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The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) Manual

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CHAPTER 1: INTRODUCTION

“An important challenge in determining the relationship between health and physical activity is valid assessment.”

Various levels of physical activity participation are associated with health benefits and/or health risks. As a result, it is important that we have valid tools for assessing physical activity at various ages. This becomes particularly important with longitudinal research, which might span a number of years. The Physical Activity Questionnaire for Older Children (PAQ-C) and the Physical Activity Questionnaire for Adolescents (PAQ-A) provide a general measure of physical activity for youth from grades 4-12 (approximately ages 8-20).

The purpose of the PAQ manual is to ensure that you can easily administer the PAQ measures in research and to provide you with a library of studies utilizing the PAQ-C and the PAQ-A.

Physical Activity Questionnaire for Older Children (PAQ-C)

The PAQ-C is appropriate for elementary school-aged children (grades 4-8; approximately ages 8-14) who are currently in the school system and have recess as a regular part of their school week.

Physical Activity Questionnaire for Adolescents (PAQ-A)

The PAQ-A is appropriate for high school students (grades 9-12; approximately ages 14-20) who are currently in the school system.

This manual provides a comprehensive overview of the PAQ-C and PAQ-A.

- Chapter 1: Describes why the PAQ-C and the PAQ-A were created and the limitations and strengths of these measures.
- Chapters 2 and 3: Includes keys to successful administration of the PAQ-C and the PAQ-A, scoring the questionnaires, validation and reliability studies, and the actual measures.
- Chapter 4: Summarizes the studies that we are aware of (as of August 2004) that have used or reviewed the PAQ-C or PAQ-A.

1.1 Why were the PAQ-C and the PAQ-A Created?

It is difficult to determine the best instruments to assess physical activity when a gold standard does not exist. Examples of instruments that have been used include a variety of physiological indicators, laboratory methods, direct observation, motion sensors, and self-report measures (Sallis & Saelens, 2000; Tremblay, Shephard, McKenzie, & Gledhill, 2001; Welk & Wood, 2000). Self-report measures are most frequently utilized for the assessment of physical activity levels in children and adolescents because they are typically low in cost and can be

easily administered to large populations. However, few recall instruments have strong validity and are feasible for large-scale research (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997).

In response to the need for a valid and feasible self-report measure for large-scale research with children and adolescents, the Physical Activity Questionnaire for Older Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; Kowalski, Crocker, & Faulkner, 1997) and the Physical Activity Questionnaire for Adolescents (PAQ-A; Kowalski, Crocker, & Kowalski, 1997) were developed and validated. The PAQ-C and PAQ-A are self-administered, 7-day recall questionnaires that measure general moderate to vigorous physical activity levels during the school year. Generally, the PAQs have had relatively strong correlation coefficients with other physical activity measures compared to other recall measures (Kowalski, Crocker, & Faulkner, 1997; Kowalski, Crocker, & Kowalski, 1997).

The PAQ-C and the PAQ-A may be advantageous for use in longitudinal research. The PAQs' low cost, reliable and valid assessment of physical activity from childhood through adolescence, and ease of administration make the PAQs feasible for large-scale studies. The questionnaires use a common scoring scheme and were used successfully in the University of Saskatchewan's longitudinal bone mineral accrual study (Bailey, McKay, Mirwald, Crocker, & Faulkner, 1999).

1.2 The Limitations and Strengths of the PAQ Measures

All physical activity measures, including the PAQ-C and the PAQ-A, have their strengths and limitations. For example, some tools may or may not be feasible for large-scale research, be cost and time efficient, have good adherence, have participant demand, and/or have acceptable distribution properties.

The PAQ-C's and the PAQ-A's limitations

- 1) The PAQ-C and PAQ-A were developed to assess general levels of physical activity. They do not provide an estimate of caloric expenditure or specific frequency, time, and intensity information.
- 2) The PAQs do not discriminate between specific activity intensities, such as moderate and vigorous activities; they simply provide a summary activity score (see the scoring section in Chapters 2 and 3).
- 3) The PAQ-C and the PAQ-A are only appropriate when used during the school year; they should *not* be used to assess physical activity in the summer or holiday periods. Therefore, the PAQ-C and the PAQ-A only assess activities for individuals in the school system.

The PAQ-C's and the PAQ-A's strengths

- 1) The PAQ-C and the PAQ-A have been supported as valid and reliable measures of general physical activity levels from childhood to adolescence (see the validation/reliability studies in Chapters 2 and 3). The PAQs' measurement of general physical activity levels is one its strengths because it is difficult to precisely measure intensity, frequency, and duration of young people's activities, especially with self-report (Kowalski, Crocker, & Faulkner, 1997)
- 2) The PAQs utilize memory cues such as lunch and evening items to enhance the recall ability of children and adolescents (see the PAQ measures in Chapters 2 and 3).
- 3) The PAQ-C and PAQ-A are cost and time efficient, easy to administer to large-scale populations, and display normal distribution properties (see the validation reliability studies in Chapters 2 and 3).

1.3 References

- Bailey, D. A., McKay, H. A., Mirwald, R. L., Crocker, P. R. E., & Faulkner, R. A. (1999). A six-year longitudinal study of the relationship of physical activity to bone mineral accrual in growing children: The University of Saskatchewan bone mineral accrual study. *Journal of Bone and Mineral Research, 14*, 1672-1679.
- Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise, 29*, 1344-1349.
- Kowalski, K. C., Crocker, P. R. E., & Faulkner, R. A. (1997). Validation of the Physical Activity Questionnaire for Older Children. *Pediatric Exercise Science, 9*, 174-186.
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- Sallis, J.F., & Saelens, B. E. (2000). Assessment of physical activity by self-report: Status, limitations, and future directions. *Research Quarterly for Exercise and Sport, 71*, 1-14.
- Tremblay, M. S., Shephard, R. J., McKenzie, T. L., & Gledhill, N. (2001). Physical activity assessment options within the context of the Canadian Physical Activity, Fitness, and Lifestyle Appraisal. *Canadian Journal of Applied Physiology, 26*, 388-407.
- Welk, G. J. & Wood, K. (2000). Physical activity assessments in physical education: A practical review of instruments and their use in the curriculum. *Journal of Physical Education, Recreation and Dance, 71*, 30-40.

CHAPTER 2: Physical Activity Questionnaire for Older Children (PAQ-C)

2.1 What is the PAQ-C?

The PAQ-C is a self-administered, 7-day recall instrument. *It was developed to assess general levels of physical activity throughout the elementary school year for students in grades 4 to 8 and approximately 8 to 14 years of age.* The PAQ-C can be administered in a classroom setting and provides a summary physical activity score derived from nine items, each scored on a 5-point scale.

2.2 Keys to Successful Administration

1) *When the PAQ-C is administered it is important to stress 2 points:*

- a) Explain it is **NOT A TEST**
- b) Explain you are interested in **ACTUAL** activity during the last **7 DAYS**

2) *To Prevent Missing Data, have the research assistants quickly glance through the questionnaires when they are gathered from the students.*

a) Missing one response for an activity on item 1 has little effect on the overall score, but you don't want the students missing entire items (ie. not having a response for item 6).

b) Explain to the students that the research assistants are not looking at their activity levels, but rather just making sure they haven't missed any of the questions.

3) *Overhead projectors may be helpful with younger age groups.*

- a) This allows researchers to read along with the students as they fill out their questionnaires.

Scoring

Overall process - Find an activity score between 1 and 5 for each item (excluding item 10)

Five Easy Steps

1) *Item 1 (Spare time activity)*

- Take the mean of all activities ("no" activity being a 1, "7 times or more" being a 5) on the activity checklist to form a composite score for item 1.

2) *Items 2 to 8 (PE, recess, lunch, right after school, evening, weekends, and describes you best)*

- The answers for each item start from the lowest activity response and progress to the highest activity response

- Simply use the reported value that is checked off for each item (the lowest activity response being a 1 and the highest activity response being a 5).

3) *Item 9*

- Take the mean of all days of the week ("none" being a 1, "very often" being a 5) to form a composite score for item 9.

4) *Item 10*

- Can be used to identify students who had unusual activity during the previous week, but this question is **NOT** used as part of the summary activity score.

5) *How to calculate the final PAQ-C activity summary score*

- Once you have a value from 1 to 5 for each of the 9 items (items 1 to 9) used in the physical activity composite score, you simply take the mean of these 9 items, which results in the final PAQ-C activity summary score.
- A score of 1 indicates low physical activity, whereas a score of 5 indicates high physical activity.

2.3 Validation Reliability Studies Concerning the PAQ-C

The following paragraphs summarize the original development, validity, and reliability studies for the PAQ-C. The summaries provide a brief synopsis of each study's findings (we recommend that the complete studies be reviewed as the final reference).

Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise*, 29, 1344-1349.

Evidence was provided that supported the PAQ-C as a reliable and valid measure of general physical activity levels in children during the school year. In three studies, Crocker, Bailey, Faulkner, Kowalski, and McGrath (1997) administered the PAQ-C to (N = 215, N = 84, and N = 200) elementary school children during the school year. The children were between the ages of 8 to 16 and attended a public school.

In the first study, the item and scale properties of the PAQ-C were examined. Ninety girls and 125 boys (ages 9-15) completed the PAQ-C on the same day. The mean activity score for females was 2.96 ($SD = 0.69$) and 3.44 ($SD = 0.68$) for males. Boys were significantly more active than girls with respect to the PAQ-C mean scores, $t(213) = 5.15$, $p < 0.01$, and each item score ($p < 0.05$), excluding the physical education item ($p < 0.08$). The item scale correlations were all above 0.30, and the scale reliability was acceptable for both females ($\alpha = 0.83$) and males ($\alpha = 0.80$). Recess and lunch items had the lowest correlations with the other items for males ($r = 0.33$ and 0.30 respectively) and females ($r = 0.42$ and 0.55 respectively). Most PAQ-C items had means close to the center of the range and the variability was acceptable. Overall, the PAQ-C was found to have acceptable measurement properties.

The second study examined the PAQ-C's test re-test reliability, internal consistency, and sensitivity to gender differences. Forty-three boys and 41 girls (ages 9-14) completed the PAQ-C. The children were assessed twice during school hours with one week in between assessments. The PAQ-C was relatively stable over the one-week assessment period (males, $r = 0.75$ and females, $r = 0.82$). However, further analysis showed significant increases in PAQ-C activity scores for both males, 2.85 ($SD = 0.73$) to 3.16 ($SD = 0.91$) and females, 2.56 ($SD = 0.65$) to 2.79 ($SD = 0.80$) over the two assessments, $F(1,83) = 22.26$, $p < 0.01$. Crocker et al. (1997) suggested a possible rationale for the increase in activity might be due to the change in weather. The first assessment week was cold and snowy, whereas the second assessment week was much warmer. The internal consistency for the first assessment was ($\alpha = 0.79$) and ($\alpha = 0.89$) for the second assessment. In general, the boys were found to be more active than the girls for weeks one and two, $t(82) = 1.93$, $p < 0.05$ and $t(82) = 1.97$, $p < 0.05$ respectively. The results of this study provide support for the test-retest reliability of the PAQ-C, and, similar to study 1, showed that the PAQ-C was sensitive to gender differences in physical activity levels.

The third study examined the reliability of the averages of 2 or 3 PAQ-C scores as a composite yearly activity score for children. Ninety-eight boys and 102 girls (ages 8-16) who were participants in the Saskatchewan pediatric bone study completed the PAQ-C. The PAQ-C was slightly modified for the adolescent participants with the recess item omitted, and some of

the activity checklist items were changed to represent adolescent activity choices. Using generalizability theory, the results suggested that the use of 3 and 2 PAQ-C scores as a yearly activity composite score were reliable for younger participants ($G = 0.86$ and $G = 0.80$ respectively) and older participants ($G = 0.90$ and $G = 0.85$ respectively). Sex, $F(1,199) = 20.22$, $p < 0.01$, and time, $F(2,398) = 34.34$, $p < 0.01$, effects were found. The marginal mean male activity score was higher than females' (3.11 and 2.71 respectively). Students were more active in April than Oct-Nov (3.10 and 2.79 respectively). In summary, the PAQ-C had acceptable measurement properties, internal consistency, and reliability for using the average of either two or three PAQ-C scores gathered during fall, winter, and spring. These results provided initial support that the PAQ-C is a valid measure of physical activity in children.

Kowalski, K. C., Crocker, P. R. E., & Faulkner, R. A. (1997). Validation of the Physical Activity Questionnaire for Older Children. *Pediatric Exercise Science*, 9, 174-186.

Two studies by Kowalski, Crocker, and Faulkner (1997) supported the PAQ-C as a valid measure of general physical activity levels. Two independent samples ($N = 89$ and $N = 97$) of children grades 4 to 8 completed the PAQ-C along with other physical activity measures.

In the first study, the convergent, construct, and divergent validity of the PAQ-C were examined. Thirty-eight boys and 51 girls ages 8 to 13 completed a behavioural conduct scale ($M = 2.92$, $SD = 0.53$), an athletic competence scale ($M = 2.94$, $SD = 0.58$), the PAQ-C ($M = 3.23$, $SD = 0.78$), and an activity rating ($M = 3.62$, $SD = 1.02$). Following the questionnaires, the classroom teachers completed a teacher's rating of physical activity questionnaire ($M = 68.13$, $SD = 10.97$), and the children completed the moderate to vigorous physical activity (MVPA) each day for 1 week.

Convergent validity was supported by moderate relationships with the activity rating ($r = 0.63$), week summation of 24-hr moderate to vigorous activity recalls ($r = 0.53$), and teacher's rating of physical activity ($r = 0.45$). The PAQ-C's moderate correlation with perceptions of athletic competence ($r = 0.48$) provided support for the construct validity of the PAQ-C. Divergent validity of the PAQ-C was supported by no relationship between the behavioural conduct scale and the PAQ-C. Gender differences were found on the PAQ-C and teacher's rating of physical activity.

In the second study, the convergent and construct validity of the PAQ-C was further examined. Forty-one boys and 56 girls completed the PAQ-C ($M = 3.35$, $SD = 0.68$), an activity rating ($M = 3.67$, $SD = 0.97$), the Leisure Time Exercise Questionnaire ([LTEQ]; $M = 75.31$, $SD = 58.20$), the Canadian home fitness test ([step test]; $M = 4.09$, $SD = 1.68$), the seven-day recall interview ([PAR]; $M = 37.72$, $SD = 4.13$), and wore the Caltrac motion sensor ([Caltrac]; $M = 426.54$, $SD = 131.61$). The children completed the Caltrac and PAR during a different week from the other measures due to possible carry over effects. The PAQ-C was moderately related to the activity rating ($r = 0.57$), LTEQ ($r = 0.41$), Caltrac ($r = 0.39$), PAR ($r = 0.46$), and the step test of fitness ($r = 0.28$). Unlike the first study, no gender differences were found for the PAQ-C. Overall, the results of these studies supported the validity of the PAQ-C.

2.4 The PAQ-C Measure

See the following page.

Physical Activity Questionnaire (Elementary School)

Name: _____

Age: _____

Sex: M _____ F _____

Grade: _____

Teacher: _____

We are trying to find out about your level of physical activity from ***the last 7 days*** (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

1. There are no right and wrong answers — this is not a test.
2. Please answer all the questions as honestly and accurately as you can — this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rowing/canoeing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In-line skating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking for exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jogging or running	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerobics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baseball, softball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Football	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Badminton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skateboarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soccer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Street hockey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volleyball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Floor hockey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basketball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice skating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross-country skiing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice hockey/ringette	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other:					
.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

- I don't do PE
- Hardly ever
- Sometimes
- Quite often
- Always

3. In the last 7 days, what did you do most of the time *at recess*? (Check one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

4. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 or 5 last week
- 6 or 7 times last week

7. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time
- 2 — 3 times
- 4 — 5 times
- 6 or more times

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

- A. All or most of my free time was spent doing things that involve little physical effort
- B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
- C. I often (3 — 4 times last week) did physical things in my free time
- D. I quite often (5 — 6 times last week) did physical things in my free time
- E. I very often (7 or more times last week) did physical things in my free time

9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wednesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thursday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saturday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sunday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

- Yes
- No

If Yes, what prevented you? _____

CHAPTER 3: Physical Activity Questionnaire for Adolescents (PAQ-A)

3.1 What is the PAQ-A?

The PAQ-A (a slightly modified version of the PAQ-C with the “recess” item removed) is a self-administered, 7-day recall instrument. *It was developed to assess general levels of physical activity for high school students in grades 9 to 12 and approximately 14 to 19 years of age.* The PAQ-A can be administered in a classroom setting and provides a summary physical activity score derived from eight items, each scored on a 5-point scale.

3.2 Keys to Successful Administration

1) *When the PAQ-A is administered it is important to stress 2 points:*

- a) Explain it is **NOT A TEST**
- b) Explain you are interested in **ACTUAL** activity during the last **7 DAYS**

2) *To Prevent Missing Data, have the research assistants quickly glance through the questionnaires when they are gathered from the students.*

a) Missing one response for an activity on item 1 has little effect on the overall score, but you don't want the students missing entire items (ie. not having a response for item 6).

b) Explain to the students that the research assistants are not looking at their activity levels, but rather just making sure they haven't missed any of the questions.

