Energy Balance of Nutrition and Activity in a Group of Nursing Students

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La présente étude descriptive présente une esquisse des éléments de l'équilibre énergétique, de la nutrition et de l'activité chez un groupe d'étudiants en sciences infirmières du niveau baccalauréat (n = 21). Les outils de collecte de données comprenaient les rapports individuels remplis par chaque répondant, le relevé de la nourriture et des exercices physiques pendant trois jours consécutifs, ainsi qu'un questionnaire sur les antécédents de la personne. Les résultats obtenus révélèrent que les apports énergétiques étaient suffisants pour satisfaire à l'apport des éléments nutritifs recommandés, sauf pour les hydrates de carbone qui ne suffisaient pas pour satisfaire aux niveaux de dépense d'énergie. L'engagement des étudiants dans diverses activités exigeant une dépense d'énergie substantielle ajouté à la perte de poids suite à un régime qu'ont fait plusieurs étudiants semble expliquer ce déséquilibre énergétique. On recommande à ce groupe d'étudiants en sciences infirmières d'accroître leur consommation d'hydrates de carbone et de diminuer celle de matières grasses.

This descriptive study presents a profile of energy balance, nutrition, and activity in a group of baccalaureate nursing students (N=21). Self-reported, consecutive, three-day food and physical activity records as well as a background questionnaire served as the instruments for data collection. Findings revealed that energy intakes were adequate to meet recommended nutrient intakes for all nutrients except carbohydrate, but insufficient to meet their levels of energy expenditure. Student involvement in a range of activities that required substantial energy expenditure, coupled with weight-loss dieting by several students appear to explain this observed energy imbalance. Increased carbohydrate intake and decreased fat intake would seem to be recommended nutritional modifications warranted for this group of nursing students.

Nursing students, as future health care professionals, receive education in wellness and health promotion. Therefore, it is often assumed that they practice healthy lifestyles. The wellness and health-related behaviors and practices of nursing students have been studied very generally (Boyd, 1988; Dittmar, Haughey, O'Shea & Brasure, 1989; MacDonald & Faulkner, 1988; Sabina-McVety, Booth, Orban & Richards, 1988; Viar & Urey, 1988), typically addressing topics such as smoking, alcohol consumption, breast self-examination, and sleep, as well as nutrition and physical activity. Findings have shown that nursing students do not always apply their knowledge of personal health behaviours. For example, Sabina-McVety et al. (1988) reported that although their group of undergraduate nursing students valued exercise, they did not regularly participate in it.

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Literature Review

Research into the nutritional and physical activity practices of nursing students has been limited and very qualitative in nature. Survey research has consistently revealed a number of poor dietary practices including breakfast-skipping, between-meal snacking, vending machine usage, and heavy alcohol consumption (Dittmar et al., 1989; Viar & Urey, 1988). However, dietary analysis of nursing students has not been reported. Analysis of the nutritional status of female college students (Gottschalk, MacAulay, Sawyer, & Miles, 1977; Hernon, Skinner, Andrews, & Penfield, 1986) has found that mean energy intakes were below recommended amounts, with associated sub-optimal intakes of iron (Gottschalk et al 1977; Jakobovits, Halstead, Kelley, Roe, & Young, 1977), calcium (Hernon et al., 1986; Hoffman, 1989; Ostrom & Labuza, 1977), thiamine, riboflavin, and niacin (Hernon et al., 1986). It is unknown whether these trends apply to nursing students, although their reported dietary practices would appear to put them at risk for nutritional deficiencies.

Qualitative assessment of the activity practices of nursing students has indicated low participation in aerobic activities (Boyd, 1988; Viar & Urey, 1988). The one study that provided quantitative data found that from the first to the fourth year of their nursing program, baccalaureate nursing students experienced an increase in maximal oxygen consumption from 33 to 36 ml/kg/min (MacDonald & Faulkner, 1988). Though statistically significant, this increase does not reflect a physiological difference with the final value being classified as below average and suggestive of a sedentary lifestyle (Fitness Canada, 1986).

Additionally, although it has been suggested that the low energy intakes observed among female university students may be related to low activity levels, only one study of British physical-education students has measured both energy expenditure and activity levels (Watson & Jennings-White, 1974). In fact, several studies noted that interpretation of their caloric and nutrient intake findings was limited by the lack of concurrent energy expenditure information (Gottschalk et al., 1977; Hernon et al., 1986; Jakobovits et al., 1977). Without examining both the nutritional and physical activity status of nursing students, it is not possible to determine whether any relationship exists between these two parameters for this population. Thus, the purposes of this study were to quantitatively assess the caloric energy intake and energy expenditure (i.e., energy balance) of nursing students as well as their nutrient status, and to compare these findings with the Canadian Nutrition Recommendations.

Method

Study Population

A third-year undergraduate nursing class (N=45) was approached during a mid-winter semester. Upper level students were chosen because it was felt that there would be less influence of the home environment and fewer students living in residence so that a more representative picture of eating and activity patterns could be obtained. Also, there was an increased likelihood that these subjects would have completed an elective course in nutrition. Twenty-seven students initially volunteered to participate, four dropped out, possibly due to a heavy student workload, and 23 completed the study.

