gymnasts using a two-tailed t-test.

Table 13: Use of Vitamin Supplementation in Female Athletes (percentages)

Variable	Speed Skaters n=25	Gymnasts n=32	All athletes n=57
Use Supplements	60%	37.5%	47.4%
Multivitamin	7.0%	25.0%	26.3%
Vitamin C	48.0%*	18.8%	31.6%
Iron	16.0%	12.5%	14.0%
Calcium	16.0%	6.3%	10.5%
Other	4.0%	3.1%	3.5%

*$p<0.05$ Speed Skaters vs Gymnasts using Chi-Square test. All other comparisons were not significant.

84% of the gymnasts were Caucasian. Other racial origins included one skater (6%) who was in the "Other or Mixed" category. For gymnasts, two (6%) were Oriental and three (9%) were coded in the "Other or Mixed" category. Of the athletes who were not Caucasian, none reported avoiding milk or dairy products.

The athletes in the two sports were compared for reported allergies to milk or dairy products, and two skaters and no gymnasts reported allergies. However, following examination of the FFQ data, only one of the skaters avoided milk or dairy products. Therefore, only the athlete who avoided milk or dairy products was excluded from further analyses.

As shown in Table 14, training volume and competitive level of the two groups of athletes were compared. For training volume, the gymnasts had significantly ($p<0.001$) longer training sessions and trained for significantly ($p<0.05$) more months of the year compared to the skaters. However, athletes participating in the two sports trained a comparable number of times per week. Similar to the males, it is not possible to suggest that the gymnasts were more highly trained from this data since the type of training involved for each sport cannot be compared. There was no significant difference in the competitive level of athletes in the two sports except significantly ($p<0.05$) more skaters competed at an international level compared to the gymnasts. Regardless, both groups of athletes were considered highly conditioned since on average, they trained in excess of four sessions per week for more than ten months of the year.

The final descriptive characteristic that was to be addressed for both genders was socioeconomic status. To facilitate the calculation, the athletes were asked to specify their parents' occupations. Unfortunately, many of the participants were

Table 14: Training Volume and Competitive Level of Female Athletes (means, standard deviations and percentages)

Variable	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
Hours/Session	1.5 ± 0.6**	4.3 ± 0.6	3.0 ± 1.5
Sessions/Week	4.2 ± 1.3	4.6 ± 0.9	4.4 ± 1.1
Months/Year	10.0 ± 1.5*	11.3 ± 0.8	10.7 ± 1.3
City Championships[1]	88.0%$	96.9%	93.0%
Provincial Championships[1]	100.0%$	100.0%	100.0%
National Championships[1]	68.0%$	53.1%	59.6%
International Championships[1]	72.0%*	37.5%	52.6%

**$p < 0.001$ Speed Skaters vs Gymnasts using a two tailed t-test.
*$p < 0.05$ Speed Skaters vs Gymnasts using Chi-Square for level of competition and a two-tailed t-test for training volume.
$ = No significant difference between Speed Skaters vs Gymnasts for competitive level using a Chi-Square test.
[1]Values represent percent of athletes who competed in competitions at that level.

unable to provide sufficient information about their parents' occupations to determine their socioeconomic status. Therefore, socioeconomic status could not be included in the data analysis because over one third of the participants had missing data.

3. Food Frequency Questionnaire

Tables 15, 16, 17 and 18 summarize the average number of servings per month of each food from the FFQ for male and female athletes. "Visual Inspection" of Tables 15 to 18 suggests that for male athletes, skaters and gymnasts generally ate a similar amount of most foods, while for female athletes, skaters appeared to eat more of most foods than gymnasts. However, no statistical analyses were conducted for individual foods with two exceptions, diet soda and regular soda. These beverages were included in the FFQ since it has been reported that calcium intake is inversely related to soft drink consumption in American teenagers (Guenther, 1986). In this section, these beverages were investigated in terms of sport differences in consumption. The analyses showed that, for male athletes, there were no significant differences between the two sports for the consumption of diet soda, regular soda or both types of soda combined using the Mann-Whitney U test. In contrast, for the female athletes, the skaters consumed significantly ($p<0.001$) more regular soda and significantly ($p<0.05$) less diet soda than the gymnasts. However, when both types of soda were combined, the consumption of soda was similar for both sports.

Table 19 shows the comparisons between the sports for daily calcium intake, the contribution of dairy products (fluid milk and other dairy foods) and contribution of non-dairy foods to daily calcium intake for male and female athletes. Analysis of variance was used to examine the difference between the groups for total dietary

Table 15: Number of Servings Per Month of Non-Dairy Product Foods For Male Athletes (means and standard deviations)[1]

Food Item and Serving Size	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
White Bread (1 Slice)	51.3±64.8	46.7±58.6	49.3±61.7
Brown Bread (1 slice)	45.4±64.7	51.0±51.1	47.8±58.8
Muffin (1 large)	6.3±7.7	6.7±7.5	6.5±7.3
Pizza (1 medium slice)	7.9±9.0	8.2±13.2	8.0±10.9
Cheeseburger (1 slice)	4.4±4.4	3.4±4.9	4.0±4.6
Broccoli (125 ml)	3.3±3.9	5.6±5.7	4.3±4.8
Chinese Broccoli (125 ml)	0.4±1.0	0.3±0.9	0.4±1.0
Chinese Cabbage (125 ml)	0.7±2.9	0.7±2.0	0.7±2.5
Canned Salmon (1/2 small can)	2.3±4.7	2.0±4.7	2.2±4.7
Regular Pop (1 can)	13.0±15.0	12.4±11.2	12.7±13.3
Diet Pop (1 can)	4.3±11.7	2.9±8.6	3.7±10.4
Tea/Coffee (1 cup)	5.1±12.4	7.6±12.7	6.2±12.5
Tofu (60 gm)	0.1±0.4	1.8±6.4	0.8±4.2
Orange Juice (250 ml)	30.0±34.4	35.6±39.3	32.4±36.4
Macaroni & Cheese (250 ml)	4.8±5.6	4.0±4.0	4.5±5.0

[1]Data were not analyzed statistically except for regular and diet pop. There was no significant difference between skaters and gymnasts for the consumption of regular or diet soda using a Mann-Whitney U test.

Table 16: Number of Serving Per Month of Dairy Products for Male Athletes (means and standard deviations)[1]

Food and Serving Size	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
Milk (250 ml)	89.6±70.2	70.1±67.0	81.1±68.9
Milk on Cereal (125 ml)	32.3±34.2	30.3±23.5	31.4±29.8
Cheese (20 g)	35.0±41.4	36.4±64.0	35.6±52.0
Ice Cream (125 ml)	18.6±44.0	17.8±29.9	18.2±38.3
Frozen Yogurt (125 ml)	2.0±3.0	1.2±1.9	1.6±2.6
Fast Food Milk Shake	2.5±2.4	1.3±2.6	2.0±2.5
Cottage Cheese (125 ml)	0.9±1.7	3.0±6.5	1.8±4.5
Yogurt (175 ml)	3.3±4.2	7.4±19.0	5.0±12.7

[1]Data were not analyzed statistically.

Table 17: Number of Servings Per Month of Non-Dairy Product Foods For Female Athletes[1]

Food Item and Serving Size	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
White Bread (1 Slice)	49.3±46.3	31.2±32.7	39.3±40.0
Brown Bread (1 slice)	23.7±36.3	19.4±29.5	21.3±32.4
Muffin (1 large)	6.6±7.5	4.2±3.6	5.3±5.7
Pizza (1 medium slice)	4.9±4.4	3.4±3.2	4.1±3.8
Cheeseburger (1 slice)	3.8±5.3	1.1±1.3	2.3±3.8
Broccoli (125 ml)	8.2±14.4	4.7±5.7	6.3±10.5
Chinese Broccoli (125 ml)	0	0.2±0.7	0.1±0.6
Chinese Cabbage (125 ml)	0.3±0.8	0.3±0.9	0.3±0.8
Canned Salmon (1/2 small can)	0.7±.4	0.6±1.3	0.7±1.3
Regular Pop (1 can)	15.3±29.3**	3.4±4.3	8.6±20.3
Diet Pop (1 can)	1.5±1.8*	5.3±6.9	3.7±5.6
Tea/Coffee (1 cup)	6.8±11.9	4.2±6.9	5.4±9.4
Tofu (60 gm)	0	0.2±0.8	0.1±0.6
Orange Juice (250 ml)	30.5±28.6	26.8±34.0	28.4±31.5
Macaroni & Cheese (250 ml)	11.3±24.0	7.4±14.5	9.1±19.2

[1]Data were not analyzed statistically except for comparison between sports for diet and regular soda.
*$p < 0.05$ Skaters vs Gymnasts using a Mann-Whitney U test.
**$p < 0.001$ Skaters vs Gymnasts using a Mann-Whitney U test.

Table 18: Number of Serving Per Month of Dairy Products for Female Athletes (means and standard deviations)[1]

Food and Serving Size	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
Milk (250 ml)	78.7±56.5	42.9±3.5	58.6±48.0
Milk on Cereal (125 ml)	24.6±27.5	25.4±32.4	25.0±30.1
Cheese (20 g)	37.3±43.7	20.5±16.5	27.9±32.3
Ice Cream (125 ml)	6.8±8.9	4.8±6.9	5.7±7.8
Frozen Yogurt (125 ml)	3.8±8.1	2.4±3.5	3.0±6.0
Fast Food Milk Shake	1.3±1.4	0.7±1.0	1.0±1.2
Cottage Cheese (125 ml)	4.4±12.3	1.2±3.6	2.6±8.6
Yogurt (175 ml)	12.7±19.2	5.7±7.8	8.8±4.3

[1]Data were not analyzed statistically.

Table 19: Calcium Intake for Male and Female Athletes (means and standard deviations)

Variable	Speed Skaters	Gymnasts	All Athletes
Fluid Milk (mg/day)*			
Males	1107±845	871±695	1006±789
Females	953±643	582±435	745±562
Other Dairy Calcium (mg\day)			
Males	276±241	304±523	288±381
Females	362±314	188±147	264±249
Non-Dairy Calcium (mg/day)			
Males	289±150	275±134	289±143
Females	308±280	209±148	253±220
Total Calcium Intake (mg/day)*			
Males	1681±931	1456±984	1590±951
Females	1527±750	1005±534	1235±683

* 2X2 ANOVA (Gender X Sport) revealed a significant effect of sport, ($p<0.05$).

calcium intake. The results showed that averaged over the two sports, there was no significant main effect of gender on total daily calcium intake ($F_{1,100}=2.90$, $p=0.09$). There was, however, a significant main effect for sport, meaning that averaged over gender, the skaters consumed significantly more dietary calcium per day than the gymnasts ($F_{1,100}=6.63$, $p=0.011$). There was no significant interaction effect for total calcium intake suggesting that the differences in calcium intake between the two sports were similar for each gender ($F_{1,100}=0.52$, $p=0.47$).

Since sport differences were found for intake of total dietary calcium, it was decided to investigate where the differences existed. For this reason, analysis of variance was used to examine the differences between the groups for calcium intake provided from fluid milk, other dairy products and non-dairy products.

The analysis showed that when calcium intake from fluid milk was averaged over the two sports, there was no significant main effect of gender ($F_{1,109}=3.63$, $p=0.06$). There was, however, a significant main effect of sport on calcium intake from fluid milk ($F_{1,109}=6.10$, $p=0.02$). There was no significant interaction effect of gender and sport on calcium intake ($F_{1,109}=0.62$, $p=0.43$), indicating that the differences in calcium intake from fluid milk between the two sports were similar for both genders.

When calcium intakes from other dairy sources were analyzed for differences, the results showed that there were no significant main effects of either gender ($F_{1,108}=0.18$, $p=0.67$) or sport ($F_{1,108}=2.23$, $p=0.14$). Similarly, there was no significant interaction effect of gender and sport on calcium intake from other dairy sources ($F_{1,108}=0.10$, $p=0.75$). These results suggest that all groups of athletes had similar calcium intakes from other dairy food sources.

Comparable results were seen when calcium intakes from non-dairy sources were analyzed. There were no significant main effects of either gender ($F_{1,100} = 2.62$, $p = 0.11$) or sport ($F_{1,100} = 2.66$, $p = 0.11$) on calcium intake and there was no significant interaction effect of gender and sport on calcium intake ($F_{1,100} = 2.23$, $p = 0.14$). These results indicate that all groups of athletes had similar calcium intakes from non-dairy food sources.

To investigate whether employment status influenced total dietary calcium intake, a Mann-Whitney U test was used to compare intakes of athletes who did and did not work. The analysis showed that both groups of athletes had similar total dietary calcium intakes. Similarly, to investigate the influence of supplementation on total dietary calcium intake, a Mann-Whitney U test was used to compare intake of athletes who took vitamin/mineral supplements to those who did not. The results showed that the supplement users had similar calcium intakes to the non-supplement users.

The type of milk usually drunk by the athletes was investigated using Chi-Square. Tables 20 and 21 show that no significant difference existed between the sports for the type of milk usually drunk by the athletes (males and females respectively). For male athletes, approximately 88% of the skaters and 84% of the gymnasts consumed low-fat milk (2%, 1%, or skim milk). For female athletes, approximately 92% of the skaters and 91% of the gymnasts reported consuming low-fat milk (2%, 1%, or skim milk) as the milk they usually drank.

Overall, the results from the analyses of variance suggest that sport differences existed for total calcium intake and that these differences were a result of the skaters consuming greater amounts of calcium from fluid milk than the gymnasts. In addition,

Table 20: Type of Milk Consumed by Male Athletes (percentages)

Type of Milk	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
Whole Milk	6.3%	4.0%	5.3%
2% Milk	53.1%	44.0%	49.1%
1% Milk	28.1%	32.0%	29.8%
Skim Milk	6.3%	8.0%	7.0%
Chocolate Milk	3.1%	4.0%	3.5%
No Milk	3.1%	8.0%	5.3%

No significant difference existed in the type of milk drunk by the athletes in the two sports as assessed using Chi-Square.

Table 21: Type of Milk Consumed by Female Athletes (percentages)

Type of Milk	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
Whole Milk	0%	3.1%	1.8%
2% Milk	52.0%	34.4%	42.1%
1% Milk	20.0%	43.8%	33.3%
Skim Milk	20.0%	12.5%	15.8%
Chocolate Milk	4.0%	3.1%	3.5%
No Milk	4.0%	0%	1.8%

No significant difference existed in the type of milk drunk by the athletes in the two sports as assessed using Chi-Square.

the differences that existed between the two sports for calcium intake from fluid milk, and therefore total calcium intake, were consistent for both genders.

