International Journal of Behavioral Nutrition and Physical Activity

Research

Development of the Physical Activity Interactive Recall (PAIR) for Aboriginal children

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Published: 29 March 2004

International Journal of Behavioral Nutrition and Physical Activity 2004, **1**:8

Received: 05 December 2003
Accepted: 29 March 2004

This article is available from: http://www.ijbnpa.org/content/1/1/8

Abstract

Background: Aboriginal children in Canada are at increased risk for type 2 diabetes. Given that physical inactivity is an important modifiable risk factor for type 2 diabetes, prevention efforts targeting Aboriginal children include interventions to enhance physical activity involvement. These types of interventions require adequate assessment of physical activity patterns to identify determinants, detect trends, and evaluate progress towards intervention goals. The purpose of this study was to develop a culturally appropriate interactive computer program to self-report physical activity for Kanien'kehá:ka (Mohawk) children that could be administered in a group setting. This was an ancillary study of the ongoing Kahnawake Schools Diabetes Prevention Project (KSDPP).

Methods: During Phase I, focus groups were conducted to understand how children describe and graphically depict type, intensity and duration of physical activity. Sixty-six students (40 girls, 26 boys, mean age = 8.8 years, SD = 1.8) from four elementary schools in three eastern Canadian Kanien'kehá:ka communities participated in 15 focus groups. Children were asked to discuss and draw about physical activity. Content analysis of focus groups informed the development of a school-day and non-school-day version of the physical activity interactive recall (PAIR). In Phase II, pilot-tests were conducted in two waves with 17 and 28 children respectively to assess the content validity of PAIR. Observation, videotaping, and interviews were conducted to obtain children's feedback on PAIR content and format.

Results: Children's representations of activity type and activity intensity were used to compile a total of 30 different physical activity and 14 non-physical activity response choices with accompanying intensity options. Findings from the pilot tests revealed that Kanien'kehá:ka children between nine and 13 years old could answer PAIR without assistance. Content validity of PAIR was judged to be adequate. PAIR was judged to be comprehensive, acceptable, and enjoyable by the children.

Conclusions: Results indicate that PAIR may be acceptable to children between nine and 13 years old, with most in this age range able to complete PAIR without assistance. The flexibility of its programming makes PAIR an easily adaptable tool to accommodate diverse populations, different seasons, and changing trends in physical activity involvement.

Background

Aboriginal children in Canada are at increased risk for type 2 diabetes and experience younger average age of onset than children in the general population [1,2]. Given that physical inactivity is an important modifiable risk factor for type 2 diabetes, prevention efforts targeting Aboriginal children include interventions to enhance physical activity involvement [3-9]. These types of interventions require adequate assessment of physical activity patterns to identify physical activity determinants, detect physical activity trends, and evaluate progress towards intervention goals [10].

Self-report methods are a convenient way to assess the main parameters of physical activity involvement: type, frequency, duration, and intensity. There are, however, several difficulties inherent to assessing activity patterns in children through self-report. Children have difficulty with recall [11], are not time conscious [11,12], and do not exercise in consistent bouts [13-15]. Moreover, it remains unclear whether existing methods, validated in other populations, are also valid for Aboriginal children [10]. In a recent review of children's physical activity measures, Kohl and colleagues [10] reported low to moderate validity for self-report and lower test-retest reliabilities in younger children as compared with older children.

Computerized instruments offer an interesting alternative to traditional paper and pencil self-report instruments that may be burdensome to young children with limited reading experience. Computer technology has captured the interest of young children who increasingly use interactive technology as a source of entertainment, information and learning [16]. Early work using visual images of children at play suggests that this method may help children discriminate between different levels of physical exertion [17,18]. Assessment instruments that solicit a variety of senses (e.g., manipulating a mouse or touching a keyboard, listening to instructions and music, watching animated characters) may be particularly appropriate for Aboriginal children who are reported to be especially visually and spatially adept [19,20] and who show a tendency for imagery coding over verbal coding [21,22].

Several previous-day self-report recalls for assessing physical activity involvement in children exist [23-26]. Most of these measures, including the graphically enhanced Cooper Aerobics Institute's computer-based ACTIVITYGRAM [23], require advanced reading skills (i.e., grade 5). With the exception of Tremblay et al.'s ACTIVITY video recall [17] which requires no reading skills, there exists no physical activity recall that is simple to understand and use, does not require reading, and is culturally appropriate for Aboriginal children.

