Reliability and validity of a physical activity questionnaire in children

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Abstract

Background: valid and appropriate assessment of physical activity in children is still needed. Aim: to determine the test–retest reliability and validity of the Arabic version of the Questionnaire l’Activite Physique en Altitude Chez les Enfants. Methods: Population: 6- to 9-year-old children were recruited in Al Ain, United Arab Emirates. Reliability: questionnaire was administered twice, 3 weeks apart. Intraclass correlation coefficients and 95% confidence interval calculated. Validity: comparison between the questionnaire and pedometer. Spearman’s correlation coefficients were calculated. Bland–Altman method was used to detect potential bias. Results: a fair-to-good reliability was found, with the highest values for running during breaks at school and total active time during weekdays. No significant difference between the two measurements was observed. The validity was acceptable for total active time during weekdays. Discussion: for the first time, a questionnaire was identified as very promising to assess physical activity in Arabic children.

Keywords: validation, questionnaire, pedometer, youth

Introduction

Physical activity is an important contributor related to health. In children, physical activity plays a role on the body weight not only during childhood but also in the lifecycle too, including the impact on the obesity-related diseases (Olstad and McCargar 2009; McCurdy et al. 2010).

To counteract low physical activity in children, school-based interventions are thought to be the most universally applicable and effective way because school is a critical part of the social environment of children (Kriemler et al. 2011). Nevertheless, most intervention strategies have focused on television viewing, with mixed evidence as to the effectiveness of these strategies. Recently, potential novel intervention approaches to increase children’s physical activity, including activity breaks during class time at school, were strongly encouraged (Salmon 2010).

To evaluate the effectiveness of such interventions and also to better understand the association between physical activity and health, and to monitor secular trends in behaviour, it is crucial to have reliable and valid approaches to assess physical activity in children and especially at school and during breaks at school (Corder et al. 2008; Salmon 2010).

Valid and appropriate assessment of physical activity in children is a challenging task, mainly due to the cognitive changes that occur during growth and a more intermittent pattern of habitual physical activity (Corder et al. 2008).

Physical activity can be estimated either objectively or subjectively. Typically, because of their feasibility and cost, subjective measures such as questionnaires are used to assess physical activity in children. A physical activity questionnaire must fulfil the criteria of non-reactiveness (it does not alter the behaviour of the study population), practicability, applicability (it is particularly designed to suit the population) and accuracy (it is reliable and valid) (Caspersen et al. 1998). In children, a recent review concluded that no questionnaire was available with both reliability and validity, highlighting the necessity of exploring other promising questionnaires (Chinapaw et al. 2010). Besides, most questionnaires were developed in English and need to be adapted to other populations.
using a different language. Particularly, no validated culturally adapted Arabic questionnaire is available for children. In the current context, in terms of physical activity habits and health status in children, this gap needs to be urgently filled. Indeed, a few studies conducted in Arabic countries like the United Arab Emirates (UAE) to assess physical activity in children reported sedentary habits in the population (Henry et al. 2004). Besides, a worrying health status of children, particularly a high prevalence of physical activity-related diseases like obesity, has been observed (Ng et al. 2011).

Pedometers are objective instruments that have already been used to measure physical activity in studies involving children. These devices have been shown to be a valid determinant of physical activity in children (Rowlands et al. 1997; Tudor-Locke et al. 2002, Tudor-Locke et al. 2004; McNamara et al. 2010). The Quantification de l’Activite Physique en Altitude Chez les Enfants (QAPACE) is a supervised self-administered questionnaire developed for children. Good reliability and validity were demonstrated in this questionnaire (Barbosa et al. 2007). Besides, it is adapted to our target population because it is short and easy to administer, assesses popular types of physical activity done by children in the country and does not contain any culturally non-acceptable issue. Besides, it enables to clearly distinguish activities at school, during breaks at school and at home, which may facilitate the assessment.

Thus, the aim of this study is to determine the reliability and validity of a modified version of QAPACE among Arabic children aged 6–9 years by using the pedometer for comparison.

Methods

Participants

One class from each grade (grades 1–4) was selected from the Universal Private School in Al Ain, UAE. A sample of 79 children aged between 6 and 9 years was recruited. All the children were born in the UAE, were speaking Arabic fluently and had Arabic as their mother tongue. The school was contacted for permission to survey the children. All children within the selected classes were invited to be part of the study. This research was approved by the ethics committee and a written consent was provided by the parents. Data were collected in November 2010.