Instruments

A review of the literature revealed that the three-day food and activity record was the most appropriate method for assessing nutrient intake and energy balance in a university student population (Barr, 1987; Karkeck, 1987; Underwood, 1986). The three-day food record for this study, designed in consultation with a nutritionist, consisted of four columns for recording a description of the food or fluid item consumed, the amount of the item eaten, and the time and place where it was eaten. All food records were analyzed for energy and nutrient intakes using the Canadian version of the Nutripractor 6000 Program (Practocare, Inc.).

To assess energy expenditure, the three-day activity record developed by Bouchard, Tremblay, Leblanc, Lortie, Savard & Theriault (1983) was chosen, since the authors reported intraclass reliability correlations ranging from .86 to .96 ($p < .01$). This activity record broke the day into 96 fifteen-minute blocks; participants recorded a categorical value representing the dominant physical activity during each period (refer to Table 3). Categories ranged from a value of 1, representing activities with the lowest energy expenditure (.26 kcal/kg/15 min), to a value of 10, representing activities with the highest energy expenditure (2.40 kcal/kg/15 min). The categorical values recorded by students on their activity records were translated into energy expenditures using the median energy costs and then summed for the day.

The background questionnaire, developed by the researchers in collaboration with the nutritionist, elicited information related to the students' food- and activity-related practices. The specific information obtained included the students' living arrangements, nature of meal preparation, eating-out patterns, dieting practices, use of dietary and/or vitamin supplements, as well as body weight and physical activity patterns over the previous month.

Pilot testing of the data collection instruments and procedures was done for one day using 16 undergraduate students who were not participants in the final study. Their recorded food intake was cross-validated with, and compared favourably to, a 24-hour recall procedure. Modifications and additions were made to the activity record to make the categories more representative of typical undergraduate student activities. For example, physical activities that student nurses would be performing in the course of providing patient care as well as common recreational activities were included. For these adaptations, cross-referencing of energy expenditures for the added activities were obtained from Shephard (1986) and McArdle, Katch & Katch (1991). Subsequently, a video was made of the detailed procedures for accurately completing the activity and food records, paying particular attention to food item descriptions, preparation, and portion-size estimations.

Procedures

A three-stage study protocol was utilized: practice data collection, review, and actual data collection. All potential subjects were introduced to the study protocol and procedures and viewed the video during a regularly scheduled nursing class. Each student received a packet that included: an information and consent form; a background questionnaire; a practice one-day food and activity record; instructions for completing the records; a physical activity guide with the energy expenditure categories (1-10), together with corresponding examples of typical activites; and a completed example of a meal recording and an activity recording. Students wishing to participate in the study were asked to complete the informed consent, background questionnaire, and 24-hour food and activity record, and return these to the researchers within 48 hours. The researchers reviewed the practice 24-hour food and activity records to identify problems in the recording process, then met with students to present feedback. Students received both written feedback on their individual records, and verbal feedback that addressed problems common to the group as a whole. Participants then received their consecutive three-day (Thursday, Friday, Saturday) food and activity records and were given final instructions. They were asked to keep complete and accurate records of all fluids and foods consumed and to not make any unusual changes in their food and activity patterns for the duration of the study period. Students had telephone access to the researchers for assistance if difficulties were encountered. Completed forms returned to the researchers were reviewed immediately for completeness and accuracy, with any questionable entries being verified or clarified. Of the 27 volunteers, 4 did not return their forms, and data from an additional two were dropped – one because of illness, and the other because it was incomplete.

Statistical analyses were completed using the Statistical Analysis Systems software package (Schlotzhauer & Littell, 1987) with alpha set at $p \leq .05$. Values were reported as means with standard deviations ($M \pm$ S.D.). A two-way repeated measures ANOVA was used to assess energy intake and energy expenditure across days. A one-way repeated measures ANOVA was used to compare macronutrient intake across days. When appropriate, differences between means were assessed using the orthogonal contrast post-hoc procedure. Pearson product-moment correlation coefficients were determined between energy intake, energy expenditure, and all macronutrients.

Results

Twenty-one third year nursing students (21.5 ± 1.8 years old; 162.7 ± 10.8 cm average height; 62.2 ± 7.6 kg average weight) completed the study. The Body Mass Index (BMI), computed from the students' self-reported heights and weights, was 22.6. The students' self-reported food and activity related practices over the month preceding the study are outlined in Table 1.

The groups' mean daily energy expenditure was 2705 kilocalories compared to a mean daily energy intake of 2094 kilocalories, reflecting a negative energy balance for the group as a whole. As shown in Table 2, there was wide individual variation in energy balance, from a deficit of –2340 kcals to a surplus of +868 kcals. Only two students approximated an energy balance.