Scoring

Overall process - Find an activity score between 1 and 5 for each item (excluding item 9)

Five Easy Steps

1) *Item 1 (Spare time activity)*

- Take the mean of all activities (“no” activity being a 1, “7 times or more” being a 5) on the activity checklist to form a composite score for item 1.

2) *Item 2 to 7 (PE, lunch, right after school, evening, weekends, describes you best)*

- The answers for each item start from the lowest activity response and progress to the highest activity response

- Simply use the reported value that is checked off for each item (the lowest activity response being a 1 and the highest activity response being a 5).

3) *Item 8*

- Take the mean of all days of the week (“none” being a 1, “very often” being a 5) to form a composite score for item 8.

4) *Item 9*

- Can be used to identify students who had unusual activity during the previous week, but this question is **NOT** used as part of the summary activity score.

5) How to calculate the final PAQ-A activity summary score

- Once you have a value from 1 to 5 for each of the 8 items (items 1 to 8) used in the physical activity composite score, you simply take the mean of these 8 items, which results in the final PAQ-A activity summary score.

- A score of 1 indicates low physical activity, whereas a score of 5 indicates high physical activity.

3.3 Validation Reliability Study Concerning the PAQ-A

The following paragraphs summarize the development, validity, and, reliability study for the PAQ-A. The summary provides a brief synopsis of the study's findings (we recommend that the complete study be reviewed as the final reference).

Kowalski, K. C., Crocker, P. R. E., & Kowalski, N. P. (1997). Convergent validity of the Physical Activity Questionnaire for Adolescents. *Pediatric Exercise Science, 9, 342-352.*

The PAQ-A (a modified version of the PAQ-C) was developed to measure general levels of physical activity in adolescents. Kowalski, Crocker, and Kowalski (1997) administered the PAQ-A along with other physical activity measures to 85 high school students during the school year. The students consisted of 41 males and 44 females (grades 8 through 12), ages 13 to 20.

Two schools were assessed separately (late March-early April and late May-early June). The assessments were scheduled over two-week periods that avoided any special school events. The students were administered the PAQ-A ($M = 2.31$, $SD = 0.63$), an activity rating ($M = 3.15$, $SD = 0.93$), Leisure Time Exercise Questionnaire ([LTEQ]; $M = 54.02$, $SD = 30.23$), Caltrac motion sensor ([Caltrac]; $M = 355.88$, $SD = 126.01$), and the 7-day physical activity recall interview ([PAR]; $M = 36.21$, $SD = 3.24$). To ensure no carry over effects, the Caltrac and PAR were administered over a different 1-week period than the other measures. The PAQ-A was the only measure sensitive to gender differences, $t(83) = 3.01$, $p < 0.05$. The males were more active than the females (mean scores of 2.52 and 2.12 respectively).

The PAQ-A was significantly correlated to all self-report measures (activity rating, $r = 0.73$; LTEQ, $r = 0.57$; and PAR, $r = 0.59$). The PAQ-A was also related to the Caltrac ($r = 0.33$). A limitation of this study was that only 56.47% of students' Caltrac data were usable. The main problem with the Caltrac devices was that the students tampered with them. The PAQ-A scores differed significantly between those who had usable Caltrac data and those that did not, $t(83) = 2.78$, $p < 0.05$. These results provided support for the convergent validity of the PAQ-A.

3.4 The PAQ-A Measure

See the following page.

Physical Activity Questionnaire (High School)

Name: _____

Age: _____

Sex: M _____ F _____

Grade: _____

Teacher: _____

We are trying to find out about your level of physical activity from *the last 7 days* (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

3. There are no right and wrong answers — this is not a test.
4. Please answer all the questions as honestly and accurately as you can — this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rowing/canoeing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In-line skating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking for exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jogging or running	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerobics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baseball, softball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Football	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Badminton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skateboarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soccer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Street hockey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volleyball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Floor hockey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basketball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice skating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross-country skiing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice hockey/ringette	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other:					
_____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
_____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

- I don't do PE
- Hardly ever
- Sometimes
- Quite often
- Always

3. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

4. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

5. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 or 5 last week
- 6 or 7 times last week

6. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time
- 2 — 3 times
- 4 — 5 times
- 6 or more times

7. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

- F. All or most of my free time was spent doing things that involve little physical effort
- G. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
- H. I often (3 — 4 times last week) did physical things in my free time
- I. I quite often (5 — 6 times last week) did physical things in my free time
- J. I very often (7 or more times last week) did physical things in my free time

8. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wednesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thursday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saturday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sunday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

- Yes
- No

If Yes, what prevented you? _____

CHAPTER 4: Overview of Studies Using the Physical Activity Questionnaires

4.1 How has the PAQ-C and the PAQ-A been utilized in research?

The Physical Activity Questionnaire for Older Children (PAQ-C) and the Physical Activity Questionnaire for Adolescents (PAQ-A) have been used to classify children and adolescents into different activity levels (e.g., Mackelvie, McKay, Khan, & Crocker, 2001a; Kowalski, Crocker, Kowalski, 1997) and to investigate the relationship between physical activity and health outcomes (e.g., Bailey, McKay, Mirwald, Crocker, & Faulkner, 1999; Mackelvie, McKay, Khan, & Crocker, 2001b). In the following paragraphs, every study that we are aware of that has used the PAQ-C and/or the PAQ-A (as of August 2004) will be summarized (interested readers should consult the *Web of Science* citation indexes for updates). The reference for each study summary will be provided at the beginning of its summary. *The following study summaries focus on how the PAQ-C and the PAQ-A were utilized in the research.* These summaries should be considered brief overviews only, and you are encouraged to consult the primary sources when referencing these studies.

Bailey, D. A. (1997). The Saskatchewan pediatric bone mineral accrual study: Bone mineral acquisition during the growing years. *International Journal of Sports Medicine*, 18, S191-S194.

The six-year bone mineral accrual study described by Bailey (1997) examined the bone mineral accretion from childhood to adolescence. Sixty-eight elementary school boys and 72 elementary school girls were assessed. The children were recipients of Dual x-ray scans once a year and anthropomorphic measures every six months. As well, the children completed the PAQ-C and a nutrition questionnaire at least three times per year for the first three years and then twice a year every year after.

The results of Bailey's (1997) bone mineral accrual study suggest that adolescents' growth period is an important time for bone mineral accretion. The focus of this study was on physical growth; unfortunately the physical activity results were not reported. Bailey suggested that more research was needed to examine the relationship between physical activity and bone mineral accrual during adolescents' peak growth period (see Bailey, McKay, Mirwald, Crocker, & Faulkner, 1999, for the physical activity data in this study).

Bailey, D. A., McKay, H. A., Mirwald, R. L., Crocker, P. R. E., & Faulkner, R. A. (1999). A six-year longitudinal study of the relationship of physical activity to bone mineral accrual in growing children: The University of Saskatchewan bone mineral accrual study. *Journal of Bone and Mineral Research*, 14, 1672-1679.

The PAQ-C was used successfully in longitudinal research to measure children's general physical activity levels from childhood to adolescence. The above study investigated the relationship between physical activity levels and bone mineral accrual as children matured into adolescents. Two hundred and twenty-eight children were recruited from the Saskatchewan pediatric bone mineral accrual study. All children were Caucasian and 8 to 14 years of age. After 6 years of data collection, 68 boys and 72 girls remained and most provided acceptable longitudinal data for analyses. The measures administered were DEXA scans to assess bone mineral content, height and weight measurements, 24-hr recalls to assess dietary calcium, and the PAQ-C to assess general levels of physical activity (note that the PAQ-C was incorrectly called the PAC-Q in this study).

The children completed the PAQ-C at least 3 times per year for the first three years, and every additional year after the third year the PAQ-C was completed twice per year. Based on the PAQ-C mean activity score and *SD* for each age group, every child was given an age-gender specific *Z* score that signified the child's activity level as either active, average activity, or inactive. Fifteen boys and 13 girls were categorized as active, 30 boys and 27 girls were of average activity, and 15 boys and 13 girls were inactive.

Children's physical activity scores were significantly correlated with peak total body bone mineral accrual and total amount of bone mineral accumulated during the 2 years around the age of peak bone mineral content velocity ([PBMCV]; $r = 0.39$, $r = 0.40$ respectively for males; $r = 0.41$, $r = 0.38$ respectively for females; and both $p < 0.05$). For the lumbar spine, girls produced the highest correlation between physical activity and PBMCV ($r = 0.47$). The active boys and girls combined had a significantly different magnitude of total body bone mineral accrual at peak and total amount of bone mineral accumulated during the 2 years around PBMCV compared to inactive boys and girls combined.

Ball, G. D. C., Marshall, J. D., & McCargar, L. J. (2003). Fatness and fitness in obese children at low and high health risk. *Pediatric Exercise Science*, 15, 392-405.