Procedures

To test the reliability of the questionnaire, trained data collectors administered the modified questionnaire to the children in groups at two occasions, 3 weeks apart. Wake-up time and bedtime during school days and weekend days, walking and running time during breaks at school, time spent on physical activity at school after class time, time spent on sedentary activities at home after school, time spent on physical activity at home after school, time spent on sedentary activities at home during weekend days and time spent on physical activity at home during weekend days were assessed. Each item of the questionnaire was read out by the interviewer to the group of children. Children were permitted to ask questions if they did not understand the meaning. The interviewers were trained beforehand to answer by using wordings and methods adapted to children but without influencing their answer. To minimize missing data, a trained data collector checked each item of the questionnaire with children. The total administration time was about 45 minutes per group. All data were collected during class time.

To test the construct validity of the questionnaire, children were asked to wear a pedometer, Yamax Digiwalker SW-200, New Lifestyles, Inc., 5201 Ne Maybrook Road, Lee’s Summit, MO 64064, for 3 consecutive days, including 2 weekdays and 1 weekend day, during the week of the first administration of the questionnaire.

Physical activity measured by the questionnaire

The original QAPACE was used for this study. As religion is a sensitive issue in the country, items related to this aspect were removed from the original version of the questionnaire. Because of the generalization of a domestic help, house cleaning was removed as well. The questionnaire finally includes 18 questions classified into five domains: sleeping, physical activity at school (during breaks, after class time), physical activity at home, sedentary activities at home and physical education at school. Difference was made between weekday and weekend day for the evaluation of the physical activity and sedentary activity at home. The questions related to physical education at school were answered by the physical education teacher who had to report the theoretical and the real time of physical education.

For each question, the duration had to be reported. As suggested in the validation study of the QAPACE questionnaire (Barbosa et al. 2007), to facilitate the answer by the children, different appropriate time intervals were provided (for example, ≤ 30 minutes, 31–60 minutes, 1–2 hours, 2–3 hours, 3–4 hours, and 4 hours).

The last version of the questionnaire was translated into Arabic. After back translation, necessary additional adaptations were carried out.

The total time spent in being physically active at school was calculated by adding the time spent on physical activity during breaks, after class time and during the physical education courses.

The total time spent in being physically active was calculated by adding the active time at school and at home for weekday and the active time at home for weekend day.
**Physical activity measured by pedometer**

Children were asked to wear a pedometer, Yamax Digiwalker SW-200, on their waists, during waking hours except during bathing or swimming and doing ordinary activities. Pedometer has been recognized as a valid tool to assess physical activity levels in individuals, including children (Tudor-Locke et al. 2002, Tudor-Locke et al. 2004; McNamara 2010).

The pedometer was worn for 3 days, including 2 weekdays and 1 weekend day. The average of the step counts over the 2 weekdays was calculated. To obtain a total physically active time, number of steps were converted into minutes, e.g. 1 minute = 100 steps (Tudor-Locke and Bassett 2004).

**Data analysis**

**Test–retest reliability of the questionnaire**

The test–retest reliability of the questionnaire was determined by comparing the results on the two separate occasions the questionnaire was filled in. The intraclass correlation coefficients (ICCs) were calculated for the sleeping time, the time spent in walking at school during breaks, running at school during breaks, being physically active at school but after class time, being physically active at home after school, being physically active at home during the weekend, doing sedentary activities at home during the week and the weekend, the total active time at school, the total active time per day in a week and the total active time per day in the weekend.

An ICC with a value of < 0.40 was rated as a poor agreement, with 0.40–0.75 as fair-to-good agreement and with > 0.75 as excellent agreement (Altman 1991).

Besides, as correlational analysis alone may not reveal the potential bias, Bland–Altman method was used in which a fair agreement was first obtained as defined by an ICC with value ≥ 0.40 (Schmidt and Steindorf 2006). To build a Bland–Altman plot, the differences between the values reported at the two questionnaire administrations against the means of these values were represented. The mean ± SD of the differences and the limits of agreement defined as this mean ± 1.96 SD were calculated (Hanneman 2008).

**Construct validity of the questionnaire**

As good test–retest reliability is a prerequisite to validity, only variables for which a fair reliability was identified were considered in the study of construct validity. The construct validity was assessed by comparison with the pedometer. Spearman’s correlation coefficients were calculated. Bland–Altman plot was built as described above. The mean ± SD of the differences and the limits of agreement defined as this mean ± 1.96 SD were calculated (Hanneman 2008).

All statistical analyses were performed using SPSS software version 19.0 (Japan Inc., Tokyo, Japan).

**Results**

Questionnaires were obtained from 79 children at the two occasions. Of these 79 children, 32 were considered to have worn the pedometer continuously from morning to night for three days.

**Subjects characteristics**

Among the 79 children that answered the questionnaire, 48 were boys and 31 were girls.