4. Dieting Sub-Scale

The dieting sub-scale from the Eating Attitudes Test was used to measure pathological tendencies towards dissatisfaction with body shape and avoidance of fattening foods. A score of eight or greater suggests disturbed dieting behaviours. Tables 22 and 23 show the dieting sub-scale scores for individual questions and overall scores for male and female athletes respectively. The overall scores were assessed for differences between gender and sport using an ANOVA.

The analysis showed that averaged over the two sports, there was a significant main effect of gender on the dieting sub-scale score ($F_{1,105}=21.86$, $p<0.001$), meaning that the female athletes had a significantly higher score than the male athletes. However, there was no significant main effect for sport ($F_{1,105}=0.23$, $p=0.64$), indicating that when the scores were averaged over gender, the two sports had similar scores. No significant effect was seen for the interaction of gender and sport on the dieting sub-scale score ($F_{1,105}=1.09$, $p=0.30$), meaning that the differences in scores between gender were similar for both sports. Although gender differences existed for the dieting sub-scale score, the mean scores were not suggestive of tendencies toward disturbed eating behaviour.

Next, the dieting sub-scale scores were examined to determine the percentage of athletes who scored eight or higher on the scale. The Chi-Square analysis showed that for both male and female athletes there was a similar percentage of athletes who scored eight or higher in both sports. For females, 16% of the skaters and 25% of

Table 22: Dieting Sub-Scale Scores for Male Athletes (means and standard deviations)

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. Am terrified about being overweight	0.0±0.0	0.1±0.3	0.0±0.2
2. Aware of the calorie content of foods that I eat	0.1±0.4	0.1±0.3	0.1±0.4
3. Particularly avoid foods with high carbohydrate content (eg. bread, rice, potatoes, etc)	0.0±0.0	0.0±0.0	0.0±0.0
4. Feel extremely guilty after eating	0.0±0.2	0.0±0.0	0.0±0.0
5. Am preoccupied (think a lot about) with a desire to be thinner	0.3±0.7	0.0±0.0	0.0±0.1
6. Think about burning up calories when I exercise	0.0±0.2	0.2±0.6	0.2±0.7
7. Am preoccupied with (think a lot about) with the thought of having fat on my body	0.0±0.2	0.0±0.0	0.0±0.1
8. Avoid foods with sugar in them	0.0±0.2	0.1±0.4	0.1±0.3
9. Eat diet foods or drinks	0.1±0.2	0.1±0.4	0.1±0.3
10. Feel uncomfortable after eating sweets	0.2±0.4	0.1±0.4	0.1±0.4
11. Go on diets to lose weight	0.0±0.0	0.0±0.0	0.0±0.0
12. Like my stomach to be empty	0.0±0.2	0.0±0.0	0.0±0.1
13. Enjoy trying rich new foods[1]	1.1±1.0	0.9±0.9	0.1±0.9
Dieting Sub-Scale Total Score[2]	1.9±2.0	1.5±1.4	1.7±1.8

[1]Scores were reversed.
[2]Only variable analyzed statistically. 2X2 ANOVA (Gender X Sport) showed a significant main effect of gender, ($p<0.05$). (See Table 23 for data on females).

Table 23: Dieting Sub-Scale Scores for Female Athletes (means and standard deviations)

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. Am terrified about being overweight	0.7±1.1	1.0±1.2	0.8±1.2
2. Aware of the calorie content of foods that I eat	0.4±0.7	0.3±0.6	0.3±0.7
3. Particularly avoid foods with high carbohydrate content (eg. bread, rice, potatoes, etc)	0.0±0.2	0.0±0.0	0.0±0.1
4. Feel extremely guilty after eating	0.1±0.4	0.2±0.7	0.2±0.6
5. Am preoccupied (think a lot about) with a desire to be thinner	0.5±1.0	0.4±0.8	0.5±0.9
6. Think about burning up calories when I exercise	0.7±1.1	0.4±0.7	0.5±0.9
7. Am preoccupied with (think a lot about) with the thought of having fat on my body	0.6±1.2	0.6±0.8	0.6±1.0
8. Avoid foods with sugar in them	0.1±0.3	0.2±0.6	0.2±0.5
9. Eat diet foods or drinks	0.3±0.6	0.7±1.0	0.5±0.9
10. Feel uncomfortable after eating sweets	0.3±0.7	0.5±1.0	0.4±0.9
11. Go on diets to lose weight	0.2±0.8	0.1±0.4	0.2±0.6
12. Like my stomach to be empty	0.0±0.0	0.1±0.4	0.0±0.3
13. Enjoy trying rich new foods[1]	1.1±1.1	1.3±0.8	1.2±0.9
Dieting Sub-Scale Total Score[2]	4.3±5.0	5.4±4.5	4.9±4.7

[1]Scores were reversed.
[2]Only variable analyzed statistically. 2X2 ANOVA (Gender X Sport) showed a significant main effect of gender, ($p<0.05$). (See Table 22 for data on males).

the gymnasts had dieting sub-scale scores of eight or greater, while for the male athletes, 8% of the skaters and none of the gymnasts had scores in the range suggestive of disturbed eating behaviours. These results indicate that in this study, there were no significant differences between the sports for the percentage of athletes who had scores suggestive of tendencies towards disturbed eating behaviours.

5. Differential Association Variable

As discussed under the section, Internal Consistency of the Questionnaire in this chapter, the overall differential association score was used to represent the differential association variable in the statistical analysis. This variable was created by averaging the scores from all sixteen questions in the differential association scale. Therefore, it represents the athletes' interaction and identity with different groups of the social environment (family, friends, health experts and media) in terms of their perceptions, consumption, persuasive qualities and recommendations about the use of milk. Tables 24 and 25 show the differential association sub-scale scores and overall differential association scores for the male and female athletes respectively. Mean scores for the individual questions from the sub-scales for all groups of athletes can be found in Appendix D.

Analysis of variance showed that when differential association scores were averaged over the two sports, there was no significant main effect of gender on the differential association variable ($F_{1,103}=0.76$, $p=0.38$). Neither was there a significant main effect for sport ($F_{1,103}=0.56$, $p=0.46$), meaning that when both genders were combined, the scores were similar between the two sports. No

Table 24: Average Scores for Differential Association Sub-Scales and Overall Differential Association Score for Male Athletes

Scale	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
Friends	3.3±0.6	3.3±0.5	3.3±0.6
Family	3.8±0.7	3.6±0.8	3.7±0.7
Media	2.9±1.0	3.1±0.7	3.0±0.9
Experts	3.4±0.6	3.4±0.7	3.4±0.6
Total Score[1]	3.4±0.4	3.3±0.5	3.4±0.4

[1]Only variable analyzed statistically. 2X2 ANOVA (Gender X Sport) showed no significant main effects for gender or sport and no significant interaction effect. (See Table 25 for data on females).

Table 25: Average Scores for Differential Association Sub-Scales and Overall Differential Association Score for Female Athletes (means and standard deviations)

Scale	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
Friends	3.5±0.7	3.5±0.5	3.5±0.6
Family	3.8±1.0	3.9±0.7	3.9±0.8
Media	3.3±0.8	3.0±0.7	3.1±0.8
Experts	3.4±0.7	3.3±0.6	3.3±0.7
Total Score[1]	3.5±0.6	3.4±0.4	3.4±0.5

[1]Only variable analyzed statistically. 2X2 ANOVA (Gender X Sport) showed no significant main effects for gender or sport and no significant interaction effect. (See Table 24 for data on males).

significant interaction effect was seen for the differential association score ($F_{1,103}=0.05$, $p=0.82$). These results suggest that no significant differences existed between the groups for the differential association variable, therefore, the social environment appeared to exert similar influences on all groups of athletes. Thus, the athletes agreed to some extent that they perceived that their social environment was supportive of the consumption of milk. Since milk comprises approximately 65% of total calcium intake, the social environment exerted a similar impact on total calcium intake for these athletes.

6. Lifestyle Variable

The frequency of eating away from home has been identified as a factor of the social environment that may influence calcium intake (Lewis et al., 1989). For the purpose of this study, "Lifestyle" has been defined as the percent of meals and snacks eaten away from home. Tables 26 and 27 show the total numbers of meals and snacks eaten per week and the percent of meals and snacks eaten away from home per week (lifestyle variable) for male and female athletes respectively. The analysis of variance showed that when the total number of meals and snacks eaten per week was averaged over the two sports, there was a significant main effect of gender ($F_{1,109}=26.14$, $p<0.001$), meaning that the male athletes consumed significantly more meals and snacks per week than the female athletes. However, when both genders were averaged, there was no significant main effect of sport ($F_{1,109}=0.03$, $p=0.86$), meaning that the total number of meals and snacks eaten per week was similar between the two sports. There was no significant interaction effect ($F_{1,109}=3.81$, $p=0.53$), indicating that the differences in the number of meals and

Table 26: Number of Meals and Snacks Eaten and "Eaten Out" Per Week by Male Athletes (means and standard deviations)

Meals and Snacks	Speed Skaters n=32 Eaten ("Out")	Gymnasts n=25 Eaten ("Out")	All Athletes n=57 Eaten ("Out")
Breakfast	6.4 ± 1.2 (0.1 ± 0.3)	6.3 ± 1.2 (0.0 ± 0.0)	6.4 ± 1.2 (0.0 ± 0.2)
Morning Snack	2.1 ± 2.4 (0.3 ± 0.8)	2.9 ± 2.7 (0.1 ± 0.5)	2.4 ± 2.6 (0.2 ± 0.7)
Lunch	6.5 ± 0.9 (1.0 ± 1.4)	6.6 ± 1.0 (0.9 ± 1.1)	6.6 ± 0.9 (1.0 ± 1.3)
Afternoon Snack	4.1 ± 2.5 (0.4 ± 0.8)	5.0 ± 2.0 (0.3 ± 0.5)	4.5 ± 2.3 (0.3 ± 0.7)
Dinner	6.9 ± 0.4 (0.8 ± 0.8)	7.0 ± 0.0 (0.9 ± 0.8)	7.0 ± 0.3 (0.8 ± 0.8)
Evening Snack	5.0 ± 2.1 (0.3 ± 0.8)	5.0 ± 2.3 (0.2 ± 0.7)	5.0 ± 2.2 (0.2 ± 0.7)
Total Number of Meals & Snacks[1]	31.0 ± 5.5 (2.8 ± 2.4)	32.8 ± 5.5 (2.4 ± 2.4)	31.8 ± 5.5 (2.6 ± 2.4)
Lifestyle Variable (Percent of all Meals & Snacks eaten out)[1]	8.9 ± 7.5	7.2 ± 7.2	8.2 ± 7.3

[1]Only variables analyzed statistically. 2X2 ANOVA (Gender X Sport) showed a significant ($p < 0.05$) main effect of gender on total number of meals and snacks but no significant main effect of sport and no significant interaction effect. 2X2 ANOVA (Gender X Sport) for the lifestyle variable showed no significant main effects of gender or sport and no significant interaction effect. (See Table 27 for data on females).

Table 27: Number of Meals and Snacks Eaten and "Eaten Out" Per Week by Female Athletes (means and standard deviations)

Meals and Snacks	Speed Skaters n=25 Eaten ("Out")	Gymnasts n=32 Eaten ("Out)	All Athletes n=57 Eaten ("Out")
Breakfast	5.5±2.3 (0.2±0.4)	5.5±1.9 (0.1±0.2)	5.5±2.0 (0.1±0.3)
Morning Snack	1.6±2.1 (0.2±1.0)	2.0±2.1 (0.1±0.3)	1.8±2.1 (0.1±0.7)
Lunch	6.0±1.8 (0.8±0.9)	6.2±1.3 (0.7±1.0)	6.1±1.5 (0.7±1.0)
Afternoon Snack	3.7±2.7 (0.1±0.5)	2.3±1.9 (0.1±0.2)	2.9±2.4 (0.1±0.3)
Dinner	6.8±0.7 (1.0±1.0)	6.3±1.6 (0.9±0.9)	6.5±1.3 (0.9±1.0)
Evening Snack	4.2±2.0 (0.1±0.3)	3.4±2.2 (0.0±0.2)	3.8±2.1 (0.1±0.2)
Total Number of Meals & Snacks[1]	27.8±5.9 (2.4±2.4)	25.7±4.4 (1.8±2.0)	27.7±5.2 (2.1±2.2)
Lifestyle Variable (Percent of all Meals & Snacks eaten out)[1]	8.5±8.2%	6.9±8.1%	7.6±8.1%

[1]Only variables analyzed statistically. 2X2 ANOVA (Gender X Sport) showed a significant ($p<0.05$) main effect of gender on the total number of meals and snacks but no significant main effect of sport and no significant interaction effect. 2X2 ANOVA (Gender X Sport) for the lifestyle variable showed no significant main effects of gender or sport and no significant interaction effect. (See Table 26 for data on males).

snacks eaten per week between the genders was similar for the skaters and gymnasts.

The results from the analysis of the lifestyle variable showed that there was no significant main effect of gender on the lifestyle variable ($F_{1,102}=0.06$, $p=0.80$), indicating that when averaged over the two sports, both genders consumed a similar percent of meals and snacks away from home. Similarly, there was no significant main effect of sport ($F_{1,102}=1.20$, $p=0.28$), meaning that when averaged over both genders, there was no significant difference between the sports for the percent of meals and snacks eaten away from home. No significant interaction effect was seen ($F_{1,102}=0.00$, $p=0.97$), indicating that the differences between the genders for the percent of meals and snacks eaten away from home was similar for both sports. Overall, while the males consumed more meals and snacks than the females, all groups were similar for the percent of meals and snacks that they consumed away from home (lifestyle variable).

7. Social Reinforcement Variable

The social reinforcement variable reflected the athletes' perceptions concerning positive feelings, a sense of belonging to a group and pleasing others as a function of consuming milk (Lewis, 1986). The participants' responses to the questions were scored on a five point scale. Therefore, scores greater than 3.0 reflected agreement that the consumption of milk evoked positive feelings and a sense of belonging to a group. A score of less than 3.0 reflected disagreement with the above statement. Tables 28 and 29 show the average responses to all questions and the overall scores for male and female athletes respectively.