To investigate whether or not physical activity levels predict the presence of metabolic risk factors of cardiovascular disease (CVD) and type 2 diabetes, the PAQ-C was used to classify children's physical activity levels. Body composition, physical inactivity, and cardiorespiratory fitness were also investigated in this study to determine their prediction ability. Obese children ($N = 83$) ages 6 to 12 years of age from Edmonton and the surrounding area participated in this study.

Children were tested for CVD and type 2 diabetes risk factors. Dyslipidemia, insulin resistance, and elevated blood pressure were measured for; as well, assessments of height, weight, BMI, skinfolds, and total body and regional body composition (as assessed by DEXA scans) were completed. The sum of 5 skinfolds was used to classify children as obese. The children completed the PAQ-C and a physical maturation questionnaire, and the parents filled out a questionnaire classifying their social economic status. Physical inactivity was estimated from the previous 7 days of self-reported time spent watching television and playing video/computer games. Ethnic background, CVD, and type 2 diabetes histories were reported by parents. The children completed a

cardiovascular test, blood samples were taken, and blood pressure, insulin levels, and glucose levels were measured. Children were categorized as either low health risk (LHR) or high health risk (HHR). Those children with 1 or more risk factor for CVD or type 2 diabetes were categorized as HHR, whereas no risk factors produced a LHR status. Risk factors for CVD and type 2 diabetes included dyslipidemia, insulin resistance, and elevated blood pressure.

Fifty-three children were categorized as HHR and 30 children were categorized as LHR. Together, 24/83 children had 2 or more risk factors. The LHR children and the HHR children had almost identical activity levels as assessed by the PAQ-C ($M = 3.01$, $SD = 0.65$ and $M = 3.00$, $SD = 0.66$; respectively). Significant predictors of an HHR classification were central body fat mass and the sum of 5 skinfolds. LHR children and HHR children differed significantly ($p = 0.05$) in mean total body lean mass, mean total body fat mass, and mean central body fat mass. Physical activity along with other lifestyle variables did not predict metabolic risk for CVD and type 2 diabetes. Central body fat mass was the strongest predictor of an HHR categorization.

Carter, L. M., Whiting, S. J., Drinkwater, D. T., Zello, G. A., Faulkner, R. A., & Bailey, D. A. (2001). Self-reported calcium intake and bone mineral content in children and adolescents. *Journal of the American College of Nutrition, 20*, 502-509.

The physical activity levels of children and adolescents were assessed by the PAQ-C to determine whether or not physical activity has a relationship to bone mineral density. Two hundred and twenty-seven children from the Saskatchewan pediatric bone mineral accrual study were assessed in the fall of 1993. Additional measurements administered were DEXA scans to assess bone mineral, two to four 24-hour recalls monitoring dietary intake, maturity ratings, anthropomorphic measures such as height, weight, and adiposity. High school students were given a modified PAQ-C that omitted the recess item (i.e., PAQ-A).

Generally, in comparison to females, the males had higher activity scores. Males had a mean physical activity score of 3.1 ($SD = 0.6$, $n = 107$) and the females mean activity score was 2.7 ($SD = 0.6$, $n = 117$). For both males and females, there were no significant correlations between activity scores and lumbar spine bone mineral content or total body bone mineral content. Using a multiple linear regression model of lumbar spine bone mineral content in males and females, the activity score was a significant predictor of lumbar spine bone mineral content only for females.

Crocker, P. R. E., Eklund, R. C., & Kowalski, K. C. (2000). Children's physical activity and physical self-perceptions. *Journal of Sports Sciences, 18*, 383-394.

The PAQ-C and the Physical Self-Perception Profile (PSPP) were used to study the relationship between children's physical activity levels and physical self-perceptions. Two hundred and twenty boys and 246 girls were recruited. The children were in grades 5 to 8 and were selected from five different schools.

The PAQ-C scores differed significantly between the boys and the girls ($p < 0.008$). The mean activity scores for boys, girls, and boys and girls combined were 3.21($SD = 0.67$), 2.95 ($SD = 0.64$), and 3.07 ($SD = 0.67$) respectively. A multivariate analysis of variance of the PAQ-C activity checklist displayed that the frequency of reporting certain activities differed between boys and girls (Wilks' lambda = 0.638, $F_{22, 451} = 11.63$, $p < 0.001$). However, the effect sizes for most activity differences reported were small. The authors suggested caution when interpreting the differences between the boys' and the girls' activities because the PAQ-C questionnaire is based only on the previous 7 days.

Children's physical activity levels were significantly correlated with self-perceptions of sport competence, body attractiveness, physical conditioning, physical strength, and general physical self-worth ($r = 0.26-0.47$ for girls and $r = 0.28-0.47$ for boys, $p < 0.05$). The physical self-perception model with pathways from physical condition and sport competence to the PAQ-C predicted 27 to 29 percent of the variance in boys' and girls' activity scores.

Crocker, P. R. E., Holowachuk, D. R., & Kowalski, K. C. (2001). Feasibility of using the Tritrac motion sensor over a 7-day trial with older children. *Pediatric Exercise Science, 13*, 70-81.

To assess the feasibility of the Tritrac-R3D activity monitor (Tritrac), the PAQ-C along with other physical activity measures were compared to the Tritrac. Seventy-nine children in grades 4 to 8 participated. The final sample consisted of 34 girls and 27 boys who were predominately Caucasian and lived in a middle class area. The Tritrac and the Caltrac personal activity computer (Caltrac) were used by the children. The children also completed the PAQ-C and the 7-day physical activity recall interview (PAR). They wore the Tritrac and Caltrac monitors for 7 consecutive days.

The PAQ-C was significantly correlated with the PAR summary score ($r = 0.39$); however, the PAQ-C was not related to the Tritrac ($r = 0.13$), and the Tritrac was related to the Caltrac ($r = 0.86$). One explanation as to why the Tritrac was not correlated with the PAQ-C may be due to adherence issues with the Tritrac. Problems with the Tritrac included mechanical problems, social embarrassment, discomfort, and forgetting to wear the device. Of the 79 students that participated in this study, 22 students did not reach 56 hours of Tritrac data per week. The adherence problems with the Tritrac may have distorted the children's normal activity patterns, which may explain the low correlations between subjective and objective measures. The results of this study suggest that the Tritrac may not be feasible for studies of longer duration assessing general levels of physical activity in children.

Crocker, P. R. E., Sabiston, C., Forrester, S., Kowalski, N. P., Kowalski, K. C., & McDonough, M. (2003). Predicting change in physical activity, dietary restraint, and physique anxiety in adolescent girls. *Canadian Journal of Public Health, 94*, 332-337.

The PAQ-A was used in this two-year study to measure adolescent females' physical activity levels. The girls' body mass index (BMI), global self-esteem (GSE), physical self-perceptions, social physique anxiety (SPA), and dietary restraint were also examined. Of most importance were the changes in these constructs and the relationships that followed.

Six hundred and thirty-one female adolescents (ages 15-16) participated. The girls were enrolled in schools in Saskatoon and the surrounding area. They completed the Physical Self-Perceptions Profile, the Dutch Eating Behavior Questionnaire-Restrained Eating (DEBQ-R), the PAQ-A, and the Social Physique Anxiety Scale during class time. BMIs were also calculated (range = 14.8-36.9) based on self-reported height and weight.

The adolescent females' physical activity scores decreased (year 1 $M = 2.65$, $SD = 0.59$; year 2 $M = 2.40$, $SD = 0.55$; $p < 0.05$). Cross-sectional analysis for the first year revealed that the PAQ-A was significantly correlated ($p < 0.05$) to GSE, BMI, and physical self-perceptions of physical self-worth (PSW), body appearance, conditioning, sport, and strength (range = 0.12-0.51). For year 2, the PAQ-A was correlated to the same variables as year 1 (range = -0.12-0.58), except for BMI (and also with the addition of SPA). Pearson product moment correlations displayed that a change in physical activity was related to a change in each self-perception (excluding BMI), and physical conditioning was found to be the strongest predictor of physical activity change.

Ernst, M. P., & Pangrazi, R. P. (1999). Effects of a physical activity program on children's activity levels and attraction to physical activity. *Pediatric Exercise Science, 11*, 393-405.

The impact of both an activity intervention (termed P.L.A.Y.) and a modified P.L.A.Y. placebo intervention on elementary school children was partially assessed by the PAQ-C. The PAQ-C was used to monitor activity levels from the start of the study to following the intervention. The teachers from 5 elementary schools ($N = 28$) and their students participated. Each class consisted of approximately 25 students. The students were in either grades 4, 5, or 6 and the ratio of boys to girls was approximately balanced. The majority of teachers and students were Caucasian and were of middle economic status. The children were categorized as either high or low activity levels from their pre-test PAQ-C scores. The PAQ-C and the Children's Attraction to Physical Activity (CAPA) scale were administered at the same time.