Table 1

Self-reported food and activity related practices of the nursing students (N=21) in the month preceding study

Food/Activity Related Practices	Student Responses	
	% Yes	% No
Living off campus	95.2	4.8
Living at home or with relative	33.3	66.7
Self-prepared meals	71.4	28.6
Use of fast food restaurants (1–2/wk)	47.6	52.4
Breakfast skipping (>2/wk)	47.6	52.4
Use of vitamin/mineral supplements	23.8	76.2
Weight loss dieting	33.3	66.7
Weight change (±5 lbs or >)	33.3	66.7
Taken/ing university nutrition course	23.8	76.2
Activity level: ≥30–60 minutes of exercise 3 times per week	42.9	57.1

Table 2

Nursing students' (N=21) daily energy balance

Subject	M Energy intake (kcal)	M Energy expenditure (kcal)	Difference (kcal)
1	2547	2042	+505
2	2178	2129	+49
3	1384	2307	–923
4	2203	4142	–1939
5	1537	2598	–1061
6	1680	2859	–1179
7	1971	2597	–626
8	2164	2518	–354
9	2920	2526	+394
10	1735	2716	–981
11	2693	2231	+462
12	1004	2853	–1849
13	2070	2312	–242
14	1296	3636	–2340
15	1938	2196	–258
16	2524	2452	+72
17	2758	3471	–713
18	2072	2912	–840
19	3554	2686	+868
20	1613	3320	–1707
21	2144	2311	–167
M±S.D.	2095±602	2705±541	–611±875

For each of the three days, energy intake was significantly less than energy expenditure ($r \leq .05$), but the day-to-day differences in energy balance were not significant (Figure 1). Furthermore, no significant relationship was observed between energy intake and energy expenditure on Thursday, Friday or Saturday ($r = -.23, -.02$, and $.10$, respectively).

Looking specifically at self-reported physical activity over the three days, the mean minutes per day that students spent in each energy expenditure category are listed in Table 3. Activities in which students participated ranged from light to heavy physical intensity, with proportionately more time spent in physical activities of low (.57 to .84 kcal/kg/15 min) median energy cost; 71.1% of their day was spent sleeping and in sitting activities. Light intensity activities comprised 24.4% of the students daily time, and moderate to heavy intensity activities, 4.5% (Figure 2).

Comparison of the students' mean three-day macronutrient and micronutrient intake with the Canadian Recommended Nutrient Intakes is presented in Table 4. Except for carbohydrate, on a per gram basis, the study group exceeded the mean recommended nutrient intakes for all micronutrients and

Figure 1

Comparison of mean energy intake and mean energy expenditure across the three days for nursing students (N=21)

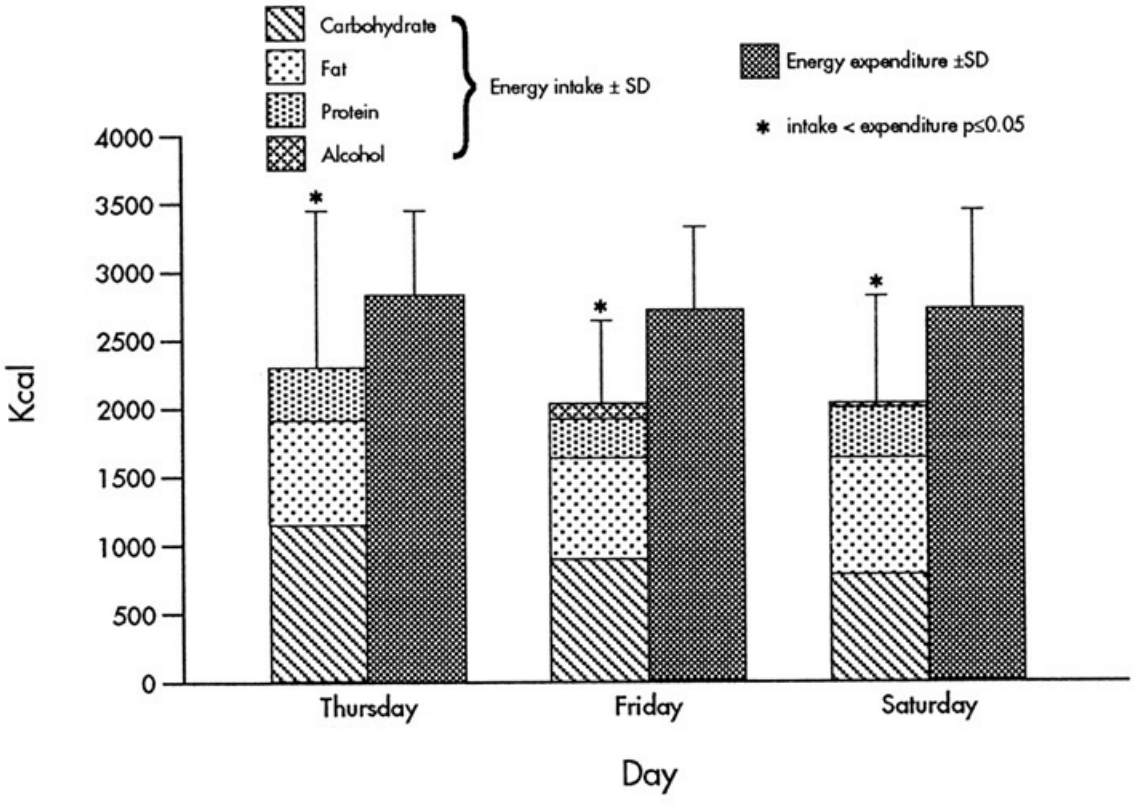

Figure 2

Self-reported mean daily physical activity of nursing students (N=21) expressed relative to (a) time (24 hours) and (b) total energy expenditure (kilocalories·day^{-1})