Table 28: Scores for Social Reinforcement Questions and Overall Social Reinforcement Score for Males (means and standard deviations)

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. Drinking milk makes me feel part of a special group of people	2.0±1.1	1.6±0.9	1.8±1.0
2. When I drink milk I feel I get approval from the people who matter to me	2.6±0.9	2.3±1.0	2.5±0.9
3. It gives me a nice feeling to have a glass of milk with friends	2.7±1.0	2.4±0.9	2.6±1.0
4. When I drink milk, I please people who are important to me	2.6±0.9	2.2±0.9	2.4±0.9
Social Reinforcement Score[1]	2.5±0.7	2.1±0.6	2.3±0.7

[1]Only variable analyzed statistically ($p<0.05$). 2X2 ANOVA (Gender X Sport) revealed a significant main effect of sport, no significant main effect of gender and no significant interaction effect. (See Table 29 for data on females).

Table 29: Scores for Social Reinforcement Questions and Overall Social Reinforcement Score for Females (means and standard deviations)

Question	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
1. Drinking milk makes me feel part of a special group of people	2.5±1.0	2.0±0.8	2.2±0.9
2. When I drink milk I feel I get approval from the people who matter to me	2.6±1.2	2.3±0.9	2.4±1.0
3. It gives me a nice feeling to have a glass of milk with friends	2.7±1.0	2.3±0.9	2.5±0.9
4. When I drink milk, I please people who are important to me	2.6±1.2	2.8±0.8	2.7±1.0
Social Reinforcement Score[1]	2.6±0.9	2.3±0.6	2.4±0.7

[1]Only variable analyzed statistically ($p<0.05$). 2X2 ANOVA (Gender X Sport) revealed a significant main effect of sport, no significant main effect of gender and no significant interaction effect. (See Table 28 for data on males).

The results from the ANOVA showed there was no significant main effect of gender when the social reinforcement score was averaged over the two sports ($F_{1,107}=1.67$, $p=0.20$), meaning that when the two sports were combined, both genders disagreed to a similar extent that the consumption of milk evoked positive feelings, a sense of belonging to a group and pleasing others. There was, however, a significant main effect of sport ($F_{1,107}=5.78$, $p=0.02$), indicating that while athletes in both sports disagreed with the statements, the gymnasts exhibited stronger disagreement to the statements that the consumption of milk evoked positive feelings and a sense of belonging to a group than the skaters. There was no significant interaction effect ($F_{1,107}=0.36$, $p=0.55$), meaning that the differences which existed between the sports for the social reinforcement variable were similar for both genders.

8. Modelling Behaviour Variable

The modelling behaviour variable was created by averaging the scores from all five questions in the modelling behaviour scale. This scale reflected the frequency with which the athletes had seen certain models consuming milk. Statistical analysis was only conducted for the overall modelling behaviour score. A score of 2.5 or greater suggests that the athletes saw the models, as a group, drinking milk at least "Fairly Often". A score of 2.0 or less suggests that the athletes observed the models consuming milk "Not Very Often" or "Almost Never". Tables 30 and 31 show the results from the modelling behaviour scale for male and female athletes respectively.

The analysis of variance showed that there was no significant main effect of gender on the modelling behaviour variable ($F_{1,93}=3.46$, $p=0.07$), indicating that for both sports combined, both the male and female athletes observed the models

Table 30: Modelling Scores for Male Athletes (means and standard deviations)

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. Mother	2.6±0.8	2.1±0.9	2.4±0.9
2. Father	2.7±0.9	2.5±0.9	2.6±0.9
3. Adult in Family you admire	2.6±0.9	2.3±0.9	2.5±0.9
4. Friend of opposite sex	2.7±0.9	2.5±1.0	2.6±1.0
5. Friend you admire	2.6±0.9	2.6±0.9	2.6±0.9
Modelling Behaviour Score[1]	2.6±0.6	2.3±0.8	2.5±0.7

[1]Only the overall behaviour modelling score was analyzed statistically. 2X2 ANOVA (Gender X Sport) showed no significant main effects of gender or sport and no significant interaction effect. (See Table 31 for data on females).

Table 31: Modelling Scores for Female Athletes (means and standard deviations)

Question	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
1. Mother	2.3 ± 1.1	2.7 ± 1.0	2.5 ± 1.0
2. Father	2.9 ± 0.9	2.8 ± 1.2	2.7 ± 1.0
3. Adult in Family you admire	2.7 ± 0.9	2.7 ± 0.7	2.6 ± 0.9
4. Friend of opposite sex	2.8 ± 0.8	2.3 ± 0.9	2.6 ± 0.9
5. Friend you admire	3.1 ± 0.7	2.9 ± 0.8	2.8 ± 0.9
Modelling Behaviour Score[1]	2.7 ± 0.6	2.7 ± 0.5	2.7 ± 0.6

[1]Only the overall behaviour modelling score was analyzed statistically. 2X2 ANOVA (Gender X Sport) showed no significant main effects of gender or sport and no significant interaction effect. (See Table 30 for data on males).

consuming milk "Fairly Often". There was no significant main effect of sport on modelling behaviour ($F_{1,93}=2.17$, $p=0.14$), meaning that averaged over gender, athletes in the two sports indicated that they observed the models consuming milk more often than not. There was no significant interaction effect ($F_{1,93}=0.66$, $p=0.42$), meaning that the differences between genders for the modelling behaviour variable were similar for both sports. Overall, no significant differences were detected between the groups for the modelling behaviour variable.

9. Non-Social Reinforcement (Taste) Variable

The non-social reinforcement variable represented how much the athletes enjoyed the taste of dairy products. The scores of the eight foods were averaged and represented the non-social reinforcement variable. A score of three or greater on the five point scale suggested that the athletes enjoyed the taste of the foods. Tables 32 and 33 show the taste enjoyment scores for the individual dairy foods and the overall non-social reinforcement variable for the male and female athletes respectively.

The analysis showed that when the non-social reinforcement variable was averaged over the two sports, there was no significant main effect of gender ($F_{1,107}=2.73$, $p=0.10$), meaning that, on average, both male and female athletes reported enjoying the taste of dairy products to a similar extent. When averaged over gender, there was no significant main effect of sport ($F_{1,107}=0.58$, $p=0.45$). Nor was there a significant interaction effect of gender and sport on the non-social reinforcement variable ($F_{1,107}=3.41$, $p=0.07$). These results indicate that on average, all groups of athletes tended to enjoy the taste of milk and dairy products to a similar extent.

Table 32: Scores for Non-Social Reinforcement (Taste) Questions and Overall Non-Social Reinforcement Score for Male Athletes (means and standard deviation)

Question	Speed Skaters n=32	Gymnasts n=25	All athletes n=57
1. How much do you enjoy the taste of whole milk?	1.3±1.7	2.2±2.0	1.7±1.9
2. How much do you enjoy the taste of low-fat (2% or 1%) milk?	4.2±1.3	4.3±1.2	4.2±1.3
3. How much do you enjoy the taste of skim milk?	2.0±1.6	2.6±1.4	2.3±1.5
4. How much do you enjoy the taste of fruit-flavoured yogurt?	3.9±1.4	4.1±1.3	4.0±1.4
5. How much do you enjoy the taste of plain yogurt?	2.0±1.3	2.1±1.3	2.0±1.3
6. How much do you like the taste of cottage cheese?	2.2±1.5	2.4±1.7	2.3±1.6
7. How much do you like the taste of hard cheese (such as cheddar)?	4.0±0.9	4.4±0.7	4.2±0.8
8. How much do you like the taste of ice cream?	4.8±0.5	4.8±0.5	4.8±0.5
Overall Score[1]	3.1±0.7	3.4±0.7	3.2±0.7

[1]Only variable analyzed statistically. A score of 1 revealed that the athletes liked the taste "Not At All", while a score of 5 indicated that the taste was liked "Very Much". No significant effects were detected in a 2X2 ANOVA (Gender X Sport). (See Table 33 for data on females).

Table 33: Scores for Non-Social Reinforcement (Taste) Questions and Overall Non-Social Reinforcement Score for Female Athletes (means and standard deviation)

Question	Speed Skaters n=25	Gymnasts n=32	All athletes n=57
1. How much do you enjoy the taste of whole milk?	1.9±1.4	1.5±1.3	1.7±1.4
2. How much do you enjoy the taste of low-fat (2% or 1%) milk?	3.9±1.3	4.1±1.1	4.0±1.2
3. How much do you enjoy the taste of skim milk?	2.9±1.7	2.7±1.5	2.8±1.5
4. How much do you enjoy the taste of fruit-flavoured yogurt?	4.4±1.2	4.3±0.9	4.3±1.0
5. How much do you enjoy the taste of plain yogurt?	2.4±1.4	2.3±1.3	2.3±1.4
6. How much do you like the taste of cottage cheese?	3.4±1.7	2.9±1.4	3.1±1.6
7. How much do you like the taste of hard cheese (such as cheddar)?	4.5±0.9	4.4±1.0	4.4±1.0
8. How much do you like the taste of ice cream?	4.4±1.2	4.6±0.6	4.5±0.9
Overall Score[1]	3.5±0.6	3.3±0.5	3.4±0.5

[1]Only variable analyzed statistically. A score of 1 revealed that the athletes liked the taste "Not At All", while a score of 5 indicated that the taste was liked "Very Much".No significant effects were detected in a 2X2 ANOVA (Gender X Sport). (See Table 32 for data on males).

10. Univariate Correlation Analyses

Pearson Correlation Coefficients were calculated to examine the univariate linear relationship between daily dietary calcium intake and the independent variables. The following independent variables were included in the analyses: age, soda intake, dieting sub-scale score, differential association variable, social reinforcement variable, modelling behaviour variable, lifestyle variable, weight, percent body fat and the non-social reinforcement variable. Correlation coefficients were calculated for all athletes combined and then the athletes were divided into two groups by gender and then further divided by sport. Athletes who reported allergies to milk or dairy products and therefore avoided the consumption of milk, were excluded from these analyses.

A) All Athletes

Table 34 shows the correlation coefficients calculated using data collected from all athletes. These results show that there was a weak but significant positive linear relationship ($p<0.05$) between estimated dietary calcium intake and the following independent variables: differential association variable, social reinforcement, non-social reinforcement, modelling behaviour and weight, explaining only 7%, 7%, 4%, 4% and 5% of the variance in total dietary calcium intake respectively.

B) Males

Table 35 shows the univariate correlation coefficients for the independent variables with daily dietary calcium intake for the male athletes. When both sports were combined, the only two variables which had a significant ($p<0.05$) linear correlation with calcium intake were differential association and social reinforcement.

Table 34: Univariate Correlation Coefficients for Daily Calcium Intake and the Independent Variables for All Athletes[1]

Variable	Correlation Coefficient (n=112)	Alpha Level
Age	.02	.411
Weight	.22	.014*
Soda Intake[2]	.06	.274
Dieting Sub-scale Variable	-.07	.238
Differential Association Variable	.26	.006*
Social Reinforcement Variable	.26	.005*
Modelling Behaviour Variable	.21	.022*
Lifestyle Variable	.17	.055
Percent Body Fat	.10	.156
Non-Social Reinforcement Variable	.19	.030*

[1]Analysis does not include athletes who reported allergies to milk or dairy products and who avoided milk.
[2]Soda Intake = Diet Soda + Regular Soda.
*$p<0.05$

Table 35: Univariate Correlation Coefficients for Daily Calcium Intake and the Independent Variables for Male Athletes[1]

Variable	Speed Skaters (n=31) "r"	alpha	Gymnasts (n=25) "r"	alpha	All Athletes (n=56) "r"	alpha
Age	0.20	.145	-0.05	.418	0.06	.336
Weight	0.04	.419	-0.14	.263	0.04	.393
Soda Intake[2]	-0.02	.465	-0.01	.483	0.01	.460
Dieting Sub-scale Score	-0.21	.130	-0.19	.193	-0.18	.105
Differential Association Score	0.31	.049*	0.35	.059	0.33	.009*
Social Reinforcement Score	0.10	.300	- 0.32	.080	0.25	.038*
Modelling Behaviour Score	-0.08	.337	0.41	.051	0.20	.090
Lifestyle Score	-0.13	.244	0.36	.067	0.09	.263
Percent Body Fat	-0.02	.457	0.01	.477	0.12	.199
Non-Social Reinforcement Score	0.25	.091	0.28	.101	0.20	.078

[1]Analysis does not include athletes who reported allergies to milk or dairy products and who did not consume milk.
[2]Soda Intake = Diet Soda + Regular Soda.
*$p < 0.05$

This analysis suggests that once the effect of gender was controlled, the associations of the non-social reinforcement variable, the modelling behaviour variable and weight with total dietary calcium were no longer significant. However, the linear correlations between total calcium intake and the independent variables, differential association and social reinforcement, were weak since only 11% and 6% of the variance in total dietary calcium intake was explained by each variable respectively.

Next, the athletes were divided by sport and the linear relationships re-examined. These results show that for skaters, only one weak but significant ($p < 0.05$) linear relationship between daily dietary calcium intake and the independent variable, differential association, remained. This indicated that once gender and sport were controlled for, the differential association variable explained only 10% of the variance in total dietary calcium intake. However, for gymnasts, there were no significant linear relationships between estimated total dietary calcium intake and the independent variables, suggesting that once gender and sport are controlled for, none of the independent variables were linearly related to total dietary calcium intake.

C) Females

Table 36 shows the univariate correlation coefficients for the independent variables with daily dietary calcium intake for female athletes. For both sports combined, these results showed that there were significant ($p < 0.05$) positive linear correlations between daily calcium intake and the following variables: social reinforcement variable, non-social reinforcement variable, modelling behaviour variable, body weight and percent body fat. These variables were able to explain 10%, 8%, 12%, 14%, and 12% of the variance in total calcium intake respectively.