The children were randomly assigned to either the intervention group or the placebo group before the study began. The P.L.A.Y. intervention and the P.L.A.Y. placebo intervention were 12 weeks in length and consisted of 2 steps. The first step (a duration of 4 weeks) included a 15-minute activity break during the school day. During these weeks, the P.L.A.Y. intervention group was encouraged to participate in activity and their teachers taught a new activity game each day (total of 15 games), whereas the placebo group was not encouraged to be active and no games were taught. The children were given a logbook to complete step 2 (8 weeks in duration). The P.L.A.Y. intervention group logged their activity hours from the previous day, and the P.L.A.Y. placebo group recorded the number of hours spent watching television. At this step the 15-minute activity breaks were discontinued for both groups.

The intervention group consistently had significantly higher activity scores compared to the placebo group ($p < 0.05$). The intervention boys' and girls' mean baseline physical activity scores were 3.05 ($SD = 0.68$) and 2.89 ($SD = 0.54$) respectively, whereas the control boys' and girls' mean baseline physical activity scores were 3.01 ($SD = 0.72$) and 2.77 ($SD = 0.50$) respectively. The mean activity scores for the intervention boys' at the midpoint and at the end of the intervention were 3.40 ($SD = 0.57$) and 3.37 ($SD = 0.48$) respectively, whereas the placebo boys' mean activity scores were 2.93 ($SD = 0.66$) and 3.02 ($SD = 0.56$) respectively. The girls had similar results. The intervention girls' mean activity scores at the midpoint and at the endpoint were 3.16 ($SD = 0.43$) and 3.09 ($SD = 0.40$) respectively, whereas the placebo girls' mean scores were 2.80 ($SD = 0.52$) and 2.76 ($SD = 0.39$) respectively. The effect size for both the intervention boys and girls were significant at the midpoint and post-test (0.71 and 0.63 respectively for boys and 0.69 and 0.85 for girls). The P.L.A.Y. intervention children who were classified in the high activity group always had higher activity scores than the placebo group. The majority of children with high and low physical activity levels who participated in the P.L.A.Y intervention improved their physical activity status.

Gurd, B., & Klentrou, P. (2002). Physical and pubertal development in young male gymnasts. *Journal of Applied Physiology*, 95, 1011-1015.

This study measured adolescent boys' weekly energy expenditure with the help of the PAQ-A. The boys were gymnasts and had intense training programs. Their physical growth and sexual maturation were investigated for training effects.

Twenty-one elite male gymnasts and 24 controls (enrolled in a martial arts school) were recruited to participate. Each gymnast was participating in at least 15 hours of training per week, whereas the controls completed 2 hours or less per week (M age = 13.3 years, M age = 13.5 years; respectively). Measurements of height, weight, pubertal maturation, salivary testosterone, and relative body fat (as assessed by bioelectrical impedance) were taken once before the adolescents' regular training. As well, the adolescents reported the number of training sessions and training hours per week. The PAQ-A assisted the measurement of weekly energy expenditure [metabolic equivalents (MET)/wk].

The PAQ-A general physical activity scores were not reported. Energy expenditure (MET/wk), training sessions/wk, and training duration (h/wk) made up the males' physical activity characteristics. The elite male gymnasts had significantly ($p \leq 0.05$) greater energy expenditures, training duration, and training sessions per week compared to the controls. Training variables and energy expenditure were significantly ($p \leq 0.05$) correlated to relative body fat but not to physical growth or sexual maturation.

Heinonen, A., McKay, H. A., Whittall, K. P., Forster, B. B., & Khan, K. M. (2001). Muscle cross-sectional area is associated with specific site of bone in prepubertal girls: A quantitative magnetic resonance imaging study. *Bone*, 29, 388-392.

In this study, a modified PAQ-C was used to estimate the duration (hours per week) of loaded physical activity children performed. The possible relationship between muscle cross-sectional area and total cortical bone area in prepubertal and early pubertal girls was of greatest importance. Specifically, this study investigated whether or not a region-specific relationship existed.

Prepubertal and early pubertal girls ($N = 17$) who were participating in regular physical education classes; of tanner stage I-II; had no metabolic disorders and musculoskeletal complications; and were not taking medications that would influence bones, balance, or strength participated in this study. The girls attended elementary school and were between the ages of 9 to 11 years. The children's height and weight were measured, and a maturity rating was established. Calcium intake and health history were also assessed. Muscle and bone measurements were measured by an MRI, lower limb explosive performance capacity was assessed, and drop jump and side-to-side jump ground reaction forces were evaluated. The duration (h/week) of loaded physical activity was estimated from the PAQ-C's after school and during school items.

The PAQ-C scores were not reported; however, all girls were reported to be moderately active. The mean time that children spent in loaded physical activity was 5 hours/week ($SD = 3.5$).

MacKelvie, K. J., McKay, H. A., Khan, K. M., & Crocker, P. R. E. (2001a). Lifestyle risk factors for osteoporosis in Asian and Caucasian girls. *Medicine and Science in Sports and Exercise*, 33, 1818-1824.

The PAQ-C was used to assess the level of children's participation in loaded physical activity. MacKelvie, McKay, Khan, and Crocker (2001) studied 191 young girls' (9-12 years of age) bone mineral content and associated lifestyle factors. The girls were classified as either Tanner breast stage I or Tanner breast stage II. There were 56 Asian girls and 75 Caucasian girls from 14 schools outside of Vancouver in the Richmond school district. The girls were classified into ethnic groups and the following measurements were taken: maturity ratings, bone mineral measures assessed by DEXA scans, height and weight measurements, calcium intake assessed by a food frequency questionnaire, and physical activity participation assessed by a modified PAQ-C. The modified PAQ-C included a measurement of time ($\text{h} \times \text{wk}^{-1}$) spent in loaded physical activities (impact > walking) and a record of how often the child participated in evening organized sports and/or activity lessons per week.

The Tanner I Asian girls participated significantly less in general physical activity ($p < 0.05$) and had significantly lower calcium intake ($p < 0.001$) than the Tanner I Caucasian girls. The Tanner I Asian girls' mean scores for general physical activity, sport nights per week, and time spent in loaded physical activity (hr/wk) were 2.7($SD = 0.5$), 1.0 ($SD = 1.3$), and 4.2 ($SD = 4.0$) respectively, whereas the Tanner I Caucasian girls' mean scores were 3.0 ($SD = 0.6$), 1.5 ($SD = 1.7$), and 4.6 ($SD = 3.5$) respectively. The Tanner I Caucasian girls spent 66% of their time in sport outside of school, whereas the Tanner I Asian girls spent 40% of their time in extracurricular sports. The Tanner I Caucasian girls contributed 9% more of their time in loaded physical activity per week compared to Tanner I Asian girls.

The Tanner II Caucasian girls had significantly higher loaded physical activity participation ($p < 0.01$), sports nights per week ($p < 0.05$), and calcium intake ($p < 0.001$) than the Tanner II Asian girls. The Tanner II Caucasian girls' mean scores for general physical activity, sport nights per week, and time spent in loaded physical activity (hr/wk) were 2.9 ($SD = 0.6$), 2.5 ($SD = 1.8$), and 5.9 ($SD = 4.1$) respectively. In comparison to the Tanner II Caucasian girls, the Tanner II Asian girls' mean score for general physical activity was similar (2.7, $SD = 0.6$), lower for sport nights per week (1.3, $SD = 2.0$), and lower for time spent in loaded physical activity (3.3, $SD = 2.7$). The Tanner II Caucasian girls had approximately 41% higher calcium intake, more participation in out-of-school sports per week, and 44% more time in loaded activity.

MacKelvie, K. J., McKay, H. A., Khan, K. M., & Crocker, P. R. E. (2001b). A school-based exercise intervention augments bone mineral accrual in early pubertal girls. *The Journal of Pediatrics*, 139, 501-508.

The PAQ-C was used to examine whether or not physical education exercise interventions may be beneficial for bone health in prepubertal and early pubertal girls. Fourteen mixed ethnic schools from the Richmond school district outside of Vancouver participated in a school-based physical activity intervention. The schools were randomly assigned to either the control or the intervention group. This study focused on the girls who participated (26 prepubertal (PRE) control, 44 PRE intervention, 64 Early puberty (Early) control, and 43 Early intervention). The girls underwent the following measurements: maturity ratings, bone mineral measurements assessed by DEXA scans, height and weight, calcium intake assessed by a food frequency questionnaire, and physical activity participation assessed by a modified PAQ-C. The modified PAQ-C included a measurement of time spent in loaded activities and in common sports, as well as a measurement of how often the child participated in evening organized sports. The children in the intervention group participated 3 times per week in a 10-12 minute, high impact, weight bearing training program where the intensity of the program was increased progressively.