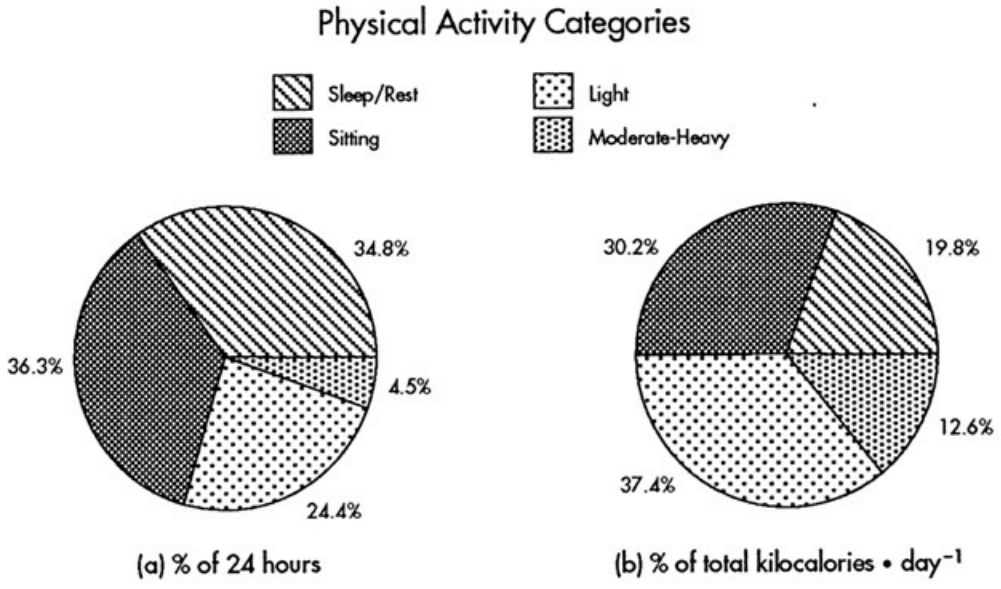

Table 3

Self-reported physical activity of the nursing students

Energy Expenditure Categories*			Physical Activity (mean minutes per day)		
Categorical value	Example activities	Median energy cost (kcal/kg/15 min)	Thu	Fri	Sat
1	Sleeping or resting in bed	0.26	479	470	554
2	Sitting: eating, studying, watching TV, listening, writing, etc.	0.38	534	579	456
3	Light activity standing: washing, ironing, shaving, combing, cooking, etc.	0.57	92	101	128
4	Slow walking, driving, dressing, showering, playing musical instruments, etc.	0.69	100	158	148
5	Light manual work: sweep floor, rake leaves, waiting on tables, house chores, classroom presentation, general nursing care, etc.	0.84	159	68	100
6	Leisure activities and sports in recreational environment: golf, easy cycling, curling, bowling, baseball, weightlifting, walking at normal pace, warm-up/cool-down activities.	1.20	47	41	32
7	Manual work at moderate pace: snow shoveling, carpentry, nursing care (moving and lifting patients), walking uphill, scrubbing floors	1.40	11	4	16
8	Leisure sport activities of higher intensity (not competitive): skiing, canoeing, swimming, tennis, walking at brisk pace, jogging, cycling quickly, dancing, circuit weight training, etc.	1.50	19	16	6
9	Intense manual work, high intensity sport activity or leisure sport competition: running, skipping rope, aerobic dance (stimulus phase), racquetball, hiking with pack, swimming, carrying heavy loads, etc.	2.00	0	2	0
10	Intense training for competitive sport activities: cross-country running, cycling, basketball, field hockey, rowing, wrestling, swimming, soccer, etc.	2.40	0	0	0

*Adapted from Bouchard et al., 1983

macronutrients. When macronutrient intakes were expressed as a percentage of total energy intake, nursing students had a diet consisting of 44.2% carbohydrate, 38.2% fat, and 15.3% protein. Alcohol comprised the remaining 2.3% of energy intake. There were no significant differences in fat or protein intake across days, but carbohydrate intake was significantly lower on day three (Saturday) than on day one (Thursday). As expected, significant rela-

Table 4

Mean energy and nutrient intakes of nursing students (N=21) as assessed by a three-day food record