The mean ± SD of the different variables assessed by the questionnaire and reported by children are provided in Table I.

Physical education teachers reported the actual time of physical activity during physical education courses of 30 minutes, either, three quarters of the scheduled time, three times per week.

**Test–retest reliability**

Table I shows the physical activity parameters assessed by the questionnaire at the two different occasions and the corresponding ICCs. The ICCs ranged from 0.02 to 0.50 with wide 95% CI. Fair-to-good agreement

<table>
<thead>
<tr>
<th>Variables</th>
<th>Measurement 1</th>
<th>Measurement 2</th>
<th>ICC (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping time weekday (h/day)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>0.37 (0.02–0.60)</td>
</tr>
<tr>
<td>Sleeping time weekend day (h/day)</td>
<td>8.95 (1.53)</td>
<td>9.17 (2.34)</td>
<td></td>
</tr>
<tr>
<td>Walking time at school (min/day)</td>
<td>10.71 (2.26)</td>
<td>10.22 (2.51)</td>
<td>0.45 (0.14–0.65)</td>
</tr>
<tr>
<td>Active time at school (min/day)</td>
<td>10.60 (5.12)</td>
<td>8.82 (5.23)</td>
<td>0.40 (0.05–0.61)</td>
</tr>
<tr>
<td>Running time at school (min/day)</td>
<td>7.56 (5.67)</td>
<td>6.78 (5.02)</td>
<td>0.50 (0.21–0.68)</td>
</tr>
<tr>
<td>Active time at school after class time (min/day)</td>
<td>11.78 (19.01)</td>
<td>7.04 (9.93)</td>
<td>0.22 (–0.22–0.50)</td>
</tr>
<tr>
<td>Sedentary time at home after school (min/day)</td>
<td>234.68 (14.22)</td>
<td>238.10 (7.35)</td>
<td>0.02 (–0.53–0.37)</td>
</tr>
<tr>
<td>Total active time at school (min/day)</td>
<td>51.70 (27.98)</td>
<td>61.77 (15.97)</td>
<td>0.27 (–0.14–0.54)</td>
</tr>
<tr>
<td>Active time at school after class time (min/day)</td>
<td>93.37 (72.35)</td>
<td>62.19 (55.04)</td>
<td>0.31 (–0.07–0.56)</td>
</tr>
<tr>
<td>Total active time during weekday (min/day)</td>
<td>141.82 (74.40)</td>
<td>101.86 (56.29)</td>
<td>0.41 (0.08–0.62)</td>
</tr>
<tr>
<td>Sedentary time at home during weekend day (min/day)</td>
<td>236.58 (17.97)</td>
<td>239.62 (3.38)</td>
<td>0.12 (–0.38–0.43)</td>
</tr>
<tr>
<td>Total active time at home during weekend day (min/day)</td>
<td>171.84 (79.02)</td>
<td>206.02 (41.83)</td>
<td>0.13 (–0.36–0.44)</td>
</tr>
</tbody>
</table>
were obtained for the time spent in running at school during breaks, the time spent in walking at school during breaks, the total active time during a weekday and the sleeping time during weekend.

Bland–Altman analysis showed no significant difference between the two measurements for walking time at school, running time at school, sleeping time during weekend and the total active time in weekday. Most values fall between $0 \pm 1.96$ SD (Figure 1). Furthermore, no systematic trend of correlation was observed ($\rho = 0.09$, 0.08, 0.11 and 0.20 for walking time at school, running time at school, sleeping time during weekend and total active time in weekday, respectively).

**Construct validity**

In the 32 children for whom data from pedometer were acceptable, the average number of steps during the week was $11,084.13 \pm 4331.01$ (mean ± SD) steps per day and $12,744.16 \pm 4384.99$ (mean ± SD) steps per weekend day.

The correlations between the questionnaire and the step counts are presented in Table II. There were significant correlations between the time spent in running at school during breaks ($\rho = 0.424, p < 0.05$) and the step counts. Higher correlation was found between the total active time during weekday ($\rho = 0.890, p < 0.01$) and the step counts.

Bland–Altman plot was built for the total active time in a weekday (Figure 2) compared with step counts recorded by the pedometer. It shows that two out of 32 points are outliers and are below the lower limit of agreement. The bias ($\pm$ SD) is on average (11.29 ($\pm 43.98$) minutes, indicating that, on average, the questionnaire measures higher total active time in weekday than the pedometer. The plot suggests that, in the area below a total active time of 150 minutes per weekday, for a majority of points (18 out of 21 points), the questionnaire measures

![Figure 1. Questionnaire to test–retest reliability. Bland–Altman plot is presented. The difference and the mean of variables assessed by the questionnaire at two separate occasions, Test 1 and Test 2 are considered.](image-url)
rather lower total active time in a weekday than the pedometer and, in the area above a total active time of 150 minutes per weekday, the questionnaire measures rather higher values than the pedometer (8 out of 9 points) and higher differences are observed in this area.