Table 36: Univariate Correlation Coefficients for Daily Calcium Intake and the Independent Variables for Female Athletes[1]

Variable	Speed Skaters (n=24) "r"	alpha	Gymnasts (n=32) "r"	alpha	All Athletes (n=56) "r"	alpha
Age	-0.25	0.139	0.03	0.439	-0.08	0.284
Weight	0.26	0.130	0.12	0.266	0.38	0.004*
Soda Intake[2]	0.01	0.483	-0.07	0.371	0.07	0.312
Dieting Sub-scale Score	0.33	0.082	0.02	0.456	0.08	0.314
Differential Association Score	0.50	0.010*	-0.10	0.320	0.22	0.071
Social Reinforcement Score	0.46	0.017*	0.10	0.306	0.31	0.017*
Modelling Behaviour Score	0.30	0.104	0.38	0.029*	0.34	0.012*
Lifestyle Score	0.11	0.323	0.30	0.070	0.23	0.063
Percent Body Fat	0.21	0.176	0.03	0.432	0.35	0.007*
Non-Social Reinforcement Score	0.11	0.324	0.47	0.006*	0.28	0.026*

[1]Analysis does not include athletes who reported allergies to milk or dairy products and who avoided milk.
[2]Soda Intake = Diet Soda + Regular Soda.
*$p<0.05$

When the sports were analyzed separately, different relationships were observed. For skaters, there was a significant ($p<0.05$) positive relationship between dietary calcium and two of the independent variables. The differential association variable and the social reinforcement variable were able to explain 25% and 21% of the variance in total calcium intake respectively. For gymnasts, significant ($p<0.05$) positive correlations were found between the dependent variable and two different independent variables. Modelling behaviour and non-social reinforcement explained 14% and 22% of the variance in total calcium intake for the female gymnasts. These results suggest that for the female athletes in this study, sport differences were evident for the univariate linear relationships between estimated dietary calcium intake and the independent variables.

Overall, these results suggest that the groups of athletes studied were very different in terms of the types of independent variables which predicted total dietary calcium intake as the dependent variable. However, the groups of athletes were also similar in the respect that only a small number of the independent variables influenced calcium intake.

11. Multiple Regression Analysis

Stepwise forward entry multiple regression Analysis (MRA) was used to study the relationship between calcium intake and the independent variables. The purpose of conducting MRA was to determine which independent variable(s) were the most useful for predicting calcium intake. The intent of this study was to establish how traditional independent variables compared to social independent variables for predicting the dependent variable, calcium intake. Therefore, the first MRA included all athletes and two analyses were conducted, one analysis for the Traditional Model and one analysis for the Social Model. Then, the athletes were divided by gender and by sport and additional MRA conducted. When variables from the models significantly ($p<0.05$) explained variance in total calcium intake, the results were summarized on Table 37 and equations were generated. Residuals from the MRA were plotted and exhibited normality and linearity when the dependent variable was transformed by natural logs. (As indicated in the Methods, all statistical analyses related to calcium intake were performed using log transformed calcium values).

A) All Athletes

i) Traditional Model

The results of the MRA for all athletes are shown in Table 37. This analysis showed that when predicting calcium intake using the traditional variables (age, sex, sport, weight, %BF), only sport explained a significant amount of variance in calcium intake. Based on the adjusted R squared value, only 10% of the variance in the athletes' total calcium intake was explained by the type of sport. These results indicated that much of the variance in total dietary calcium intake was unexplained by this model. The regression equation generated for this model was ($F_{1,100}=11.78$, $p<0.001$):

$$\ln(\text{Predicted Calcium Intake}) = 7.681 - 0.381(\text{Sport})$$

Where the numeric values for sport were: 1 = skaters 2 = gymnasts.

ii) Social Model

The MRA for the Social Model showed that when predicting calcium intake

Table 37: Multiple Regression Analysis Summary Table

ATHLETES	MODEL	STEP AND VARIABLE	R	Adj R^2	"T" and alpha
ALL	Trad[a]	1. Sport	0.32	0.10	-3.43 $p<0.001$
	Soc[b]	1. SRV	0.26	0.06	2.52 $p=0.013$
MALES	Soc[b]	1. DAV	0.33	0.09	2.30 $P=0.026$
FEMALES	Trad[a]	1. Sport	0.41	0.15	-3.06 $p=0.004$
	Soc[b]	1. MBV	0.35	0.10	2.45 $p=0.019$
FEMALE GYMNASTS	Soc[b]	1. NSRV	0.47	0.18	2.54 $p=0.018$
FEMALE SKATERS	Soc[b]	1. DAV	0.50	0.21	2.41 $p=0.028$

[a]Trad = Traditional Model (Age, Sport, %BF, Weight, Gender)
[b]Soc = Social Model [Dieting Sub-Scale Score (DSS), Differential Association Variable (DAV), Social Reinforcement Variable (SRV), Non-Social Reinforcement Variable (NSRV), Lifestyle Variable (LV), Modelling Behaviour Variable (MBV)]

using social independent variables (dieting behaviour score, differential association variable, social reinforcement variable, non-social reinforcement variable, modelling behaviour variable, and the lifestyle variable), only social reinforcement explained a significant amount of the variance in total calcium intake. Table 37 shows that, when using the adjusted R squared value, the social reinforcement variable only accounted for six percent of the variance in total calcium intake. Similar to the Traditional Model, much of the variance in total dietary calcium intake remains unexplained by the variables in the Social Model. The predictive equation generated for this Model was ($F_{1,88} = 6.37$, $p = 0.013$):

ln(Predicted Total Calcium Intake) = 6.577 + 0.221(Social Reinforcement Variable).

These results suggest that while the Traditional Model was able to explain more variance in calcium intake than the Social Model, neither Model contained powerful predictors of total calcium intake.

B) Male Athletes

MRA were conducted using both the Traditional and Social Models for the male athletes combined, the male gymnasts and then male skaters. As shown in Table 37, for male athletes combined, only one variable from the Social Model explained a significant amount of variance in the dependent variable. The differential association variable explained nine percent of the variance in total dietary calcium intake for the male athletes combined. The predictive equation generated for this model was

($F_{1,43}=5.31$, $p=0.026$):

$$\ln(\text{Predicted Total Calcium Intake}) = 5.743 + 0.438(\text{Differential Association Variable})$$

None of the variables from the Traditional Model were able to explain variance in the dependent variable. Similarly, when the athletes were divided by sport, none of the variables from either model (Traditional or Social) were able to explain variance in total calcium intake. These results suggest that for the variables studied, none have a significant influence on predicting total calcium intake for the male athletes in this study. Thus, for male athletes, the variance in total dietary calcium intake was not explained by the variables in either the Traditional Model or the Social Model.

C) Female Athletes

i) Traditional Model

MRA was conducted using variables from the Traditional Model for all female athletes combined. Table 37 shows that when total calcium intake was predicted from the traditional variables, only sport explained a significant amount of variance in the dependent variable. Based on the adjusted R squared value, sport was able to explain 15% of the variance in calcium intake for the female athletes. The predictive equation generated for this model was ($F_{1,47}=9.36$, $p=0.004$):

$$\ln(\text{Predicted Calcium Intake}) = 7.719 - 0.466(\text{Sport})$$

Where the numeric values for sport were: 1 = Skaters 2 = Gymnasts.

These results show that when the athletes were divided by gender, sport became a more powerful predictor of calcium intake for the female athletes. However, when the MRA was conducted using the Traditional Model for each sport separately, none of the variables were able to significantly explain the variance in total calcium intake. These results suggest that for the Traditional variables, only sport was useful for predicting total calcium intake.

ii) Social Model

Table 37 shows the results of the MRA for the Social Model for all female athletes combined. The analysis showed that the modelling behaviour variable was the only variable that was able to explain a significant amount of variance in calcium intake. Modelling behaviour explained nine percent of the variance in total calcium intake based on the adjusted R squared value. The equation created for this model was ($F_{1,42}=5.51$, $p=0.024$):

$$\ln(\text{Predicted Calcium Intake}) = 6.042 + 0.350(\text{Modelling Behaviour Variable}).$$

Table 37 shows the results from the MRA using the Social Model for female gymnasts. This analysis showed that only one social variable entered into the equation, non-social reinforcement variable. Based on the adjusted R squared value, the non-social reinforcement variable explained 18% of the variance in total calcium intake. These results show that for the social variables included in this study, the non-social reinforcement variable was the only variable capable of predicting calcium intake in adolescent female gymnasts. The equation generated for this MRA was

($F_{1,23}=6.44$, $p=0.018$):

ln(Predicted Calcium Intake) = 5.108 + 0.501(Non-Social Reinforcement Variable)

The MRA was also conducted for the female skaters using variables from the Social Model. Table 37 shows that, for the skaters, the differential association variable explained 21% of the variance in total calcium intake based on the adjusted R squared value. The equation generated from this MRA was ($F_{1,17}=5.81$, $p=0.028$):

ln(Predicted Total Calcium Intake) = 5.723 + 0.438(Differential Association Variable)

These results suggest that sport differences exist for the predictive power the different variables in the Social Model on total calcium intake for adolescent female athletes in this study. However, overall, these results suggest that for the female athletes, much of the variance in total calcium intake remains unexplained by the variables included in these two models.

12. Summary of Results

The results from this study provide sufficient evidence to reject the null hypothesis that there is no difference in the mean calcium intakes of athletes participating in an aesthetic sport (gymnastics) or non-aesthetic sport (speed skating). The 2x2 ANOVA (Gender X Sport) showed that averaged over gender, there was a significant main effect of sport on total dietary calcium intake, indicating that the skaters had a significantly higher intake of calcium than the gymnasts. However, there was no significant interaction effect of gender and sport, meaning that the differences between the two sports for calcium intake were similar for both genders.

The analyses also showed that there was a significant main effect of gender on the dieting sub-scale scores, meaning that the female athletes scored significantly higher than the male athletes on the scale. Although gender differences existed, neither the male nor female athletes had mean scores suggestive of disturbed eating behaviours. The univariate correlational analysis and the MRA showed that there was no relationship between the dieting sub-scale scores and total dietary calcium intake for any of the groups of athletes.

The MRA showed that for all athletes combined, sport and the social reinforcement variable had a weak but significant influence on total dietary calcium intake. When the athletes were divided by gender and the MRA re-examined, for male athletes combined, the differential association variable had a weak but significant influence on total dietary calcium intake. However, none of the variables from the Traditional Model explained a significant amount of variance in total dietary calcium intake for the male athletes. Similarly, when the male athletes were divided by sport, none of the variables from the Social or Traditional Models could significantly predict calcium intake. For female athletes, sport and the modelling behaviour variable had a weak but significant predictive power for the dependent variable. When the female athletes were divided by sport, different relationships emerged. For the female skaters, only the differential association variable entered the equation and was able to explain 21% of the variance in total dietary calcium intake. For the female gymnasts, only the non-social reinforcement variable entered the MRA equation, explaining 18% of the variance in total dietary calcium intake. Based on the MRA, the other variables from the Traditional (age, weight, gender, %BF) and Social Models (lifestyle, dieting behaviour) were not able to significantly explain variance in the dependent variable, total dietary calcium intake, in any of the athlete groups.

V. DISCUSSION

The purpose of this study was to assess the calcium intakes of adolescent athletes and to examine factors that may influence milk and therefore calcium intakes in these youths. Adolescent athletes of both genders who participated in either an aesthetic sport (gymnastics) or a non-aesthetic sport (speed skating) took part in the study. In this chapter, estimated dietary calcium intakes and factors that may influence calcium intake in this population are discussed separately. This is followed by a discussion of the best predictors of calcium intake comparing variables from the Traditional and Social Models. Finally, a conclusion and recommendations for future research are provided.

1. Estimated Dietary Calcium Intake

Inadequate calcium intakes compared to the RDA have been reported elsewhere particularly for normally-active female adolescents (Guenther, 1986) and adolescent female athletes who participate in either aesthetic or non-aesthetic sports (Moffatt, 1986; Perron and Endres, 1986; Rucinski, 1989; Chen et al., 1989; Benson et al., 1990). The interpretation of the severity of this problem is complicated by the differences of opinion among countries as to the recommended intakes for calcium during adolescence. In the present study, the mean estimated dietary calcium intake exceeded the RNI for gymnasts (1456 ± 984 mg and 1005 ± 534 mg) and skaters (1681 ± 931 mg and 1527 ± 750 mg) male and female athletes respectively. However, in Canada, the recommended intakes of calcium for adolescents, which range from 700 mg to 1100 mg for various age/sex groupings, are lower than the recommended intake of calcium for American teenagers of 1200 mg per day. Thus, athletes meeting the RNI for Canada may have intakes that would be considered sub-optimal by another country's standards. A recent study by Johnston et al. (1992), has provided further evidence in support of increasing the recommended intake of calcium during childhood and early adolescence. The researchers found that the RDA for calcium in the United States was insufficient to maximize bone mineral density especially in the normally-active prepubescent youths. However, optimal calcium intake to maximize peak bone mass has not yet been established for the adolescent population since Johnston et al. (1992) examined the effects of only two levels of calcium intake, approximately 900 mg and 1600 mg per day, on bone mineral density. Thus, whether similar increases in bone mineral density could have been achieved at calcium intakes below 1600 mg remains unknown, as does the converse, whether further increases in bone mineral density could be achieved with calcium intakes greater than 1600 mg per day. Finally, it is not yet known whether the increases in bone mineral density that occurred at higher calcium intakes will persist over time.

It has been suggested that, as a group, athletes who participate in sports which place a greater emphasis on leanness may be at greater risk for developing disturbed eating habits (Borgen and Corbin, 1987; Rosen and Hough, 1988; Davis and Cowles, 1989) and therefore nutrient inadequacies. In the present study, sport differences in mean calcium intakes were found with the skaters having higher intakes of total dietary calcium than the gymnasts, which appears to support the above hypothesis. As mentioned previously, although as a group the skaters had higher dietary calcium intakes than the gymnasts, all groups of athletes exceeded the RNI for the nutrient.

Moreover, as will be discussed further, no differences in dieting sub-scale scores were detected between sports, suggesting that the observed differences in calcium intake were not mediated by a greater tendency toward disturbed eating habits in the gymnasts.

To investigate where the differences existed between the two sports for calcium intake, differences in estimated dietary calcium from fluid milk, other dairy products and non-dairy products were assessed. The results showed that the difference in total dietary calcium intake between the sports was due to the skaters consuming more fluid milk than the gymnasts. Otherwise, all groups of athletes had similar calcium intakes provided from other dairy food sources and non-dairy food sources.

It has been suggested that American teenagers may be replacing their milk intake with soda, since a negative correlation between calcium intake and soda consumption was reported by Guenther (1986). This is a potential health problem for two reasons; first, the adolescents may be consuming inadequate amounts of calcium as a result of increased soda consumption and secondly, the high phosphorus content of soft drinks may limit calcium absorption and alter the calcium/phosphorus ratio which may contribute to the increased risk of bone fractures in later life (Wyshak et al., 1989; Gong and Spear, 1988). However, in the present study on adolescent athletes, no such relationship between total dietary calcium intake and soda consumption was established. There were no significant correlations (positive or negative) between total dietary calcium and soda intake when the analyses were conducted on all athletes together, nor when the athletes were divided by gender and then by sport. Therefore, for the athletes in this study, these results demonstrate that the youths were not replacing their milk intake and therefore calcium intake with soda.