Energy/Nutrient	Nursing Intakes (X±S.D.)	Recommended intakes*
Energy (Kcal)	2094.5±601.7	2100
Carbohydrate (g)	234.9±76.1	290 (min)
Fat (g)	91.2±34.0	70 (max)
Protein (g)	80.3±24.2	43
Iron (mg)	13.6±5.4	13
Calcium (mg)	914.2±365.0	700
Vitamin A (mg)	9944.3±8431.3	4000–5000
Vitamin C (mg)	112.9±52.7	30–60
Niacin (NE)	20.6±8.4	15
Thiamin (mg)	1.47±0.8	0.8
Riboflavin (mg)	1.68±0.7	1.1
Alcohol (g)	6.22±12.6	—

*Canadian recommended nutrient intakes, 1990

tionships were observed between energy intake and the intake of carbohydrate, fat, and protein (r= .78; r= .90; r= .78, respectively) but no significant relationships were found between intake of these macronutrients and energy expenditure (r=–.01; r= –.13; r= –.16, respectively).

Discussion

Overall, this group of health profession students experienced a negative energy balance, with energy intake being significantly less than self-reported energy expenditure over the three day study period. Although the magnitude of the imbalance was greater in the current study (–611 kcals/day), negative energy balances have also been observed by others: –86 kcals/day over seven days (Watson & Jennings-White; 1974), –287 kcals/day over 14 days (Drougas, Reed, & Hill, 1992), and –336 kcals/day over a four week period (Kalkwarf, Haas, Belko, Roach, & Roe, 1989). In contrast, other investigations have reported that energy intake and expenditure balanced well over the study period (Saris, van Erp-Baart, Brouns, Westerterp, & ten Hoor, 1989; Smoak, Singh, Day, Norton, Kyle, Pepper, & Deuster, 1988). However, these investigations utilized highly trained male subjects whose energy expenditures and intakes were approximately 6000 kcals/day.

At 2705 kcals, nursing students' mean daily energy expenditure was higher than the 2300 to 2500 kcals previously reported for the typical university female (Kalkwarf et al., 1989; Passmore & Durnin, 1955; Watson & Jennings-

White, 1974) or non-obese female (Meijer, Westerterp, van Hulsel, & ten Hoor, 1992). According to the categorization provided by the Canadian Nutrition Recommendations (Canada Health and Welfare, 1990), the nursing students, with an energy expenditure exceeding 2500 kcals, would be classified as having a heavy activity level. At first glance, the student's energy expenditures might appear inflated: they spent almost three-quarters of their time sleeping (category 1) and in sedentary activities (category 2). The time spent in these activities represents a sedentary daily energy expenditure of 1363 kcals, which approximates the 1660 kcals predicted from the students heights and weights according to the regression formula of Webb & Sangal (1991) and compares favourably to basal or sedentary energy expenditures (1300–1800 kcals) reported in other female groups (Canada Health & Welfare, 1990; Meijer et al., 1992; Staten, 1991; Watson & Jennings-White, 1974; Webb & Sangal, 1991). This sedentary activity, though comprising a substantial proportion (71.1%) of the students' day, accounts for only 50% of their total energy expenditure. Activities of moderate to high intensity comprised 12.6% of the students' energy expenditure, which, translated into an energy expenditure of 344 kcals, is the equivalent of a typical 45-minute to one-hour exercise session (McArdle et al., 1991). Light intensity activities, consuming an average of 1020 kcals over a 24-hour period, accounted for the greatest percentage of the nursing students' active energy expenditure; they appeared to differentiate nursing students' energy expenditures from those reported previously by other female students. This suggests that energy expenditures were at the magnitude reported by students.

As a group, the nursing students matched the recommended energy intake of 2100 kcals for females 19 to 24 years of age engaged in light activity (Canada Health and Welfare, 1990). Previous studies of female university students have tended to report lower energy intakes (1013 to 1930 kcals) (Bailey & Goldberg, 1989; Driskell, Keith, & Tangney, 1979; Gottschalk et al., 1977; Hernon et al., 1986; Jakobovits et al.,1977). The nursing student intakes were similar to the values reported by Kalkwarf, et al., (1989) for free-living female college students and staff (2163 kcals), but lower than the physical education students (2346 kcals) studied by Watson & Jennings-White (1974). Furthermore, both the inter- and intra-individual variation in energy intake was comparable to previous studies (Jakobovits et al.,1977; Kalkwarf et al., 1989; Tarasuk & Beaton, 1991; Watson & Jennings-White, 1974). A trend of declining intake across successive days (Thursday, Friday, Saturday) was noted, which was the reverse of that typically reported (Basiotis, Thomas, Kelsay, & Mertz, 1989; Watson & Jennings-White, 1974).