Discussion

The goal of this paper was to study the reliability and validity of the Arabic version of the QAPACE in young children. This questionnaire showed a reasonable accuracy with a fair reliability and an acceptable validity compared with the pedometer when considering the total active time during weekdays.

The questionnaire was adapted from the original QAPACE to suit the study population: some items were removed for cultural and religious reasons and for each question, time intervals were suggested to facilitate the answering process. The time needed to fill the questionnaire was acceptable compared with the concentration capacity of young children and was close to other questionnaires designed for children. (Barbosa et al. 2007; Corder et al. 2008; Bielemann et al. 2011) No major understanding problems were reported by data collectors during the administration.

Test–retest reliability

Fair-to-good test–retest reliability coefficients (ICC between 0.40 and 0.50) were obtained and support the absence of significant reactivity in the population. These coefficients were similar to those reported in previous studies conducted in young children (Corder et al. 2008; Bielemann et al. 2011). In our study, physical activity during breaks at school was associated with higher test–retest reliability coefficients compared with other physical activities assessed by the questionnaire. This is in accordance with a recent work that tested the reliability of a questionnaire designed to specifically measure physical activity during school recess in young children. A very good test–retest reliability was obtained (ICC = 0.87; Martinez-Gomez et al. 2010).

It is more difficult for young children to remember durations. But the breaks at school have a known, relatively short and constant duration and they are repetitive. Thus, it may be easier for the children to report the time spent in physical activity during these periods.

Interestingly, during breaks at school, running, considered as a vigorous activity, was associated with a greater test–retest reliability compared with walking,

Table II. Spearman’s rank-correlation coefficients between the questionnaire and the pedometer in children (n = 32).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Spearman’s coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping time weekend day</td>
<td>−0.229</td>
</tr>
<tr>
<td>Walking time at school (min/day)</td>
<td>−0.011</td>
</tr>
<tr>
<td>Running time at school (min/day)</td>
<td>0.424*</td>
</tr>
<tr>
<td>Total active time during weekday (min/day)</td>
<td>0.890**</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01

Figure 2. Questionnaire to construct validity. Bland–Altman plot is presented. The difference and the mean of the step counts recorded by the pedometer and the total active time in a weekday assessed by the questionnaire are considered.
considered as a moderate activity. This pattern of variation, with lower test–retest reliability estimates of moderate activities compared with vigorous activities, has been reported in other studies conducted on young children (Wong et al. 2006; Dwyer et al. 2011). Walking also includes any spontaneous walking done for basic and routine tasks (to go to the bathroom, to go and take a snack from the canteen), it may be more difficult to report this accurately.

The test–retest reliability of sedentary activities was low. It is well-recognized that children tend to under-report sedentary activities (Bryant et al. 2007; Clark et al. 2009). Children were guided by trained data collectors. Nonetheless, it cannot be completely excluded that some sedentary activities like incidental behaviours (toileting for example) were not well reported.

Globally, physical activity during weekday had a greater reliability compared with physical activity during weekend day. A weekday being more organized than a weekend day, with a repetitive schedule due at school, provides better time references and facilitates the evaluation of physical activity duration by young children. Besides, it is feasible that for most children physical activity varies more on weekends than weekdays and thus the difference may reflect behaviour changes.

The comparison with the agreement obtained using the original QAPACE questionnaire remains difficult as the test–retest reliability of the energy expenditure estimated using the answers was considered. Nonetheless, it can be noticed that, similarly to our results, higher agreements were observed for activities done in more limited time frame like breaks at school (Barbosa et al. 2007).

**Validity**

The level of agreement between the questionnaire and pedometer was high \( \rho = 0.89 \) for the total physical activity time during weekdays. The mean difference was 11.29 (± 43.98) minutes per day. This suggests that the Arabic version of the QAPACE has acceptable validity as a population measure of physical activity. This is supported by the fact that the agreement between the original QAPACE and Peak VO2 uptake was similar to our result (Barbosa et al. 2007). However, the 95% limit of agreement was wide. Thus, the Arabic version of the QAPACE has acceptable agreement with pedometer estimation of activity at a group level and caution should be applied when using this tool as a measure at individual level.