2. Factors Influencing Eating Behaviour

A) Dieting Sub-Scale Score

There is controversy in the literature as to whether athletes who participate in aesthetic sports are more prone to tendencies toward disturbed eating behaviours than those who participate in non-aesthetic sports (Rosen et al., 1986; Benson et al., 1990). In fact, in the study by Benson et al. (1990) on female adolescent athletes, the swimmers scored higher on the body dissatisfaction sub-scale of the Eating Disorders Inventory test than either the gymnasts or the controls. In the present study, however, the results showed that in both the aesthetic and non-aesthetic sports, male athletes scored lower than the female athletes. Thus, for these adolescent athletes, the type of sport they participated in did not influence their dieting sub-scale scores.

Although gender differences were evident in this study, neither the mean scores of the male nor female athletes were suggestive of pathogenic tendencies toward avoidance of fattening foods and shape preoccupation for the groups as a whole. However, 21% of the female athletes and eight percent of the male athletes had dieting sub-scale scores suggestive of tendencies towards disturbed eating behaviours. When the dieting sub-scale scores were examined by gender and sport, all groups showed a similar proportion of athletes with scores suggestive of disturbed eating behaviour. The results from the present study suggest that the differences in tendencies towards disturbed eating behaviours may be a result of gender differences, not type of sport.

In 1989, Rucinski reported gender differences in the EAT scores for figure skaters with the female skaters scoring significantly higher than the male skaters. Forty-eight percent of the female figure skaters and none of the male skaters had scores that were suggestive of anorexic behaviour, suggesting that gender differences exist for tendencies towards pathogenic weight control behaviours for athletes competing in aesthetic sports. While the results of the present study support this concept of gender differences in tendencies towards disturbed eating behaviours in aesthetic sports, it should be noted that similar gender differences were found for the athletes participating in a non-aesthetic sport.

It has been reported that dieting sub-scale scores increase significantly with age in normally active female adolescents (Wood et al., 1992). However, the reported increase in mean scores with age resulted in the sixteen year old females scoring approximately one point higher than those females twelve years of age on the dieting sub-scale. There were no significant increases seen in the scores as a result of age for the other sub-scales of the EAT (Wood et al., 1992). While the mean age of the female athletes in Rucinski's study (1989) was approximately three years older than the age of the gymnasts in the present study, the age difference is not able to explain the differences between the two groups of athletes for tendencies towards disturbed eating behaviours (48% in Rucinski's skaters verses 21% of gymnasts in the present study). Thus, maturation could not account for the entire difference between the female gymnasts and the female figure skaters for tendencies towards disturbed eating behaviours.

When comparing the competitive level of the athletes participating in the two studies, the athletes in Rucinski's study (1989) were all national calibre figure skaters.

However, while some gymnasts in the present study competed at national and international competitions, clearly, not all athletes were national calibre athletes. Therefore, it is possible that the difference between the two studies for tendencies towards disturbed eating behaviours may have resulted from the figure skaters in Rucinski's study experiencing greater pressures to strive for leanness because of increased performance expectations. Thus, increased performance expectations may have predisposed the figure skaters to greater tendencies towards disturbed eating behaviours and nutrient inadequacies than the gymnasts. To investigate this hypothesis in the present study, the dieting sub-scale scores of athletes competing at a national or international level were compared to those who participated only at a provincial level. The t-test showed that the athletes who competed at the higher level scored significantly higher on the dieting sub-scale (6.3 ± 5.3, $n = 33$) than the provincial level athletes (2.4 ± 1.7, $n = 18$). However, neither group had mean scores that were suggestive of tendencies towards disturbed eating behaviour.

When the univariate relationship between total dietary calcium intake and the dieting sub-scale score was examined for all athletes combined, and then re-examined when the athletes were divided by gender and then by sport, no significant linear relationships were found. These results suggest that there were no linear relationships between total dietary calcium intake and tendencies towards disturbed eating behaviours for any of the groups of athletes in this study.

B) Social Model Variables

Lewis et al. (1989) have identified social variables which have been shown to have an indirect and direct influence on beverage selection behaviour in adults. For selection of milk, these variables were differential association, social and non-social reinforcement, nutrition knowledge, attitude, commitment and behaviour modelling. In the present study, similar social variables were studied, however, overall the variables were shown to have a weak association with total dietary calcium intake and the strength of association varied among different groups of athletes.

The Social Model variables were first examined for differences between the groups of athletes on the basis of gender and sport. Main effects were seen in the dieting sub-scale scores and the social reinforcement scores. The influence of gender on dieting sub-scale scores has been discussed above, and therefore, will not be discussed in this section. The results of the ANOVA for the social reinforcement variable indicated that the gymnasts exhibited stronger disagreement to the statements that the consumption of milk evoked positive feelings and a sense of belonging to a group than the skaters. These sport differences in the social reinforcement variable were similar for both genders. When the univariate correlation between dietary calcium intake and the social reinforcement variable was examined, a weak but significant positive relationship was found. However, when the athletes were divided by gender and sport, the strength of the correlation increased for female athletes combined and female skaters. Thus, despite the general disagreement of the athletes that the consumption of milk evoked positive feelings and a sense of belonging to a group, for female athletes combined and for female skaters, there was a weak but positive relationship between these positive feelings and calcium intake. This relationship, however, was not seen in the other groups of athletes.

When the other independent variables from the Social Model were examined for sport and gender differences, the results showed that, on average, all groups of athletes had similar scores for these variables. However, it became apparent that the relationships between these social variables and calcium intake varied greatly among the groups of athletes. For example, there was a weak but significant correlation between the modelling behaviour variable and calcium intake for all athletes combined. However, when the athletes were divided by gender and sport, the relationships that emerged were very different between the groups of athletes, with a stronger relationship between the modelling behaviour variable and dietary calcium intake for female gymnasts, while no such relationship was seen for the other groups of athletes. Other linear correlational analyses helped to confirm that despite the similar mean scores between the groups for most variables, linear univariate relationships of the independent variables with total dietary calcium intake varied greatly among the groups of athletes. In addition, the relationships between the independent variables and total dietary calcium intake were often strengthened when the athletes were divided by gender and sport. Overall, the univariate correlational analyses suggest that sport and gender differences existed for the relationships between the independent variables of the Social Model and total dietary calcium intake.

C) Traditional Model Variables

Univariate correlational analyses with total dietary calcium intake could not be conducted on all variables of the Traditional Model because it is not possible to conduct correlational analysis on categorical data. Therefore, only age, weight and %BF were analyzed for linear univariate relationships with total dietary calcium intake. Weight had a significant relationship with the dependent variable for all athletes combined. When the athletes were divided by gender, weight and %BF were significantly correlated with total dietary calcium intake for all female athletes, while for male athletes, no such relationships were seen for the Traditional variables. When the athletes were further divided by sport, the relationships no longer existed. Therefore, weight and %BF may be highly correlated with the type of sport.

3. Multiple Regression Analysis

The results of the MRA confirm what the univariate analyses suggested; namely, that there is great variation in the ability of the independent variables to predict total dietary calcium intake among the different groups of athletes. When all athletes were analyzed together, variables from neither the Social nor Traditional Models were powerful predictors of total dietary calcium intake. In addition, when the athletes were divided by gender and sport, different social variables entered the regression equations for each group. For example, the social reinforcement variable was a weak but significant predictor for all athletes; however, it was not a predictor when the athletes were divided by gender and sport. Although some of the social variables were inter-correlated, they were not highly inter-correlated, therefore, this should not have been the cause of the variation of predictive variables for total dietary calcium intake among the groups of athletes. Rather, it may be that the influence of the social variables on the dependent variables differed among the groups of athletes.

Lewis et al. (1989) set an *a priori* level for the Social and Traditional Models. The researchers felt that the Models must be able to explain 35% of the variance in the frequency of beverage selection to be useful. In addition, the researchers used a different approach than the present study for data analysis. Forced entry of the variables was used for the multiple regression analysis, and therefore, did not investigate which independent variable(s) from each model best predicted beverage consumption. By Lewis's standards, however, none of the variables in the present study, whether Social or Traditional, were able to explain 35% of the variance in total dietary calcium intake.

The ability of the Models as a whole to explain variance in total dietary calcium intake could not be directly compared to that found by Lewis et al. (1989) since the variables in the Models differed between the studies. For example, Lewis et al. (1989) included nutrition knowledge as a variable in the Traditional Model. This variable was not included in the present study because of the difficulty of constructing a knowledge test appropriate for athletes 12 to 18 years of age. Moreover, previous research generally does not support a major role for nutrition knowledge as a positive factor influencing adolescents' food intakes (Schwartz, 1975; Douglas, 1984; White and Skinner, 1988; Byrd-Bredbenner et al., 1988). As previously mentioned, the ability of the individual variables to predict beverage consumption using MRA was not analyzed by Lewis et al. (1989), so the predictability of the independent variables on the dependent variables cannot be compared between the two studies.

In the present study, when the athletes were divided by gender and the MRA re-examined, different variables entered the predictive equations. For all male athletes combined, only the differential association variable from the Social Model was able to predict total dietary calcium intake, explaining only nine percent of the variance in total dietary calcium intake. When the male athletes were further divided by sport, none of the variables from either the Social or Traditional Models were able to predict the dependent variable. Thus, the results of this study suggest that although in general male athletes enjoyed the taste of dairy products, felt that their social environment promoted the consumption of milk and had the opportunity to witness people they admire consuming milk frequently, none of these had an impact on their total dietary calcium intake. Therefore, these models were not useful for predicting total dietary calcium intake in adolescent male athletes, suggesting gender differences exist for factors that influence calcium intake in adolescent athletes.

These findings for male athletes are not necessarily surprising. Adolescence is a time of rapid growth and development which increases energy and nutrient needs. These needs are further escalated by the demands of training. Since increased nutrient needs are followed by a natural increase in appetite, it is possible that the physiological need for food dominates any possible social influences. It has been reported elsewhere that the nutritional adequacy of male adolescent athletes may be attributed to a high food consumption rather than careful food selection practices on the part of the athletes (Douglas, 1984). While both groups of male athletes in the present study had mean calcium intakes which exceeded the RNI, it cannot be discerned whether these findings reflect a general pattern of intentional healthy food choices or rather occurred inadvertently due to a high food intake.

For female athletes, sport itself was a significant predictor of total dietary calcium intake. For example, in the Traditional Model, sport increased in predictive power once the effects of gender were controlled. Since the same relationship was not seen in the male athletes, including them in the initial analysis reduced the predictive power of sport in the female athletes. It is difficult to determine why sport was a significant predictor of total dietary calcium intake for the female athletes. The ANOVAs showed that the skaters consumed more total dietary calcium than the gymnasts primarily in the form of fluid milk. The skaters were taller and heavier than the gymnasts which could explain the difference in intake since larger people generally eat more. However, sport entered the regression equations and weight did not, thus, sport had a higher partial correlation with total calcium intake than weight. When the female athletes were further divided by sport, thus in effect controlling for gender and sport in the MRA, none of the traditional variables enter into the predictive equation. Accordingly, for the traditional variables, only sport had weak but significant power for predicting total dietary calcium intake.

In the Social Model, the modelling behaviour variable was the only variable that could significantly predict total dietary calcium intake for all female athletes combined. However, the predictive power was weak and inferior to that of sport in the Traditional Model. When the athletes were divided by sport and the analysis re-run, different predictive equations were generated. For the female skaters, the differential association variable could significantly predict total dietary calcium intake. It was the only variable that entered the equation, and although the predictive power increased relatively, it was still a weak predictor of total dietary calcium intake. For female gymnasts, a different equation was generated. The non-social reinforcement variable entered the equation, explaining 18% of the variance in the dependent variable. The results of the MRA indicate that although only a weak association was found, factors that influence total dietary calcium intake varied between the two groups of female athletes.

In 1988, Contento et al. conducted a study to examine factors that influence food choices of adolescents and found that, in fact, great variation existed between adolescents in terms of influential forces on food selection behaviour. The researchers were able to identify five sub-groups within an adolescent population (n = 355) on the basis of their food choice motivations. For the food attributes studied, each sub-group's food selections were influenced to a different extent by the various attributes with some attributes exerting stronger influences and other factors exerting no influences. This study supports the findings of the present study that different sub-groups may be influenced by different components of their social environment.

It is difficult to determine why differential association and non-social reinforcement (taste) were weak yet significant predictors of total dietary calcium intake for the female skaters and female gymnasts, respectively. All groups of athletes had similar scores for both variables as shown by ANOVA. For differential association, all athletes agreed to a similar extent that they perceived that their social environment was supportive of the consumption of milk. For the female skaters, however, those who had stronger agreement with the statements had higher calcium intakes as well as the converse, those who agreed to a lesser extent or even disagreed with the statements, had lower calcium intakes. The differential association variable was a mean score derived by averaging the scores from all sub-scales, friends, family, health experts and media. Thus, it is not possible to determine whether some groups of the social environment exerted stronger influences on the dependent variable than other social environmental groups. In addition, it is possible that the sub-groups of the social environment exerted different influences on various athletes within a sub-population, thereby, diluting the association of the differential association variable with total dietary calcium intake. Unfortunately, for the previously discussed reasons, it is not possible to analyze the association of each social environmental sub-scale with calcium intake.

As for the female gymnasts, taste may have had the strongest association with the dependent variable because female gymnasts likely had lower energy requirements than the other groups of athletes in the study because of their smaller body size and the lower energy expenditure related to their sport. Thus, it is reasonable to speculate that the taste of food would be a strong predictor of food consumption since if food consumption is more limited for this group in order to maintain energy balance, it is reasonable that the athletes would want to consume foods that tasted good to them.

In the relative context of this study, variables from the Social Model were only able to explain 18% and 21% of the variance in total dietary calcium intake in the sub-groups of female athletes, while the Traditional variable, sport, explained 15% of the variance in the dependent variable for all female athletes combined. If strategies were developed to improve calcium intake using the social variables identified in this study, based on an 18% and 21% explained variance, the athletes' calcium intakes could be improved by approximately 210 mg and 320 mg of calcium per day for female gymnasts and skaters respectively. While such an improvement would seem significant, different strategies would need to be developed for each sub-group of athletes since differential association was associated with the skaters' intakes and taste of the dairy products was associated with the female gymnasts' intakes. Moreover, since on average the athletes exceeded the RNI for calcium, the merit of developing group strategies to improve calcium intake could be questioned.