The large variations in energy balance for individual students may reflect a general trend towards overestimation of energy expenditure and underestimation in energy intake. Large individual variations in energy balance both

over the duration of the reporting period and on a daily basis, while consistent with previous studies (Drougas et al., 1992; Durnin, 1957; Durnin, 1961; Watson & Jennings-White, 1974), may be due to inaccuracies in self-reporting. There may be a discrepancy between actual and reported energy expenditures (Ainsworth, Haskell, Leon, Jacobs, Montoye, Sallis, & Paffenbarger, 1993; Bouchard et al., 1983) or the amount of time actually spent in any given activity may be inaccurately estimated (Bouchard et al., 1983). With the self-recording of food intake, underestimation of energy intake may occur as a result of omitting small-quantity food items (Krall & Dwyer, 1987), altering food intake to make recording easier, or reducing food intake because of heightened awareness from the recording of what is being eaten (Barr, 1987). Drougas et al. (1992) attributed their negative energy balance to under-reporting, with the lowest differences between intake and expenditure appearing in the subgroup (dietitians) that was most highly trained in the food-recording process. In the current study, the nursing students had been fairly well trained, were highly motivated, and extremely interested in obtaining a profile of their nutritional and activity status. Although there was no way to check that students recorded accurately, food records have been shown to reflect actual intake (Bergman, Boyungs, & Erickson, 1990; Karvetti, & Knuts; Krall & Dwyer, 1987). Furthermore, the possibility of under-reporting may be offset by some overestimation of food portion sizes and certain food items (Rapp, Dubbert, Burkett, & Buttross, 1986; Webb & Yuhas, 1988).

A more likely explanation for the large energy deficits is that several of the students had reduced their energy intake to achieve a net negative energy balance; in fact, a third of the students were dieting and had been successful in losing weight during the previous month. The concern women have with their weight and the prevalence of eating disorders especially among college women have been well documented (Crockett & Littrell, 1985). Studies have shown that the numbers of college women on weight loss diets has ranged from 11% (Jakobovits et al., 1977) to 62% (Bailey & Goldberg, 1989), with the present group falling within this range. In the current study it was noted that anthropometrically the nursing students were similar to the Canadian norms (Fitness Canada, 1986) for height (50th %ile), weight (75th %ile), and body mass index (30th %ile). Only four students had BMI that fell outside the desirable weight range; two were classified as underweight and none were considered to be at a health risk (Fitness Canada, 1986).

It might be expected that a substantial proportion of the student's energy intake would be comprised of carbohydrates, to reflect their high energy expenditure. However, the carbohydrate contribution, which averaged 44% of energy intake, was not only below the 55% recommended Canadian standard (Canada Health and Welfare, 1990), but proportionately below that required for the demands of heavy activity. At 38% of energy intake, fat was

well above the 30% recommended and rose to as high as 42% on day three; protein ranged from 14% to 16% of energy intake, representing the upper limit of normal (Canada Health and Welfare, 1990). These trends are consistent with findings observed in non-athletic cohort groups but contrary to the higher carbohydrate and lower fat intakes observed in female runners (Manore, Besenfelder, Wells, Carroll, & Hooker, 1989; Pate, Sargent, Baldwin, & Burgess, 1990) and other female college athletes (Welch, Zager, Endres, & Poon, 1987), groups with whom the nursing students shared similar energy expenditures. Unlike this active but non-athletic group of nursing students, athletic individuals are perhaps better able to regulate macronutrient intake. The high fat intake reported by study participants compared to other student groups (Hernon et al., 1986; Manore et al., 1989; Ostrom & Labuza, 1977) may have resulted from their more frequent use of fast food restaurants (Shields & Young, 1990); 61% purchased fast foods once or twice weekly compared to a reported 45% use by the general population of one to three times per week (Shields & Young, 1990). Furthermore, the common misconception that carbohydrate-dense foods are high in calories may have led some nursing students to avoid these foods (Hernon et al., 1986). Except for unusually high fat and abnormally low carbohydrate intakes on day three (Saturday), however, macronutrient intakes in this study appeared typical and reasonably close to recommended nutrient values. Over three-quarters of the nursing students had not yet taken a university nutrition course, and might benefit from education focused on lowering the dietary fat content and raising the carbohydrate content. Welch, Zager, Endres, & Poon, (1987) found that a group of female college athletes who receiving nutritional counselling increased their intake of foods containing carbohydrates and fiber and decreased their intake of foods high in fat and cholesterol.

Despite a negative energy balance micronutrient intakes were not compromised in this group of nursing students; 77% of the students exceeded the recommended minimum daily energy intake of 1800 kcals and none of the remaining 23% were receiving less than 1200 kcals which is considered to be the cut-off point to ensure an adequate nutrient intake (Hernon et al., 1986). Consequently, all mean micronutrient intakes approximated or exceeded recommended Canadian values (Canada Health and Welfare, 1990); contrary to earlier studies, (Beerman, 1991; Gottschalk et al., 1977; Hernon et al., 1986; Hoffman, 1989; Ostrom & Labuza, 1977), the majority of nursing students were found to be at, or well above, the recommended nutrient intakes for calcium, iron, and vitamins. When mean individual intakes were calculated for the three days, two-thirds of the group had greater than 75% of the recommended nutrient intakes for iron and 90% of the group had greater than 75% of the recommended nutrient intakes for calcium. Few nursing students had vitamin intakes less than that recommended, with low intakes appearing for vitamins A and B only. More noteworthy are the excessive intakes of vitamins

A, B, and C; 52% to 71% of students were taking greater than 125% of Recommended Nutrient Intakes for all three vitamins. Since only one-quarter of the group consumed vitamin/mineral supplements, it would appear that diet alone was sufficient for the majority of nursing students to meet their daily requirement. This contrasts with Jakobovits et al. (1977) who found that only when their group of college women used iron supplements were they able to reach their recommended iron intake.