The Bland–Altman plot showed a difference between estimation of the activity time during weekdays by the questionnaire and the pedometer which becomes larger as the magnitude of reported time increases. This bias has already been reported in other validated questionnaires designed for children (Corder et al. 2009; Dwyer et al. 2011). The agreement between the total reported activity time during weekdays and the pedometer was closer when the reported activity time during weekdays was less than 150 minutes per day. Below 150 minutes per day, there was a bias towards under-reporting of the child’s activity. By contrast, beyond 150 minutes per day, there was a sharp positive bias towards over-reporting of the child’s activity. Most of the studies using a movement detector as reference to test the validity of a questionnaire indicated a higher estimate of physical activity by questionnaire in youth, particularly regarding vigorous activities (Sallis and Saelens 2000). This is in accordance with our results, as children that are more active also tend to do more intense activities like running instead of walking. Besides, Pedometer registers only vertical movement, thus, activities like swimming, cycling and upper-body movements are not well assessed and this may have contributed to an under-estimation of activity time by the pedometer.

The validity obtained for the time spent in running during breaks at school was good \( \rho = 0.42 \). But this result should be considered with caution as pedometer provides a global measurement of physical activity over a day. An accurate study of the validity for this variable should be conducted by considering rather the specific number of steps recorded by the pedometer and related to this particular activity.

Even though pedometer was recognized as a valid tool to assess physical activity in 6–9 years old or close age group children (McNamara et al. 2010), few studies used pedometer as reference to test the validity of questionnaires. The correlations between the questionnaire and pedometer did not exceed 0.50 and were thus below the correlation obtained for the Arabic version of the QAPACE (Treuth et al. 2003; Storey and McCargar 2011). When other activity sensors like accelerometer were considered as reference in validation studies, the correlation between questionnaire and activity sensor ranged from very low to high but, still, the global construct validity of our questionnaire is greater (Corder et al. 2008; Chinapaw et al. 2010; Bielemann et al. 2011; Dwyer et al. 2011). This suggests that the Arabic version of the QAPACE is as robust as other questionnaires used in the same age or slightly close age group.

**Limitations**

Physical activity is a complex and multi-components behaviour and is very challenging to measure. No perfect criterion measure exists for it. Questionnaires and pedometer have some strengths and limitations (Corder et al. 2008). The Arabic version of the QAPACE does not clearly differentiate intensity levels of activities; and it is well-known that intensity is related to health (Powell et al. 2011). Nonetheless, it should be noted that this questionnaire was developed for a purpose to separately assess physical activity at school and at home, to detect changes in physical
activity at school and then potentially determine school-based interventions’ effectiveness. The accuracy observed in this work tends to show that the questionnaire reaches these goals.

According to the Hawthorne effect, pedometer may alter the behaviour. Besides, pedometer records only vertical movements which may contribute to a bias towards an under-estimation of the total physical activity in children. Accelerometer, which is a triaxial device, could be another type of movement sensor that could be used for a better estimation of activity time. Indeed, accelerometer may be more accurate to assess a range of activities in children, but it is uncertain whether this warrants the extra cost (Corder et al. 2008).

Some other limitations of our study should also be raised. Different reliability and validity have been reported according to some demographic parameters especially socio-economic status (Barbosa et al. 2007). These data were not available in this study.

Children were asked to wear the pedometer for three consecutive days including two weekdays and one weekend day. Nonetheless, the lack of cooperation of some children might have contributed to inaccurate recording of the steps and to the number of children that had to be excluded from the validity analysis. Even though the duration of three days was previously demonstrated as adequate to assess physical activity, this could be extended to at least one week as it is generally recommended for accelerometer (Corder et al. 2008).

In the absence of value for children, the estimation of the activity time based on the pedometer results was done by considering a walking speed of 100 steps/minute for adults (Tudor-Locke and Bassett 2004). This may not be accurate for children and may introduce a bias.

Conclusion

The Arabic version of the QAPACE was the first Arabic physical activity questionnaire to be tested for reliability and validity. It represents a promising tool to measure global physical activity in Arabic children. It was found to have a fair-to-good test–retest reliability and an acceptable validity of total activity time during weekdays against pedometer. Activity time during breaks at school was the type of activities with the best reliability and its validity was good. This suggests that this questionnaire could be adapted as a tool to detect changes in physical activity done during breaks at school. It could thus be used to determine the effectiveness of school-based physical activity interventions that are highly encouraged to counteract low level of physical activity in children (Salmon 2010).

Acknowledgements

The authors would like to express their sincere appreciation to the Universal Private School in Al Ain for its collaboration.

Declaration of interest: No financial disclosures were reported by the authors of this paper. The authors declare that there are no conflicts of interest.

References