Since variables from neither the Social nor Traditional Models were shown to be good predictors of total dietary calcium intake, the question becomes what does predict food selection behaviour in adolescent athletes? From the literature reviewed, no specific studies have empirically examined motives behind food selection in this population. A variety of assumptions/hypotheses about factors that influence food selection in adolescents athletes have been proposed, however, they do not appear to be supported by empirical evidence. For example, there is some literature that addresses the issue of who adolescent athletes consider as their best sources for nutrition information (Douglas, 1984), where the athletes cited parents as the best source and coaches to a lesser extent. However, the athletes were high school calibre and the influence of the nutrition information sources on food selection practices was not assessed. Another study suggested that parents, friends, peers and coaches influence female adolescent swimmers' perceptions about weight (Drummer et al., 1987), however, the association between these external influences and food selection behaviour was not examined. The importance of role models has been implicated in modifying food selection behaviour (Rush, 1990), however, once again this hypothesis was not supported by research findings. The assumption that "peers have a strong influence on food selection habits" has also been used frequently in the literature, however, there is insubstantial evidence to support or contradict this hypothesis. Regardless, peer influence has somehow been advocated as an influential factor on food selection behaviour (Carruth and Skinner, 1988).

In terms of nutrition education strategies, the recurrent findings of the inability of nutrition education programs (particularly knowledge based) to demonstrate a change in food practices (Schwartz, 1975; Douglas, 1984; White and Skinner, 1988) has not deterred the recommendation of providing nutrition education for athletes to resolve the problem of inadequate nutrient intakes (Moffatt, 1984; Chen et al., 1989; Berning et al., 1991). It appears that the lack of information regarding factors that influence food selection behaviour in adolescent athletes has perpetuated the use of unsubstantiated assumptions for structuring nutrition education programs and explaining food practices.

4. Conclusion and Recommendations for Future Research

In general, all groups of athletes met their RNI for calcium intake, suggesting that calcium is not a nutrient of concern for the adolescent athletes in this study using Canadian standards. The results also indicated that, based on the mean scores from the dieting sub-scale, none of the groups of athletes exhibited tendencies towards disturbed eating behaviours. Accordingly, the athletes who participated in the aesthetic sport were not more prone to disturbed eating behaviour than those athletes who participated in the non-aesthetic sport even though they were considerably leaner.

Overall, the MRA demonstrated that variables from neither the Traditional nor Social Models were strong predictors of total dietary calcium intake. While some athletes did have low calcium intakes, none of the variables in the Social or Traditional Models could explain these low intakes. Thus, overall, in contrast to Lewis et al. (1989), social learning variables were not useful in predicting dietary calcium intakes in adolescent athletes.

The reasons why the social variables were not useful in predicting total dietary calcium intake in adolescent athletes can only be speculated. For the male athletes, it is possible that the strongest influence on food selection behaviour is the physiological need for food to support the rapid growth and development which occurs during adolescence. For female athletes, some of the social variables did have a weak but significant association with total dietary calcium intake suggesting that factors that influence the dependent variable vary between the athletic groups. In addition to the previously cited possibilities why the Social variables were not good predictors of total dietary calcium intake; namely, diversity of social influences within the sub-groups of athletes, other methodological difficulties may have contributed to the weak findings of this study. For example, the number of subjects included in the MRA for all athletes combined and when the athletes were separated by gender, was adequate for the number of independent variables. However, because separate variables affected the sub-groups differently, the relationships may have been masked in the analyses that included both genders and both sports. It is also possible that by separating the athletes into four groups by gender and sport, power was lost. The number of subjects per group may have been too small to allow the independent variable(s) to be strong predictors of total dietary calcium intake since calcium intake itself is so highly variable. However, it should be noted that the practical utility of the social learning variables is likely to be very limited since they were not obvious predictors of total dietary calcium intake for the athletes as a group.

It is also possible that the instruments used to assess social influences were not truly reflective of the athletes' social environments. For example, the modelling behaviour scale may have gathered different results if the models were more meaningful to an athletic population, such as including "the World Champion for your sport" as a model. The differential association scale may have been more reflective of the athletes' social environment if "coach" was added to the scale. It is possible that the social environment of normally active adolescents differs from the social environment of adolescent athletes. Therefore, the problem of identifying variables which predict food selection behaviour across situations remains unsolved for adolescent athletes.

Finally, there appear to be some serious gaps in the literature regarding the nutritional intakes and practices of adolescents and especially adolescent athletes. Further research is required to establish optimal calcium intakes which maximize bone health for both normally active and athletic adolescents. In addition, there is a lack of information on factors that influence food selection in these youths. Identifying factors which influence food selection is complicated by the recurrent assumptions found in the literature about adolescents which are not supported or contradicted by research (Carruth and Skinner, 1988). Thus, the challenge remains to develop a tool to identify the influences on food selection behaviour, to accept that great variation exists within this population in terms of influences on food selection behaviour and to use this information to develop effective education strategies for the appropriate sub-groups of adolescents and adolescent athletes to improve nutrition practices if required.

REFERENCES

Akers RL, Krohn MD, Lanza-Kaduce L, Rodosevich M. Social learning and deviant behavior: a specific test of a general theory. Am Soc Rev 1979;44:636-655.

American Dietetic Association. Position of the American Dietetic Association: Nutrition education for the public. J Am Diet Assoc 1990;90:107-110.

Anderson JJB. Dietary calcium and bone mass through the life cycle. Nutr Today 1990;25:9-14.

Angus RM, Sambrook PN, Pocock NA, Eisman JA. A simple method for assessing calcium intake in caucasian women. J Am Diet Assoc 1989;89:209-214.

Bachrach LK, Guido D, Katzman D, Litt IF, Marcus R. Decreased bone density in adolescent girls with anorexia nervosa. Pediatrics 1990;86:440-447.

Bailey DA, Martin AD, Houston CS, Howie JC. Physical activity, nutrition, bone density and osteoporosis. Austr J Sci Med Sport 1986;18:3-8.

Bandini LG and Dietz WH. Assessment of body fatness in childhood and obesity: evaluation of laboratory and anthropometric techniques. J Am Diet Assoc 1987;87:1344-1348.

Barr SI. Relationship of eating attitudes to anthropometric variables and dietary intakes of female collegiate swimmers. J Am Diet Assoc 1991;91:976-977.

Barr SI and Pare S. Development and validation of a food frequency questionnaire for estimation of adolescents' calcium intake. (Abstract) J Can Diet Assoc 1992;53:236.

Benson JE, Allemann Y, Theintz GE, Howald H. Eating problems and calorie intake levels in Swiss adolescent athletes. Int J Sports Med 1990;11:249-252.

Bergman EA, Boyungs JC, Erickson ML. Comparison of a food frequency questionnaire and a 3 day diet record. Am Diet Assoc 1990;90:1431-1433.

Berning JR, Troup JP, Van Handel PJ, Daniels J, Daniels N. The nutritional habits of young swimmers. Int J Sport Nutr 1991;1:240-248.

Block G. A review of validation of dietary assessment methods. Am J Epidemiol 1982;115:492-505.

Block G and Hartman AM. Issues in reproducibility and validity of dietary studies. Am J Clin Nutr 1989;50:1133-1138.

Borgen JS and Corbin CB. Eating disorders among female athletes. Phys Sportsmed 1987;15(2):89-95.

Button EJ and Whitehouse A. Subclinical anorexia nervosa. Psychological Med 1981;11:509-516.

Byrd-Bredbenner C, Shannon B, Hsu L, Smith DH. A nutrition education curriculum for senior high home economics students: its effect an students' knowledge, attitudes, and behaviors. J Nutr Educ 1988;20:341-346.

Carruth BR and Skinner JD. What do we know and what should we know about nutrition education for adolescents? J Nutr Educ 1988;20:271-272.

Chen JD, Wang JF, Zhao YW, Wang SW, Jiao Y, Hou XY. Nutritional problems and measures in elite and amateur athletes. Am J Clin Nutr 1989;49:1084-1089.

Clark N, Nelson M, Evans W. Nutrition education for elite female runners. Phys Sports Med 1988;16(2):124-136.

Committee on Sports Medicine, the American Academy of Pediatrics. Amenorrhea in adolescent athletes. Pediatrics 1989;84:394-395.

Contento IR, Michela JL, Goldberg CJ. Food choices among adolescents: population segmentation by motivations. J Nutr Educ 1988;20:289-298.

Cronbach L. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16:297-334.

Cummings SR, Block G, McHenry K, Baron RB. Evaluation of two food frequency methods of measuring dietary calcium intake. Am J Epidemiol 1987;126:796-802.

Davis C and Cowles M. A comparison of weight and diet concerns and personality factors among female athletes and non-athletes. J Psychosomat Res 1989;33:527-536.

Dawson-Hughes B, Dallal GE, Krall EA, Sadowski L, Sahyoun N, Tannenbaum S. A controlled trial of the effect of calcium supplementation on bone density in postmenopausal women. N Engl J Med 1990;323:878-883.

Deurenberg P, Kusters CLS, Smit HE. Assessment of body composition by bioelectrical impedance in children and young adults is strongly age-dependent. European J Clin Nutr 1990a;44:261-268.

Deurenberg P, Pieters JJ, Hautvast JG. The assessment of the body fat percentage by skinfold thickness measurements in childhood and young adolescence. Br J Nutr 1990b; 63:293-303.

Douglas PO. Nutrition knowledge and food practices of high school athletes. J Am Diet Assoc 1984;84:1198-1202.

Drummer GM, Rosen LW, Heusner WW, Roberts PJ, Counsilman JE. Pathogenic weight-control behaviors of young competitive swimmers. Phys Sportsmed 1987;15(5):75-84.

Durnin JVGA and Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. Br J Nutr 1974;32:77-97.

Enns MP, Drewnowski A, Grinker JA. Body composition, body size estimation and attitudes towards eating in male college athletes. Psychosomatic Med 1987;49:56-64.

Evans RA. Calcium and osteoporosis. Med J Austr 1990;152:431-433.

Falls HB and Humphrey LD. Body type and composition differences between placers and non-placers in an AIAW gymnastics meet. Res Q 1978;49:38-43.

Faria IE and Faria EW. Relationship of the anthropometric and physical characteristics of male junior gymnasts to performance. J Sports Med Phys Fitness 1989;29:369-378.

Food and Nutrition Board. Recommended Dietary Allowances. 10th ed. Washington, D.C.:National Academy of Sciences, 1989.

Forbes GB. Human body composition growth, aging, nutrition and activity. New York, Springer-Verlag, 1987.

Forsyth HL and Sinning WE. The anthropometric estimation of body density and lean body weight of male athletes. Med Sci Sports 1973;5:174-180.

Garner DM and Garfinkel PE. The eating attitudes test: an index of the symptoms of anorexia nervosa. Psychological Med 1979;9:273-279.

Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlations. Psychological Med 1982;12:817-878.

Gibson RS. Principles of nutritional assessment. New York: Oxford University Press, 1990.

Gong EJ and Spear BA. Adolescent growth and development: implications for nutritional needs. J Nutr Educ 1988;20:273-279.

Guenther PM. Beverages in the diets of American teenagers. J Am Diet Assoc 1986;86:493-499.

Harrison GG, Buskirk ER, Carter JE, Johnston FE Lohman TG, Pollock ML, Roche AF, Wilmore J. Skinfold thickness and measurement technique. In Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Champaign IL. Human Kinetics Books, 1988, pp55-68.

Health and Welfare Canada. Canadian Nutrient File. Ottawa: Bureau of Nutritional Sciences, 1982.

Health and Welfare Canada. Nutrition Recommendations. The Report of the Scientific Review Committee. Ottawa: Supply and Services Canada, 1990.

Hergenroeder AC and Klish WJ. Body composition in adolescent athletes. Pediatric Clinics North America 1990;37:1057-1083.

Highet R. Athletic amenorrhoea: an update on aetiology, complications and management. Sports Med 1989;7:82-108.

Jackson AS, Pollock ML, Ward A. Generalized equations for predicting body density of women. Med Sci Sports Exerc 1980;12:175-182.

Johnson DW and Johnson RT. Nutrition education: a model for effectiveness, a synthesis of research. J Nutr Educ 1985;17:S1-S44.

Johnston CC, Miller JZ, Slemenda CW, Reister TK, Hui S, Christian JC, Peacock M. Calcium supplementation and increases in bone mineral density in children. N Engl J Med 1992;327:82-87.

Kreipe RE and Forbes GB. Osteoporosis: A new morbidity for dieting female adolescents? Pediatrics 1990;86:478-480.

Krondl M and Lau D. Social determinants on human food selection. In Barker LM. (ed) Psychobiology of Human Food Selection. Westport, CT:AVI Publishing Co. Inc., 1982, p139-151.

Lewis CJ. Use of a social learning model to predict frequency of four food consumption behaviors, a thesis in nutrition. Pennsylvania State University, 1986.

Lewis CJ, Sims LS, Shannon B. Examination of specific nutritional health behaviors using a social cognitive model. J Am Diet Assoc 1989;89:194-202.

Lohman TG. Applicability of body composition techniques and constants for children and youths. Exerc Sport Sci Review 1986;14:325-357.

Lohman TG, Boileau RA, Slaughter MH. Body composition in children and youths. In Boileau RA (ed), Advances in Pediatric Sport Sciences. Champaign, IL: Human Kinetics, 1984, p29-57.

Margetts BM, Cade JE, Osmond C. Comparison of a food frequency questionnaire with a diet record. Int J Epidemiol 1989;18:868-873.

Matkovic V. Diet, genetics and peak bone mass of adolescent girls. Nutr Today 1991;26:21-24.

Matkovic V, Fontana D, Tominac C, Goel P, Chestnut CH. Factors that influence peak bone mass formation: a study of calcium balance and the inheritance of bone mass in adolescent females. Am J Clin Nutr 1990;52:878-888.

Matkovic V, Kostial K, Simonovic I, Buzina R, Brodarec A, Nordin BEC. Bone status and fracture rates in two regions of Yugoslavia. Am J Clin Nutr 1979;32:540-549.

Moffatt RJ. Dietary status of elite female high school gymnasts: inadequacy of vitamin and mineral intake. J Am Diet Assoc 1986;85:1361-1363.

Olson CM and Gillespie AH. Proceedings of the workshop on nutrition education research, applying principles from the behavioral sciences. J Nutr Educ 1981;13 Suppl 1:S1.