In summary, this is the first study to quantitatively assess the energy intake, energy expenditure, and nutrient status in a group of nursing students. The findings suggest that the nursing students had an adequate nutrient status even though energy intakes were inadequate to meet their high energy expenditures. Half of the students' total energy expenditure was comprised of physical activity, with light intensity activities making the largest contribution and activities of moderate to high intensity being only modestly represented. The significant contribution that daily personal and household activities make to energy expenditure should not be underestimated. While these findings indicate that macronutrient and micronutrient needs can be met when the daily energy intake is 1800 kcals or more, it is recommended that carbohydrate intake be increased to achieve energy balance, and fat intake be reduced to achieve a healthier nutritional status.

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References

Ainsworth, B.E., Haskell, W.L., Leon, A.S., Jacobs, D.R., Montoye, H.J., Sallis, J.F., & Paffenbarger, R.S. (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise, 25*(1), 71-80.

Bailey, S., & Goldberg, J.P. (1989). Eating patterns and weight concerns of college women. *Journal of the American Dietetic Association, 89*(1), 95-96.

Barr S.I. (1987). Women, nutrition and exercise: A review of athletes' intakes and a discussion of energy balance in active women. *Progress in Food Nutrition Science, 11,* 307-361.

Basiotis, P.P., Thomas, R.G., Kelsay, J.L., & Mertz, W. (1989). Sources of variation in energy intake by men and women as determined from one year's daily dietary records. *American Journal of Clinical Nutrition, 50,* 448-453.

Beerman, K.B. (1991). Variation in nutrient intake of college students: A comparison by students'residence. *Journal of the American Dietetic Association, 91*(3), 343-344.

Bergman, E.A., Boyungs, J.C., & Erickson, M.L. (1990). Comparison of a food frequency questionnaire and a 3-day diet record. *Journal of the American Dietetic Association, 90*(10), 1431-1433.

Bouchard, C., Tremblay, A., Leblanc, C., Lortie, G., Savard, R. & Theriault, G. (1983). A method to assess energy expenditure in children and adults. *American Journal of Clinical Nutrition, 37,* 461-467.

Boyd, M. A. (1988). Level of wellness of nursing students. *Health Values, 12,* 14-20.

Canada Health and Welfare. (1990). *Nutrition Recommendations.* Report of the Scientific Review Committee. Ottawa: Canadian Government Publishing Centre, Supply and Services Canada.

Crockett, S.J., & Littrell, J.M. (1985). Comparison of eating patterns between dietetic and other college students. *Journal of Nutrition Education, 17*(2), 47-50.

Dittmar, S.S., Haughey, B. P., O'Shea, R. M., & Brasure, J. (1989). Health practices of nursing students: A survey. *Health Values, 13,* 24-31.

Driskell, J.A., Keith, R.E. & Tangney, C.C. (1979). Nutritional status of white college students in Virginia. *Journal of the American Dietetic Association, 74,* 32-35.

Drougas, H.J., Reed, G., & Hill, J.O. (1992). Comparison of dietary self-reports with energy expenditure measured using a whole-room indirect calorimeter. *Journal of the American Dietetic Association, 92*(9), 1073-1077.

Durnin, J.V.G.A. (1957). The day-to-day variation in individual food intake and energy expenditure. *Journal of Physiology, 136,* 34P-35P.

Durnin, J.V.G.A. (1961). 'Appetite' and the relationship between expenditure and intake of calories in man. *Journal of Physiology, 156,* 294-306.

Fitness Canada. (1986). *Canadian Standardized Test of Fitness: Operations Manual.* (3rd. ed.) (Publication No. FAS 7378). Ottawa.

Gottschalk, P.L., MacAulay, C.M., Sawyer, J.M., & Miles, J.E. (1977). Nutrient intakes of university students living in residence. *Journal of the Canadian Dietetic Association, 38*(1), 47-54.

Hernon, J.F., Skinner, J.D., Andrews, F.E., & Penfield, M.P. (1986). Nutrient intakes and foods selected by college students: Comparisons among subgroups divided by energy intake. *Journal of the American Dietetic Association, 86*(2), 217-221.

Hoffman, C.J. (1989). Dietary intake of calcium, iron, folacin, alcohol, and fat for college students in central Michigan. *Journal of the American Dietetic Association, 89*(6), 836-838.

Jakobovits, C., Halstead, P., Kelley, L., Roe, D.A., & Young, C.M. (1977). Eating habits and nutrient intake of college women over a thirty-year period. *Journal of the American Dietetic Association, 71,* 405-411.