The intervention group and the control group for both prepubertal and early puberty girls had a similar mean calcium intake, general physical activity level (PRE control = 2.80 [0.47], PRE intervention = 2.96 [0.52], Early control = 2.90 [0.52], and Early intervention = 2.90 [0.51]), loaded physical activity (PRE control = 4.5 [3.2], PRE intervention = 4.9 [3.0], Early control = 5.7 [3.7], and Early intervention = 5.7 [4.1]), and extracurricular sport participation per week (PRE control = 1.2 [1.2], PRE intervention = 1.2 [1.4], Early control = 1.7 [1.5], and Early intervention = 1.6 [1.4]). Compared to the Early girls in the control group, the Early girls who participated in the intervention accumulated 1.5% to 3.1% more bone at the lumbar spine and femoral neck ($p < 0.05$).

MacKelvie, K. J., McKay, H. A., Petit, M. A., Moran, O., & Khan, K. M. (2002). Bone mineral response to a 7-month randomized controlled, school-based jumping intervention in 121 prepubertal boys: Associations with ethnicity and body mass index. *Journal of Bone and Mineral Research*, 17, 834-844.

Prepubertal boys' general physical activity levels were determined by the PAQ-C. Modifications were made to the PAQ-C so that the researchers could estimate the children's time spent in loaded activity and common sports. Of most interest to this study were the bone mineral changes in prepubertal boys after a 7-month jumping intervention. These changes were then compared to the control boys' bone mineral changes.

Fourteen schools outside of the Vancouver area volunteered to participate after being recruited. Three hundred and eighty-three children (ages 8.8-11.7 years) participated. The children were categorized as either Asian or Caucasian. If a child was taking medications or had a medical complication that could influence physical activity or bone development they were excluded from the study. A health history questionnaire assessing the children's health was completed by the parents. The following measurements were also taken: maturity rating, bone mineral, height, weight, calcium, and physical activity. A modified PAQ-C estimated the time (h/week) the boys spent in out-of-school sports and loaded activities (impact > walking). The mean general physical activity scores reported in this study are an average of three assessments by the PAQ-C during the school year (baseline, winter, and a final measurement).

The intervention group participated in a school-based jumping exercise intervention 3 times per week (2 physical education class times and one supervised session). The exercise intervention included high-impact, weight-bearing activity for 10 to 12 minutes. The program's difficulty and loading progressed throughout the school year.

There was no change in prepubertal boys' physical activity scores and loaded activity time for control, intervention, Asian, and Caucasian groups over the 7 months. The baseline mean physical activity score for the control boys was 3.1 ($SD = 0.5$) and 3.1 ($SD = 0.6$) for the intervention group. Asian and Caucasian control groups with an average body mass index (BMI) had mean baseline physical activity scores of 3.0 ($SD = 0.4$) and 3.0 ($SD = 0.5$) respectively. The intervention Asian and Caucasian groups with an average BMI had mean baseline physical activity scores of 3.0 ($SD = 0.6$) and 3.1 ($SD = 0.6$). The mixed ethnicity control boys had a mean baseline PAQ-C score of 3.1 ($SD = 0.6$). The mean was 3.0 ($SD = 0.4$) for the mixed ethnicity intervention group. At several different sites, the intervention boys (Asian and Caucasian) with low or average BMI gained significantly ($p < 0.01 - p < 0.05$) more bone mineral accrual than their controls. No changes were found in prepubertal intervention and control boys with a high BMI over the 7 months. The jumping intervention was reported as successful in increasing bone mineral accrual in Asian and Caucasian prepubertal boys with a low or average BMI.

MacKelvie, K. J., Petit, M. A., Khan, K. M., Beck, T. J., & McKay, H. A. (2004). Bone mass and structure are enhanced following a 2-year randomized controlled trial of exercise in prepubertal boys. *Bone*, 34, 755-764.

Prepubertal boys' general physical activity levels were determined by the PAQ-C. Modifications were made to the PAQ-C so that the researchers could estimate the children's time spent in loaded activity and common sports. Of most interest to this study were the prepubertal boys' changes in proximal femur bone geometry and strength after a

2-year loaded physical activity intervention. These results were compared to the control boys' changes. As well, the intervention boys' and the control boys' total body, proximal femur, and lumbar spine bone mineral content and bone area changes were of importance.

Fourteen schools outside of the Vancouver area volunteered to participate after being recruited. All schools were randomly assigned to either the intervention or the control groups (intervention = 7 and control = 7). Thirty-one intervention boys and 33 control boys participated. A health history questionnaire assessing the children's health was completed by the parents. The following measurements were also taken at baseline, 8 months, 12 months, and 20 months: maturity rating, bone mineral content, bone area, height, weight, calcium intake, leg length, long jump, vertical jump, and physical activity. Structural and geometric characteristics of the proximal femur were assessed by a Hologic Inc. QDR-4500 bone densitometer. These measurements were analyzed using hip structural analysis. A modified PAQ-C assessed the number of nights the boys spent in common sports per week and the time spent in loaded activities (h/week). The mean general physical activity scores reported in this study are an average of 6 assessments by the PAQ-C over the 2 school years (fall, winter, and spring completion).

The intervention group participated in a school-based jumping exercise intervention. The intervention included 3 sessions per week with high-impact, weight-bearing activity for 10 to 12 minutes. The program's difficulty and intensity progressed throughout the 2 school years.

The PAQ-C average 20-month physical activity scores were similar between the intervention and control boys, $M = 3.2$ ($SD = 0.6$) and $M = 3.1$ ($SD = 0.5$) respectively. Further, the scores for average number of sports nights per week and average time spent in loaded activity were similar between the two groups.

Mahon, A. D., Anderson, C. S., Hipp, M. J., & Hunt, K. A. (2003). Heart rate recovery from submaximal exercise in boys and girls. *Medicine and Science in Sports and Exercise*, 35, 2093-2097.

The PAQ-C was used to assess 11 boys' and 10 girls' physical activity levels. This study was interested in their heart rate (HR) changes that occurred after two separate submaximal exercise sessions.

The children's pubertal status, height, weight, and 6 skinfolds were measured. The parents completed the PAQ-C (with help from their children). To measure peak VO_2 , a graded cycle ergometer test was completed by the children on two different sessions. During these sessions resting HR, exercise HR, and postexercise HR were measured.

The boys and girls had similar physical activity levels ($M = 3.1$, $SD = 0.6$; $M = 3.0$, $SD = 0.4$; respectively). In this study, peak VO_2 was less effective in accounting for variations in postexercise HR in comparison to resting HR.

McKay, H. A., Petit, M. A., Khan, K. M., & Schutz, R. W. (2000). Lifestyle determinants of bone mineral: A comparison between prepubertal Asian- and Caucasian-Canadian boys and girls. *Calcified Tissue International*, 66, 320-324.

McKay, Petit, Khan, and Schutz (2000) compared Caucasian and Asian children's lifestyle factors that could affect bone mineral content. Ten Canadian multi-ethnic schools participated. Fifty-eight prepubertal Asian children and 110 prepubertal Caucasian children (mean age 8.9) were assessed. The children received DEXA scans of the proximal femur, lumbar spine, and total body. The following measurements were taken: stretch statures as assessed by a wall stadiometer, maturity ratings, and weight. The children completed a food frequency questionnaire to classify calcium intake and the PAQ-C to classify physical activity levels. The scoring of the PAQ-C was modified. The original PAQ-C provides an activity rating from 1 to 5 for each child (where a 1 represents a low activity level and a 5 represents a high activity level). In this study, the physical activity score was calculated from the amount of loaded physical activity that was recalled by the children in the prior week and was not scored on a 5-point scale. Additionally, the children were asked if the activity reported for the previous week was consistent with their usual activity participation.

The PAQ-C activity scores demonstrated the differences in Asian and Caucasian children's physical activity levels. Overall, Asian children had a significantly lower calcium intake and physical activity participation than the Caucasian children (70.2 [$SD = 19.2$] vs. 82.0 [$SD = 16.5$] respectively; $p < 0.001$). The mean activity score for Asian children was 67.4 ($SD = 16.6$) for boys and 73.3 ($SD = 21.5$) for girls, whereas the mean activity score for Caucasian children was 87.8 ($SD = 17.1$) for boys and 76.0 ($SD = 13.5$) for girls. Only 14% of Asian boys reported participating in sport, compared to 73% of Caucasian boys reporting involvement in organized sport. Bone mineral free lean mass, sex, and physical activity were significant predictors of areal bone mineral density at the femoral neck and the total proximal femur.