Olson CM and Leitch Kelley G. The challenge of implementing theory-based intervention research in nutrition education. J Nutr Educ 1989;21:280-284.

Perron M and Endres J. Knowledge, attitudes, and dietary practices of female athletes. J Am Diet Assoc 1985;85:573-576.

Raisz LG. Logical and systemic factors in the pathogenesis of osteoporosis. N Engl J Med 1988;318:797-803.

Ried IR. The role of dietary calcium in the pathogenesis and treatment of osteoporosis. NZ Med J 1989;102:532-533.

Riis B, Thomsen K, Christiansen C. Does calcium supplementation prevent postmenopausal bone loss? N Engl J Med 1987;316:173-177.

Rosen LW and Hough DO. Pathogenic weight-control behaviors of female college gymnasts. Phys Sportsmed 1988;16(9):141-144.

Rosen LW, McKeag DB, Hough DO, Curley V. Pathogenic weight-control behavior in female athletes. Phys Sportsmed 1986;14(1):79-86.

Rucinski A. Relationship of body image and dietary intake of competitive ice skaters. J Am Diet Assoc 1989;89:98-100.

Rush KL. The school nurse and sport nutrition for the adolescent athlete. J School Health 1990;60:425-427.

Sandler R, Slemenda CW, LaPorte RE, Cauley JA, Schramm MM, Barresi ML, Kriska AM. Postmenopausal bone density and milk consumption in childhood and adolescence. Am J Clin Nutr 1985;42:270-274.

Schwartz NE. Nutrition knowledge, attitudes, and practices of high school graduates. J Am Diet Assoc 1975;66:28-31.

Slaughter MH, Lohman TG, Boileau RA, Horswill CA, Stillman RJ, Van Loan MD, Bemben DA. Skinfold equations for estimation of body fatness in children and youth. Human Biol 1988;60:709-723.

Slaughter MH, Lohman TG, Boileau RA, Horswill CA, Wilmore JH. Influences of maturation of relationships of skinfolds to body density: a cross-sectional study. Hum Biol 1984;56:681-689.

Strickland DE. Social learning theory and deviant behavior: a specific test of a general theory- a comment and critique. Am Soc Rev 1982;47:162-173.

Stuff JE, Garza C, O'Brian Smith E, Nichols BL, Montandon CM. A comparison of dietary methods in nutritional studies. Am J Clin Nutr 1983;37:300-306.

Thorland WG, Johnson GO, Tharp GD, Fagot TG, Hammer RW. Validity of anthropometric equations for the estimation of body density in adolescent athletes. Med Sci Sport Exerc 1984;16:77-81.

Wardle J and Marshland L. Adolescent concerns about weight and eating: a social-developmental perspective. J Psychosomatic Res 1990;34:377-391.

Weststrate JA and Deurenberg P. Body composition in children: proposal for a method for calculating body fat percent from total-thickness measurements. Am J Clin Nutr 1989;50:1104-1115.

White AA and Skinner JD. Can goal setting as a component of nutrition education effect behaviour change among adolescents? J Nutr Educ 1988;20:327-335.

Willett WC, Reynolds RD, Cottrell-Hoehner S, Sampson L, Browne ML. Validation of a semi-quantitative food frequency questionnaire: comparison with a 1 year diet record. J Am Diet Assoc 1987;87:43-47.

Wilmore JH. Body composition in sport and exercise: directions for future research. Med Sci Sport Exerc 1983;15:21-31.

Wilmore J. Eating and weight disorders in the female athlete. Int J Sports Med 1991;1:104-117.

Wood A, Waller G, Miller J, Slade P. The development of eating attitude test scores in adolescence. Int J Eating Disorders 1992;11:279-282.

Wyshak G, Frisch RE, Albright TE, Albright NL, Schiff I, Witschi J. Nonalcholiolic carbonated beverage consumption and bone fractures among women former college athletes. J Orthopaedic Res 1989;7:91-99.

APPENDICES

Appendix A: Definition of Terms

1. Athlete: an individual competing at a provincial level or higher in a selected organized sport. They are members of a provincial sporting organization.

2. Adolescent: an individual within the chronological age range of 12 to 18 years.

3. Nutrient Insufficiency/Inadequacy: failure to meet the RNI or RDA. Clearly, not all individuals with an intake of less than the RNI/RDA will be failing to meet their individual requirements; however, the probability of an individual's intake being inadequate increases as their intake falls below the RNI/RDA.

4. Aesthetic sports: Sports which include aesthetics in performance scores. In this study gymnastics represents the aesthetic sports.

5. Non-aesthetic sports: Sports that have quantitative performance results such as fastest times and most points scored. In this study speed skating represents the non-aesthetic sports.

6. Differential Association: a group of environmental factors which influence food selection. These factors have been operationalized by Lewis (1986):

a) Family: use of and feelings about a given food;

b) Friends: use of and feelings about a given food;

c) Experts: perception of health experts' recommendations concerning a given food;

d) Media: perceptions of entertainment/persuasive quality of television advertising for a given food;

e) Lifestyle: degree to which breakfast, lunch, and supper are eaten away from home. In the present study this factor was separated from differential association and considered a separate variable since it was defined as the percentage of meals and snacks eaten away from home.

7. Behaviour modelling: how often certain persons (models) are seen consuming a given food (Lewis, 1986).

8. Reinforcement as operationalized by Lewis (1986):

a) Social: perception of positive feelings as a function of consuming a given food;

b) Non-social: enjoyment of the taste of a given food.

Appendix B: Informed Consent Form, Ethics Approval Form and Questionnaire:

The University of British Columbia
Office of Research Services

B91-280

BEHAVIOURAL SCIENCES SCREENING COMMITTEE FOR RESEARCH AND OTHER STUDIES INVOLVING HUMAN SUBJECTS

C E R T I F I C A T E of A P P R O V A L

INVESTIGATOR:	Barr, S.I.
UBC DEPT:	Family & Nutr Sci
INSTITUTION:	Athletes' training ctr
TITLE:	Factors associated with calcium intake in adolescent athletes
NUMBER:	B91-280
CO-INVEST:	Webster, B.
APPROVED:	OCT 4 1991

The protocol describing the above-named project has been reviewed by the Committee and the experimental procedures were found to be acceptable on ethical grounds for research involving human subjects.

Dr. R.D. Spratley
Director, Research Services
and Acting Chairman

THIS CERTIFICATE OF APPROVAL IS VALID FOR THREE YEARS FROM THE ABOVE APPROVAL DATE PROVIDED THERE IS NO CHANGE IN THE EXPERIMENTAL PROCEDURES

THE UNIVERSITY OF BRITISH COLUMBIA

School of Family and
Nutritional Sciences
Division of Human Nutrition
2205 East Mall
Vancouver, B.C. Canada V6T 1W5

FOOD HABITS OF TEENAGE ATHLETES

Dear Athlete:

You are invited to participate in a nutrition study to help us learn more about the food habits of teenage athletes. Everyone knows that the teen years are important ones for building good nutrition habits to last a lifetime. However, the purpose of this study is to learn more about what teenage athletes think about their food and nutrition and about how their busy lives affect what they eat. We also know that body shape and size are important issue at this time, and we need to know more about how food habits are affected by these and other concerns.

Your participation in this study will be of great assistance in obtaining the information that is needed about teenage athletes' nutrition. We will need you to complete a questionnaire that will take approximately 30 minutes, for which there are no right or wrong answers to the questions.

Measurements of your height, weight and assessment of percent body fat, taking approximately 10 minutes, will also be required. Percent fat will be measured using skinfold measurements (calipers) and a new technique called bioelectrical impedance analysis (BIA). BIA is a non-invasive method of assessing body composition that requires the attachment of removable adhesive electrodes to your wrist and ankle. Both of these techniques are safe and do not cause any discomfort. All information will be kept completely confidential since only the investigators will see your results. You may request a copy of your own body composition results.

This study is being conducted by Brenda Webster, P. Dt. and Dr. Susan Barr of U.B.C.'s School of Family and Nutritional Sciences. If you have any questions regarding the study, you can contact Brenda Webster at (604) 736-6133 or Dr. Susan Barr at (604) 822-2502.

I________________________________ hereby voluntarily consent to participate in the nutrition study which includes completing a questionnaire and having my body fat measured by skinfolds (calipers) and BIA. I am aware that I may withdraw from the study at any time without jeopardy to participation in my sport. I have read and understood the contents of this form and acknowledge that I have received a copy of this consent form.

Signature of athlete ________________________________

Parental/Guardian consent if athlete is under 18 years of age:
I (check one) ______ consent to my child's participation in this study.

______ do not consent to my child's participation in this study.

________________________________ ________________
Signature of Parent/Guardian Date

FOOD HABITS OF TEENAGE ATHLETES

This study is being conducted by Brenda Webster a graduate student and Dr. Susan Barr of U.B.C.'s School of Family & Nutritional Sciences (Phone 604 228-2502), to learn more about food habits of teenage athletes. Everyone knows that the teen years are important ones for building good nutrition habits to last a lifetime. However, we need to know more about what teenage athletes think about their food and nutrition, and about how their busy lives and training affect what they eat. We also know that body size and shape are important issues for your sport, and need to know more about how food habits are affected by these and other concerns.

Your participation in this study will be of great assistance in obtaining the information that is needed about teenage athletes' nutrition. There are no right or wrong answers to the questions that follow - we simply want to know what your opinions are. Completing the questionnaire will require about 30 minutes of your time. The results are completely confidential since only the investigators will see the results.

If you complete the questionnaire, it will be assumed that you have agreed to participate in the study. If you have any questions at any time, please feel free to ask them. Participation is voluntary, and you are free to refuse to participate or withdraw at any time without affecting your participation in your sport.

Thank you in advance for your valuable opinions.

WHAT YOU EAT

For each meal or snack listed below, please fill in **how many times** you eat the meal or snack **per week**. In the second column, fill in how many times per week you eat that meal or snack **"out"** (at a restaurant or fast food place).

EXAMPLE: Eric eats breakfast on weekdays, but doesn't eat it on weekends. He never eats "out" for breakfast. He eats dinner every day, and eats this meal out with friends or family about twice a week.

	Times eaten/week	Times eaten "out"/week
Breakfast	5	0
Dinner	7	2

YOUR MEALS AND SNACKS

	Times eaten/week	Times eaten "out"/week
Breakfast	______	______
Morning snack	______	______
Lunch	______	______
Afternoon snack	______	______
Dinner	______	______
Evening Snack	______	______

Next, we'd like to know about some of the foods you eat. For each food listed on the next page, please fill in how often you usually eat a portion of the size stated. If you eat the food:

- **every day or more than once a day,** fill in how many times you have it **per day.**
- **less than once a day but more than once a week,** fill in the times **per week.**
- **less than once a week, but more than once a month,** fill in the times **per month.**
- **less often than once a month, or never eat it,** put an "X" under **"do not eat".**

EXAMPLE: Jason has a glass of orange juice every morning, along with two slices of white toast. He usually has two sandwiches on brown bread at lunch, and eats french fries about three times a week. He almost never eats cauliflower.

	Per day	Per week	Per month	Don't eat
Orange juice, 1 cup	1	___	___	___
French fries, regular serving.............	___	3	___	___
Cauliflower, 1/2 cup (125 ml)	___	___	___	X
Bread or toast, 1 slice				
white..	2	___	___	___
brown...............	4	___	___	___

NUMBER OF TIMES I EAT THE FOOD

	Per day	Per week	Per month	Don't eat
Bread or toast, 1 slice or 1 roll white..	___	___	___	___
brown	___	___	___	___
Muffin, 1 large.................................	___	___	___	___
Pizza, 1 medium slice.........................	___	___	___	___
Cheeseburger	___	___	___	___
Cheese - 1 slice processed OR 1 piece hard cheese (plain or in sandwich)	___	___	___	___
Broccoli, 1/2 cup (125 ml)..................	___	___	___	___
Gai-lan (Chinese broccoli), 1/2 cup	___	___	___	___
Bok-choi (Chinese cabbage), 1/2 cup	___	___	___	___
Ice cream (large scoop)	___	___	___	___
Frozen yogurt (large scoop)	___	___	___	___

	Per day	Per week	Per month	Don't eat
Fast food milkshake...........................	___	___	___	___
Cottage cheese, 1/2 cup (125 ml)	___	___	___	___
Yogurt, small (175 ml) carton or equivalent	___	___	___	___
Canned salmon or sardines with bones 1/2 small can..................................	___	___	___	___
Soft drink, regular, 1 can or large glass......................................	___	___	___	___
Soft drink, diet, 1 can or large glass......................................	___	___	___	___
Coffee or tea, 1 cup	___	___	___	___
Tofu, 2 oz (60 gm)............................	___	___	___	___
Milk on cereal..................................	___	___	___	___
Orange juice, 1 cup	___	___	___	___
Milk (any type including chocolate) 1 cup	___	___	___	___
Macaroni & cheese, 1 cup (250 ml)	___	___	___	___

I usually drink (choose one only)

___ homo (whole) milk OR

___ 2% milk OR

___ 1% milk OR

___ skim milk OR

___ chocolate milk

___ no milk

INFORMATION ABOUT YOU

Please fill in the following information about yourself.

1. **Age**: _____ Years

2. **Sex**: ______ Male
______ Female

FEMALES ONLY

3. Have you ever had a menstrual period? ___no
___yes

4. **If YES**, approximately how many menstrual cycles have you had in the past 12 months? ______cycles

MALES ONLY

5. Has the pitch of your voice changed? _____ no
_____ yes

6. Have you started to grow hair on your face? ______ no
______ yes

EVERYONE

7. **Racial Origin:** (check one or two)
______Caucasian (white)
______Oriental
______East Indian
______Black
______Native Canadian (Indian or Inuit)
______Other (specify:____________________)
______Don't know

8. Are you allergic to milk or dairy products?______ no
______ yes

9. Do you work at a paying job?
_____no (Go to question 10)
_____yes - If so, where do you work?
______fast food restaurant
______retail sales
______paper route or babysitting
______other (______________________)

- How many hours per week do you work?_____

10. What is your mother's job? ____________________________

11. What is your father's job? ____________________________

12. Do you use any vitamin/mineral pills **every day**? ______no
______yes

If yes, check all that you use every day:
______ multivitamin/mineral pill
______ vitamin C pill
______ iron pill
______ calcium pill
______ other ____________________

HOW YOU FEEL ABOUT EATING

In this section, we are interested in how you feel about eating various foods, and how you eat. For each of the following statements, put an X in the column that best describes how often you feel or act the way that is described in the statement.