Kalkwarf, H.J., Haas, J.D., Belko, A.Z., Roach, R.C., & Roe, D.A. (1989). Accuracy of heart-rate monitoring and activity diaries for estimating energy expenditure. *American Journal of Clinical Nutrition, 49,* 37-43.

Karkeck, J.M. (1987). Improving the use of dietary survey methodology. *Journal of the American Dietetic Association, 87*(7), 869-871.

Karvetti, R-L., & Knuts, L-R. (1992). Validity of the estimated food diary: Comparison of 2-day recorded and observed food and nutrient intakes. *Journal of the American Dietetic Association, 92*(5), 580-584.

Krall, E.A., & Dwyer, J.T. (1987). Validity of a food frequency questionnaire and a food diary in a short-term recall situation. *Journal of the American Dietetic Association, 87*(10), 1374-1377.

MacDonald, M. & Faulkner, R. (1988). Lifestyle behaviors of one baccalaureate nursing class: A pilot study. *The Canadian Journal of Nursing Research, 20*(4), 19-29.

Manore, M.M., Besenfelder, M.S., Wells, C.L., Carroll, S.S. & Hooker, S.P. (1989). Nutrient intakes and iron status in female long-distance runners during training. *Journal of the American Dietetic Association, 89*(2), 257-259.

McArdle, W.D., Katch, F.I., & Katch, V.L. (1991). *Exercise physiology: Energy, nutrition, and human performance* (3rd ed.). Philadelphia: Lea & Febiger.

Meijer, G.A., Westerterp, K.R., van Hulsel, A.M., & ten Hoor, F. (1992). Physical activity and energy expenditure in lean and obese adult human subjects. *European Journal of Applied Physiology, 65,* 525-528.

Nutripractor User's Manual (1987). San Diego: Practorcare Inc.

Ostrom, S., & Labuza, T.P. (1977). Analysis of a seven-day diet survey of college students. *Food Technology,* 68-72.

Passmore, R., & Durnin, J.V.G.A. (1955). Human energy expenditure. *Physiological Reviews, 35,* 801-840.

Pate, R.R., Sargent, R.G., Baldwin, C., & Burgess, M.L. (1990). Dietary intake of women runners. *International Journal of Sports Medicine, 11*(6), 461-466.

Rapp, S.R., Dubbert, P.M., Burkett, P.A., & Buttross, Y. (1986). Food portion size estimation by men with Type II diabetes. *Journal of the American Dietetic Association, 86*(2), 249-251.

Sabina-McVety, D., Booth, B.F., Orban, W.A.R., & Richards, G.S. (1988). An analysis of the lifestyle, exercise habits and cardio-vascular fitness of an undergraduate nursing population. *Canadian Journal of Public Health, 79,* 16-19.

Saris, W. H. M., van Erp-Baart, M. A., Brouns, F., Westerterp, K. R. & tenHoor, F. (1989). Study on food intake and energy expenditure during extreme sustained exercise: The Tour de France. *International Journal of Sports Medicine, 10*(suppl 1), S26-31.

Schlotzhauer, S. D., & Littell, R. C. (1987). *SAS system for elementary statistical analysis. North Carolina: SAS Institute Inc.*

Shephard, R.J. (1986). Testing for fitness in the routine physical. *Diagnosis,* 157-172.

Shields, J. E., & Young, E. (1990). Fat in fast foods – evolving changes. *Nutrition Today, 25*(2), 32-35.

Smoak, B.L., Singh, A., Day, B.A., Norton, J.P., Kyle, S.B., Pepper, S.J., & Deuster, P.A. (1988). Changes in nutrient intakes of conditioned men during a 5-day period of increased physical activity and other stresses. *European Journal of Applied Physiology, 58,* 245-251.

Staten, M.A. (1991). The effect of exercise on food intake in men and women. *American Journal of Clinical Nutrition, 53,* 27-31.

Tarasuk, V. & Beaton, G.H. (1991). The nature and individuality of within-subject variation in energy intake. *American Journal of Clinical Nutrition, 54,* 464-470.

Underwood, B.A. (1986). Evaluating the nutritional status of individuals: A critique of approaches. *Nutrition Reviews Supplement,* May, 213-223.

Viar, V., & Urey, J.R. (1988). A survey of health-related behaviors of senior baccalaureate nursing students. *Journal of Holistic Nursing,6*(1), 46-51.

Watson, R., & Jennings-White M. (1974). Energy intake and expenditure with reference to the female physical education student. *Ergonomics, 17*(1), 23-30.

Webb, P., & Sangal, S. (1991). Sedentary daily expenditure: A base for estimating individual energy requirements. *American Journal of Clinical Nutrition, 53,* 606-611.

Webb, C.A., & Yuhas, J.A. (1988). Ability of WIC clientele to estimate food quantities. *Journal of the American Dietetic Association, 88*(5), 601-602.

Welch, P.K., Zager, K.A., Endres, J., & Poon, S.W. (1987). Nutrition education, body composition, and dietary intake of female college athletes. *The Physician and Sportsmedicine, 15*(1), 65-71.