McKay, H. A., Petit, M. A., Schutz, R. W., Prior, J. C., Barr, S. I., & Khan, K. M. (2000). Augmented trochanteric bone mineral density after modified physical education classes: A randomized school-based exercise intervention study in prepubescent and early pubescent children. *The Journal of Pediatrics*, 136, 156-162.

The PAQ-C was used to classify children's activity levels in order to determine the impact of an 8-month exercise intervention on children's areal bone mineral density. One hundred and forty-four children in grades 3 and 4 from 10 different elementary schools were assessed. Forty-nine children were Asian and 95 children were Caucasian. The schools were randomly placed into either the intervention or the control group. The intervention group participated in a loaded activity physical education intervention, whereas the control group participated in their usual physical education class. The intervention was performed 3 times per week and included 10 minutes of loaded activity, 10 tuck jumps at the beginning of class, and 10 to 30 minutes of total activity. The intensity of the intervention progressed throughout the 8 months. The children received DEXA scans and anthropometric measurements. They also completed calcium intake questionnaires, a healthy history form, a self-assessment of maturity, and the PAQ-C. The

PAQ-C was modified in order to focus on the children's loaded activity levels and the final activity score was not based on a 5-point scale.

According to the baseline measurements of the PAQ-C, the children in the control group had significantly higher physical activity levels than the intervention group (control = 86.0, exercise = 80.5, $p = 0.002$). The children who participated in the exercise intervention had significantly greater gains in femoral trochanteric areal bone mineral density than the control group (4.4% vs. 3.2 %, $p = 0.05$). Interestingly, the control group had greater activity levels compared to the intervention group at the 8-month final assessment.

Muratova, V. N., Islam, S. S., Demerath, E. W., Minor, V. E., & Neal, W. A. (2001). Cholesterol screening among children and their parents. *Preventive Medicine, 33*, 1-6.

The PAQ-C was used to classify children's physical activity levels in a school-based cholesterol-screening program. Seven hundred and nine children in the fifth grade from rural Appalachian countries participated. The children were comprised of 326 boys and 383 girls (mean age 10.8) where the majority of children were Caucasian. The cholesterol-screening program was comprised of three phases: screening, diagnosis, and intervention. The children's nonfasting finger-stick total blood cholesterol, high-density lipoprotein cholesterol, anthropomorphic measures, and dietary history were assessed in the screening phase. Additionally, physical activity levels were assessed by the PAQ-C, parental smoking was measured by a questionnaire completed by the parents, and anxiety levels were assessed on a 5-point Likert scale. The children's mean physical activity score was 2.89 ($N = 707$, $SD = 0.64$). The PAQ-C physical activity score displayed a relationship with diastolic blood pressure; however, the magnitude of the relationship was weak ($r = -0.07$).

Paxton, R. J., Estabrooks, P. A., & Dzewaltowski, D. (2004). Attraction to physical activity mediates the relationship between perceived competence and physical activity in youth. *Research Quarterly for Exercise and Sport, 75*, 107-111.

To determine children's physical activity levels, the PAQ-C was used. Relationships among children's physical activity, perceived physical competence, and attractions to physical activity were investigated. Further, this study examined whether or not attraction to physical activity mediates the relationship between perceived physical competence and physical activity.

The children of four 4-H youth development clubs were asked to participate. Sixty-three Caucasian children (ages 9-14 years) from the entire sample of 94 children provided parental consent to participate. Thirty-four percent of children were boys. A modified Perceived Physical Competence Scale for children, The Children's Attraction to Physical Activity Scale (CAPAS), and the PAQ-C were completed during the winter (*Note. In this study the PAQ-C was called the PAQ-OC*).

The children had low physical activity levels ($M = 1.83$, $SD = 0.64$). Significant ($p < 0.01$) bivariate correlations were found between physical activity and attraction to physical activity ($r = .45$) and perceived physical competence ($r = .34$). Further, attraction to physical activity mediated the relationship between perceived physical competence and physical activity.

Petit, M. A., McKay, H. A., MacKelvie, K. J., Heinonen, A., Khan, K. M., & Beck, T. J. (2002). A randomized school-based jumping intervention confers site and maturity-specific benefits on bone structural properties in girls: A hip structural analysis study. *Journal of Bone and Mineral Research, 17*, 363-372.

Prepubertal and early pubertal girls' general physical activity levels were assessed by the PAQ-C. This study focused on what geometric and structural bone changes occurred in the girls as a result of a school-based jumping exercise intervention.

Fourteen schools outside of the Vancouver area volunteered to participate after being recruited. One hundred and seventy-seven girls (ages 9-12 years) volunteered to participate. The schools were randomly assigned to either the intervention or control group. The girls' stretch statures, sitting heights, weights, calcium intakes, maturity ratings, and physical activity levels were measured. A modified PAQ-C was used so that a measure of loaded activity (impact > walking, h/week) and the number of nights the girls' participated in organized sport per week could be calculated. The girls completed the PAQ-C three times during the year.

The loaded exercise intervention included high-impact, 10 to 12 minutes sessions, and a variety of jumping activities. Two sessions per week were held during the girl's physical education class, while the third session was completed in class time on a different day. The difficulty and the intensity of the intervention progressively increased throughout the year.

The PAQ-C scores were not included. However, this study reported that the baseline measurements of physical activity for the intervention and control group showed no differences. Further, the abstract reported that physical activity levels were similar for both groups over the 7 months.

Rosendo da Silva, R. C., & Malina, R. M. (2000). Level of physical activity in adolescents from Niteroi, Rio de Janeiro, Brazil. *Cadernos-de-saude-publica-Ministerio-da-Saude,-Fundacao-Oswaldo-Cruz,-Escola-Nacional-de-Saude-Publica, 16*, 1091-1097.

Rosendo da Silva and Malina (2000) created a Portuguese version of the PAQ-C to assess general physical activity levels in Brazilian children and adolescents. The manuscript and the PAQ-C were in Portuguese; therefore, this study summary is based on its English written abstract and observations made from the Portuguese PAQ-C.

Rosendo da Silva and Malina (2000) focused on Brazilian adolescents' ($N = 325$) activity levels. Anthropomorphic measures, hours of television viewing per day, and general activity levels were measured. The males' mean PAQ-C activity score was 2.3

($SD = 0.6, p < 0.01$) and the females' mean activity score was 2.0 ($SD = 0.6, p < 0.01$). The most frequently chosen activity was soccer for males and soccer and walking for females. A high percentage of children were classified as inactive from their PAQ-C scores (85% of males and 94% of females were inactive). The authors of this study were concerned with the high percentage of inactive children because these children may be more likely to be inactive adults. Interestingly, the mean activity scores for the Brazilian females and males were slightly lower than the mean activity scores found in the English PAQ-C validation reliability studies (see Chapter 2 for the English PAQ-C scores).

The Portuguese PAQ-C has content and scoring differences compared to the English PAQ-C. The Portuguese PAQ-C has additional items and includes a television item quantifying the number of hours children and adolescents watch television per day (this item is not included in the final activity score). Both questionnaires have an activity checklist item; however, the number of activity choices differ. The Portuguese version of the PAQ-C has 15 activity choices, whereas the original PAQ-C has 23 activity choices. Therefore, researchers should be cautious in interpreting the mean value of the activity checklist item because the Portuguese activity checklist item may be prone to producing a higher or lower activity score than the original PAQ-C.

Rourke, K. M., Brehm, B. J., Cassell, C., & Sethuraman, G. (2003). Effect of weight change on bone mass in female adolescents. *Journal of the American Dietetic Association, 103, 369-372.*

The activity levels of obese female adolescents were assessed by the PAQ-C. This study was interested in obese adolescents' changes in bone mineral density and bone mineral content as a result of participating in a weight reduction program. Ninety-two obese girls (mean age = 11) were recruited through newspaper advertisements and recommendations by pediatricians. The children received DEXA scans, anthropomorphic measures, and a body composition measure. They also completed the PAQ-C. The authors used the PAQ-C data to calculate the adolescent's energy expenditure.

However, the physical activity data were not presented, although the authors stated that the activity levels of the obese adolescent girls were similar to those of a normal weight adolescent population. Also, physical activity levels were not significant predictors of bone loss or gain.

Sirard, J. R., & Pate, R. P. (2001). Physical activity assessment in children and adolescents. *Sports Medicine, 31, 439-454.*

The strengths, limitations, and validity of subjective and objective measures of physical activity in children and adolescents were reviewed. This study reviewed criterion standards (direct observation, doubly labelled water, and indirect calorimetry), secondary measures (heart rate, pedometers, and accelerometers), and subjective measures (self-report, interview, proxy-report, and diary).