EXAMPLE: Erica sometimes feels guilty after eating, and usually knows the calorie content of the foods she eats.

	Always	Very Often	Often	Sometimes	Rarely	Never
Feel extremely guilty after eating				X		
Aware of the calorie content of foods that I eat		X				

	Always	Very Often	Often	Sometimes	Rarely	Never
Am terrified about being overweight						
Aware of the calorie content of foods that I eat						
Particularly avoid foods with a high carbohydrate content (eg. bread, rice, potatoes, etc.)						
Feel extremely guilty after eating						
Am preoccupied (think a lot about) with a desire to be thinner						
Think about burning up calories when I exercise						
Am preoccupied (think a lot about) with the thought of having fat on my body						
Avoid foods with sugar in them						
Eat diet foods or drinks						
Feel uncomfortable after eating sweets						
Go on diets to lose weight						
Like my stomach to be empty						
Enjoy trying rich new foods						

YOUR THOUGHTS ABOUT MILK

Below are some statements about how milk might be a part of your life. For each statement, please place an "X" under the word or phrase which best describes how much you agree or disagree with the statement. Please respond to each statement.

EXAMPLE: Jennifer does not enjoy walking in the rain.

	STRONGLY AGREE	AGREE	UNSURE	DISAGREE	STRONGLY DISAGREE
I enjoy walking in the rain	___	___	___	X	___

	STRONGLY AGREE	AGREE	UNSURE	DISAGREE	STRONGLY DISAGREE
1. Most teens and adults in my family drink milk as part of a snack or with meals.	___	___	___	___	___
2. I have a lot of friends who drink milk	___	___	___	___	___
3. Advertisements for milk catch my attention.	___	___	___	___	___
4. My doctor recommends that I drink milk of some kind.	___	___	___	___	___
5. Drinking milk makes me feel part of a special group of people.	___	___	___	___	___
6. A meal with my friends usually doesn't include milk.	___	___	___	___	___
7. The advertisements I see for milk make me want to drink it	___	___	___	___	___
8. I often hear health experts recommend drinking milk	___	___	___	___	___
9. When I drink milk I feel I get approval from the people who matter to me	___	___	___	___	___
10. Very few adults in my family use milk on a regular basis	___	___	___	___	___
11. I hardly ever pay attention to advertisements for milk	___	___	___	___	___
12. I have heard nutritionists recommend that people of my age drink milk	___	___	___	___	___
13. My family feels that drinking milk is an important part of the diet for teens	___	___	___	___	___

	STRONGLY AGREE	AGREE	UNSURE	DISAGREE	STRONGLY DISAGREE
14. My friends seem to feel that it's important to drink milk	___	___	___	___	___
15. My doctor has shown no concern about whether I drink milk	___	___	___	___	___
16. It gives me a nice feeling to have a glass of milk with friends	___	___	___	___	___
17. It is unusual for adults in my family to drink milk	___	___	___	___	___
18. My friends think milk is drunk only by young children and not by teens or adults	___	___	___	___	___
19. I think advertisements for milk and dairy products are entertaining............................	___	___	___	___	___
20. When I drink milk, I please people who are important to me	___	___	___	___	___

Now, would you please indicate about how often you have seen certain people drink milk. **Circle** phrase which describes **how often** you see him or her drink a glass of milk of any kind.

Your mother...

VERY OFTEN | FAIRLY OFTEN | NOT VERY OFTEN | NEVER OR ALMOST NEVER

Your father...

VERY OFTEN | FAIRLY OFTEN | NOT VERY OFTEN | NEVER OR ALMOST NEVER

Another adult in your family whom you like or admire (for example, aunt or grandparent)..

VERY OFTEN | FAIRLY OFTEN | NOT VERY OFTEN | NEVER OR ALMOST NEVER

A friend of the opposite sex...

VERY OFTEN | FAIRLY OFTEN | NOT VERY OFTEN | NEVER OR ALMOST NEVER

A friend you admire...

VERY OFTEN | FAIRLY OFTEN | NOT VERY OFTEN | NEVER OR ALMOST NEVER

HOW MILK AND DAIRY PRODUCTS TASTE

Finally, we are interested in how milk and dairy products taste to you. Please circle the phrase which best describes how you feel about the taste of each of the foods listed below. If you have never tasted the food, circle "DON'T KNOW".

1. How much do you enjoy the taste of **whole (homo) milk?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

2. How much do you enjoy the taste of **low-fat (2% or 1%) milk?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

3. How much do you enjoy the taste of **skim milk?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

4. How much do you enjoy the taste of **fruit-flavoured yogurt?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

5. How much do you enjoy the taste of **plain yogurt?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

6. How much do you enjoy the taste of **cottage cheese?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

7. How much do you enjoy the taste of **hard cheese** (such as cheddar)?

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

8. How much do you enjoy the taste of **ice cream?**

VERY MUCH	IT'S O.K.	JUST "SO-SO"	NOT VERY MUCH	NOT AT ALL	DON'T KNOW

ABOUT YOUR TRAINING

Please answer the following questions about your training. Include both team practices and any other training sessions.

1. How many **hours per session** do you train?
___(hours).

2. How many training **sessions** do you have **per week?**
___sessions/week.

3. How many **months per year** do you train for your sport?
___months/year.

4. Have you ever participated in the following competitions? Please circle **"YES"** OR **"NO"**:

a) City Championships	YES	NO
b) Provincial Championships	YES	NO
c) National Championships	YES	NO
d) International Championships (ie. Pan-Americans, North Americans, World Championships, Olympic Games)	YES	NO

NAME:____

Would you like a copy of your results? ______ YES ______ NO
If yes, please provide a complete address:

____

____

____

THANK YOU VERY MUCH FOR YOUR HELP!

Appendix C: Body Composition Equations and Constants

1. Skinfold Predictive Equations:

The quadratic equation of Jackson and Pollock (1980) used to predict body density of **female** athletes as suggested by Thorland et al.(1984) is:

$$\text{Body Density} = 1.1454464 - 0.0006558(X_1 + X_5 + X_6 + X_7) + 0.0000015(X_1 + X_5 + X_6 + X_7) - 0.0000604(X_9) - 0.0005981(X_{15})$$

and the linear equation of Forsyth and Sinning for **males** (1973) is:

$$\text{Body Density} = 1.10647 - 0.00162(X_2) - 0.00144(X_6) - 0.00077(X_1) + 0.00071(X_3).$$

Where:

X_1 = triceps skinfold in mm
X_2 = scapular skinfold in mm
X_3 = midaxillary skinfold in mm
X_5 = supra-iliac skinfold in mm
X_6 = abdomen skinfold in mm
X_7 = thigh skinfold in mm
X_9 = age in years
X_{15} = hip circumference in cm.

Percent body fat is then determined using Lohman's formula (1986) for youths and his age and sex specific constants (see Table for the constants).

$$\% \text{ Body Fat} = \left[\frac{1}{D_b} \frac{(d_1 d_2)}{(d_1 - d_2)} - \frac{d_2}{d_1 - d_2} \right] \times 100$$

Where
D_b = body density in g/ml
d_1 = density of age and sex specific FFB in g/ml
d_2 = density of fat (0.90 g/ml)

Table 38: Age and Sex Specific Constants for Conversion of Body Density, Water, and Potassium to percent Fat in Children and Youths

	Fat Free Body Composition							
	Density FFBg/ml		Water % FFB[1]		K FFBg/kg[2]		Mineral %FFB[3]	
Age	Male	Female	Male	Female	Male	Female	Male	Female
7-9	1.081	1.079	76.8	77.6	2.40	2.32	5.1	4.9
9-11	1.084	1.082	76.2	77.0	2.45	2.34	5.4	5.2
11-13	1.087	1.086	75.4	76.6	2.52	2.36	5.7	5.5
13-15	1.094	1.092	74.7	75.5	2.56	2.38	6.2	5.9
15-17	1.096	1.094	74.2	75.0	2.61	2.4	6.5	6.1
17-20	1.099	1.095	74.0	74.8	2.63	2.41	6.6	6.0
20-25	1.100	1.096	73.8	74.5	2.66	2.42	6.8	6.2

[1]% Water FFB-determined using isotope dilution and the Siri Water equation.
[2]K FFB in g/kg-indirectly calculated using ^{40}K, body density, TBW %FFB.
[3]Mineral %FFB-determined using single photon absorptiometry of the radius to estimate total body bone mineral.
Adapted from: Lohman TG. Applicability of body composition techniques and constants for children and youths. Exerc Sport Sci Rev 1986;14:325-357.

Appendix D: Differential Association Sub-Scale Scores

Table 39: Scores for Friends Sub-Scale Questions and Overall Sub-Scale Score for Males (means and standard deviations)[1]

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. I have a lot of friends who drink milk.	3.5±0.7	3.6±0.8	3.5±0.8
2. A meal with my friends usually doesn't include milk.[2]	3.1±1.0	2.6±1.1	2.9±1.1
3. My friends seem to feel that it's important to drink milk.	3.0±0.7	2.9±1.0	2.9±0.9
4. My friends think milk is drunk only by young children and not by teens or adults.[2]	3.8±1.0	4.0±0.8	3.9±0.9
Overall Sub-Scale Score	3.3±0.6	3.3±0.5	3.3±0.6

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5)
[2]Scoring was reversed for negatively worded questions

Table 40: Scores for Friends Sub-Scale Questions and Overall Sub-Scale Score for Females (means and standard deviations)[1]

Question	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
1. I have a lot of friends who drink milk.	3.9±1.0	3.7±0.7	3.8±0.8
2. A meal with my friends usually doesn't include milk.[2]	3.0±1.3	3.3±0.9	3.2±1.1
3. My friends seem to feel that it's important to drink milk.	3.0±1.1	3.1±0.7	3.1±0.9
4. My friends think milk is drunk only by young children and not by teens or adults.[2]	4.0±1.0	3.8±0.5	3.9±0.7
Overall Sub-Scale Score	3.5±0.7	3.5±0.5	3.5±0.6

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.

Table 41: Scores for Family Sub-Scale Questions and Overall Sub-Scale Score for Males (means and standard deviations)[1]

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. Most teens and adults in my family drink milk as part or a snack of with meals.	4.0±0.8	3.5±1.2	3.8±1.0
2. Very few adults in my family use milk an a regular basis.[2]	3.7±1.2	3.6±1.0	3.6±1.1
3. My family feels that drinking milk is an important part of the diet for teens.	4.0±0.9	3.8±1.0	3.9±1.0
4. It is unusual for adults in my family to drink milk.[2]	3.6±1.2	3.6±1.0	3.6±1.1
Overall Sub-Scale Score	3.8±0.7	3.6±0.8	3.7±0.7

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.

Table 42: Scores for Family Sub-Scale Questions and Overall Sub-Scale Score for Females (means and standard deviations)[1]

Question	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
1. Most teens and adults in my family drink milk as part of a snack or with meals.	3.9±1.2	4.0±0.8	3.9±1.0
2. Very few adults in my family use milk an a regular basis.[2]	3.9±1.3	3.7±1.1	3.8±1.2
3. My family feels that drinking milk is an important part of the diet for teens.	3.8±0.9	4.3±0.7	4.1±0.8
4. It is unusual for adults in my family to drink milk.[2]	3.5±1.4	4.0±1.0	3.8±1.2
Overall Sub-Scale Score	3.8±1.0	3.9±0.7	3.9±0.8

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.

Table 43: Scores for Media Sub-Scale Questions for Males and Overall Sub-Scale Score (means and standard deviations)[1]

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. Advertisements for milk catch my attention.	3.1±1.0	3.4±1.0	3.2±1.0
2. The advertisements I see for milk make me want to drink it.	2.7±1.1	2.6±1.0	2.7±1.0
3. I hardly ever pay attention to advertisements for milk.[2]	3.0±1.2	3.0±1.1	3.0±1.1
4. I think advertisements for milk and dairy products are entertaining.	2.9±1.1	3.1±1.2	3.0±1.1
Overall Sub-Scale Score	2.9±1.0	3.1±0.7	3.0±0.9

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.

Table 44: Scores for Media Sub-Scale Questions for Females and Overall Sub-Scale Score (means and standard deviations)[1]

Question	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
1. Advertisements for milk catch my attention.	3.8 ± 1.1	3.0 ± 1.0	3.3 ± 1.1
2. The advertisements I see for milk make me want to drink it.	3.0 ± 1.3	2.5 ± 1.0	2.7 ± 1.2
3. I hardly ever pay attention to advertisements for milk.[2]	3.4 ± 1.1	3.2 ± 0.9	3.3 ± 1.0
4. I think advertisements for milk and dairy products are entertaining.	3.2 ± 1.1	3.1 ± 1.0	3.1 ± 1.1
Overall Sub-Scale Score	3.3 ± 0.8	3.0 ± 0.7	3.1 ± 0.8

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.

Table 45: Scores for Experts Sub-Scale Questions for Males and Overall Sub-Scale Score (means and standard deviations)[1]

Question	Speed Skaters n=32	Gymnasts n=25	All Athletes n=57
1. My doctor recommends that I drink milk of some kind.	2.9±1.1	2.9±1.1	2.9±1.1
2. I often hear health experts recommend drinking milk.	3.8±0.9	3.9±0.8	3.8±0.9
3. I have heard nutritionists recommend that people of my age drink milk.	3.9±1.0	3.7±1.0	3.8±1.0
4. My doctor has shown no concern about whether I drink milk.[2]	3.0±0.8	3.0±1.1	3.0±0.9
Overall Sub-Scale Score	3.4±0.6	3.4±0.7	3.4±0.6

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.

Table 46: Scores for Experts Sub-Scale Questions for Females and Overall Sub-Scale Score (means and standard deviations)[1]

Question	Speed Skaters n=25	Gymnasts n=32	All Athletes n=57
1. My doctor recommends that I drink milk of some kind.	2.9±1.2	2.8±0.9	2.8±1.0
2. I often hear health experts recommend drinking milk.	3.9±0.9	3.7±1.0	3.8±0.9
3. I have heard nutritionists recommend that people of my age drink milk.	3.8±1.1	3.7±0.9	3.7±1.0
4. My doctor has shown no concern about whether I drink milk.[2]	2.9±1.2	3.1±0.9	3.0±1.1
Overall Sub-Scale Score	3.4±0.7	3.3±0.6	3.3±0.7

[1]Participants answered questions using a five point scale ranging from strongly disagree (scored 1) to strongly agree (scored 5).
[2]Scoring was reversed for negatively worded questions.