Self-report questionnaires' time frames, participants, reliability, criterion measure, and validity were reported in a table. The PAQ-C was one of the measures listed, but was not discussed in the text. Limitation in subjective measures discussed included children's

recall ability and their struggle to recall intensity and type of activity. The authors suggested that survey measures be validated against strong standards of physical activity assessment.

Thompson, A. M., Baxter-Jones, A. D. G., Mirwald, R. L., & Bailey, D. A. (2003). Comparison of physical activity in male and female children: Does maturation matter? *Medicine and Science In Sports and Exercise*, 35, 1684-1690.

In this longitudinal study (from years 1991-1997), children's general physical activity levels were assessed using the PAQ-C. The boys' and girls' biological ages (chronological age at peak height velocity subtract chronological age at time of measurement) were considered during the analysis of their physical activity levels.

Seventy boys and 68 girls from the Saskatchewan bone mineral accrual study participated. Data collected when the children were ages 9 to 18 years were analyzed. The children's chronological age, height, body mass, biological age, and physical activity levels were measured. During the first 3 years of the study, the children completed the PAQ-C 3 times per year. Every year after, the PAQ-C was completed twice per year. The PAQ-C assessment scores for one year were averaged to make up a yearly summary activity score. The PAQ-A (the PAQ-C omitting the recess item) assessed high school students' physical activity levels.

When physical activity scores were analyzed by chronological age, significant ($p < 0.05$) sex differences were found between the ages of 10 to 16 years. The boys had higher activity scores compared to the girls. Further, boys' and girls' physical activity levels decreased as chronological and biological age increased. No sex differences were found (with an exception at 3 years before peak height velocity) in physical activity levels when biological age was controlled for ($p < 0.05$).

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

The PAQ-C's strengths and limitations were mentioned in this study's review of physical activity assessment. However, the PAQ-C was not included in the comparison of self-report measures. It was mentioned as an assessment tool that measures children's general physical activity levels. The authors noted that the PAQ-C's general measurement is beneficial for studies that do not need estimates of time or amounts of activity. Further, the PAQ-C was recommended as an instrument that may have the ability to differentiate between active and inactive children. The authors reported that the PAQ-C does not provide a measurement of duration, frequency, and intensity.

Welk, G. J., & Wood, K. (2000). Physical activity assessments in physical education: A practical review of instruments and their use in the curriculum. *Journal of Physical Education, Recreation and Dance*, 71, 30-40.

Welk & Wood (2000) reviewed a variety of physical activity measures, and concluded that the PAQ-C, along with other self-report measures have the potential to be used in physical education evaluation. This study reported two limitations of the PAQ-C. First, each item is scored on a 5-point scale and the final activity score is a composite score made up of 9 items. Giving equal weight to each item was viewed as a possible limitation because the items have different time periods for possible activity. Second, the PAQ-C does not provide an estimate of caloric expenditure. The PAQ-C was recognized for its ability to differentiate children into either active or non-active categories.

Welk, G. J., Wood, K., & Morss, G. (2003). Parental influences on physical activity in children: An exploration of potential mechanisms. *Pediatric Exercise Science*, 15, 19-33.

A parent's influence on their child's physical activity level was examined with the help of the PAQ-C. Children in grades 3 to 6 from three schools participated in this study. There were 994 students (505 boys and 489 girls) along with 536 parents. Only one parent from each family was asked to participate (82% were mothers, 17% fathers, and 1% were guardians). The children completed the PAQ-C and the Children's Physical Activity Correlates (CPAC) instrument during their physical education class. The CPAC consisted of an attraction to sport scale, a perceptions of competence scale, a parental influence scale, a parental role modelling scale, a parental support scale, a parental encouragement scale, a parental involvement scale, and a parental facilitation scale. The parents completed two physical activity measures at home, which assessed their physical activity level and categorised them as inactive, moderately active, or regularly active.

The boys had significantly higher activity levels than the girls, $F(1,986) = 10.7, p < 0.01$. The mean activity score for boys was 3.29 ($SD = 0.66$), whereas the mean activity score for girls was 3.16 ($SD = 0.62$). The effect size was small for the difference between boys' and girls' activity scores (0.20).

The PAQ-C was moderately related to the attraction scale, perceptions of competence scale, and the parental influence scale ($r = 0.38$ to $r = 0.52$). Together, the parental support and parental role modelling variables predicted 19.7% of the variance in the PAQ-C scores, $F(2,991) = 121.3, p < 0.001$. The parents' activity levels (NOT assessed with the PAQ-C) were weakly correlated to their children's ($r = 0.13$ to $r = 0.16$).

4.2 Reference List of Studies that have Cited or Used the PAQ-C and/or the PAQ-A

The following list of references includes 4 categories of studies: (1) the PAQ-C and PAQ-A development, validation, and reliability studies, (2) studies that used the PAQ-C and/or the PAQ-A, (3) manuscripts that reviewed the PAQ-C, and (4) manuscripts that cited the original PAQ-C and/or PAQ-A validation studies.

The PAQ-C and PAQ-A development, validation, and reliability studies

Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise*, *29*, 1344-1349.

Kowalski, K. C., Crocker, P. R. E., & Faulkner, R. A. (1997). Validation of the Physical Activity Questionnaire for Older Children. *Pediatric Exercise Science*, *9*, 174-186.

Kowalski, K. C., Crocker, P. R. E., & Kowalski, N. P. (1997). Convergent validity of the Physical Activity Questionnaire for Adolescents. *Pediatric Exercise Science*, *9*, 342-352.

Used the PAQ-C and/or the PAQ-A

Bailey, D. A. (1997). The Saskatchewan pediatric bone mineral accrual study: Bone mineral acquisition during the growing years. *International Journal of Sports Medicine*, *18*, S191-S194.

Bailey, D. A., McKay, H. A., Mirwald, R. L., Crocker, P. R. E., & Faulkner, R. A. (1999). A six-year longitudinal study of the relationship of physical activity to bone mineral accrual in growing children: The University of Saskatchewan bone mineral accrual study. *Journal of Bone and Mineral Research*, *14*, 1672-1679.

Ball, G. D. C., Marshall, J. D., & McCargar, L. J. (2003). Fatness and fitness in obese children at low and high health risk. *Pediatric Exercise Science*, *15*, 392-405.

Carter, L. M., Whiting, S. J., Drinkwater, D. T., Zello, G. A., Faulkner, R. A., & Bailey, D. A. (2001). Self-reported calcium intake and bone mineral content in children and adolescents. *Journal of the American College of Nutrition*, *20*, 502-509.

Crocker, P. R. E., Eklund, R. C., & Kowalski, K. C. (2000). Children's physical activity and physical self-perceptions. *Journal of Sports Sciences*, *18*, 383-394.

Crocker, P. R. E., Holowachuk, D. R., & Kowalski, K. C. (2001). Feasibility of using the Tritrac motion sensor over a 7-day trial with older children. *Pediatric Exercise Science*, *13*, 70-81.

- Crocker, P. R. E., Sabiston, C., Forrester, S., Kowalski, N., Kowalski, K. C., & McDonough, M. (2003). Predicting change in physical activity, dietary restraint, and physique anxiety in adolescent girls. *Canadian Journal of Public Health, 94*, 332-337.
- Ernst, M. P. & Pangrazi, R. P. (1999). Effects of a physical activity program on children's activity levels and attraction to physical activity. *Pediatric Exercise Science, 11*, 393-405.
- Gurd, B., & Klentrou, P. (2002). Physical and pubertal development in young male gymnasts. *Journal of Applied Physiology, 95*, 1011-1015.
- Heinonen, A, McKay, H. A., Whittall, K. P., Forster, B. B., & Khan, K. M. (2001). Muscle cross-sectional area is associated with specific site of bone in prepubertal girls: A quantitative magnetic resonance imaging study. *Bone, 29*, 388-392.
- MacKelvie, K. J., Khan, K. M., Petit, M. A., Janssen, P. A., & McKay, H. A. (2003). A school-based exercise intervention elicits substantial bone health benefits: A 2-year randomised controlled trial in girls [Abstract]. *Pediatric, 112*, e447-e452.
- MacKelvie, K. J., McKay, H. A., Khan, K. M., & Crocker, P. R. E. (2001a). Lifestyle risk factors for osteoporosis in Asian and Caucasian girls. *Medicine and Science in Sports and Exercise, 33*, 1818-1824.
- MacKelvie, K. J., McKay, H. A., Khan, K. M., & Crocker, P. R. E. (2001b). A school-based exercise intervention augments bone mineral accrual in early pubertal girls. *The Journal of Pediatrics, 139*, 501-508.
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- MacKelvie, K. J., Petit, M. A., Khan, K. M., Beck, T. J., & McKay, H. A. (2004). Bone mass and structure are enhanced following a 2-year randomized controlled trial of exercise in prepubertal boys. *Bone, 34*, 755-764.
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