The purpose of this study was to develop a culturally appropriate interactive computer program to self-report physical activity for Kanien'kehá:ka (Mohawk) children that could be administered in a group setting. In phase I, the objective was to understand how Kanien'kehá:ka children describe and graphically depict these physical activity parameters: activity type (i.e., activity phenotype), activity intensity (i.e., degree of perceived activity-imposed overload on physiological systems), and activity duration (i.e., temporal length of an activity bout). In phase II, the objective was to develop and pilot-test PAIR software with two waves of children.

Methods

Context

Kahnawake is a Kanien'kehá:ka (Mohawk) community of approximately 7,200 (in 2002) people, located about 15 kilometres southwest of downtown Montreal, Canada. The Kahnawake Schools Diabetes Prevention Project (KSDPP) is an ongoing community-based participatory research project to prevent type 2 diabetes. In 1994, KSDPP started as a partnership between the Kahnawake community and academic researchers. KSDPP intervention aims are to influence the physical environment and social practices of the schools and community by promoting healthy eating and regular physical activity involvement among children, parents, teachers, and community members [7,27]. The evaluation component of the project includes assessment of anthropometric measures (i.e., triceps and subscapular skinfold thicknesses, body mass index), fitness, physical activity, and eating patterns.

Phase I Instrument development

Development of PAIR was informed by a series of focus groups conducted with Kanien'kehá:ka children. These group interviews were conducted to enhance the sensitivity of PAIR to local cultural and community practices. Focus group data were then considered along with a review of recent literature on physical activity assessment in children.

Focus Groups

Participants

Participants were 66 students enrolled in grades 1 to 6 (40 girls, 26 boys, mean age = 8.8 yrs, SD = 1.8) from four elementary schools located in three Kanien'kehá:ka communities in Québec and Ontario. Efforts were made to recruit approximately five girls and five boys from each grade level in order to accommodate diversity in physical activity practices for boys and girls across grades. Parents of the participants provided written active consent in accordance with the KSDPP Code of Research Ethics [28] and as per the requirements of the relevant university Institutional Review Board. Consent rates are unavailable as the recruitment procedure was conducted on a first-come first serve

basis. Although no incentives were promised, children were given a set of felt markers as a token of appreciation for their participation.

Focus group interviews

A total of 15 focus groups were conducted with grades 1 to 6 boys and girls integrating procedures recommended by Krueger and colleagues [29-31]. The first author conducted all focus groups during class time, usually in the school library. Although we sought to include five children per focus group, group sizes ranged from three to six children usually from two consecutive grade levels (e.g., grades 1 and 2 together or grades 4 and 5 together). A two-part interview guide was developed. First, children were asked to list all activities (both physical and sedentary) in which they usually participated. A second question targeted physical activity more specifically by asking children to list all "moving your body" activities they usually did. We preferred to refer to body movement in general in order to capture a broader range of activities such as those included in free play. We avoided using "physical activity" and "exercise" after a pilot test of the interview protocol revealed that these terms were not always well understood by children. Children were asked to think about both winter and summer activities. Next, children were asked to draw themselves involved in their favourite moving your body activity using only a blue marker. They were then asked to make the following additions to their drawing. With a red marker, the children added anything conveying that they "were moving their body very hard or very fast". With a green marker, they added to their drawing anything conveying that they "had been doing this activity for a very long time". Children were only given one colour marker at a time and did not have access to other markers during the prescribed tasks. Finally, guided by their drawings, they were each asked, in turn, to describe the images they chose to convey moving hard/fast or for a long time. Each group interview lasted about 45 minutes and was audio taped.

Data analysis

The 15 taped focus groups were transcribed and formatted for import into QSR N5® qualitative software (NUD*IST, revision 5; Thousand Oaks, CA: Sage Publications Software, 2000). Drawings were scanned, compressed and also imported into QSR N5®. Data analysis was guided by predetermined physical activity parameters, or categories, corresponding to "activity type," "activity intensity," and "activity duration"; dimensions and indicators within each category emerged inductively. Responses to interview questions and the colour-coded drawings were content analysed. Codes were compared and contrasted, and sorted into conceptual groupings with internal and external homogeneity [32]. To classify the different types of activities in which the children participated and the intensity and duration related to a favourite activity, the transcripts and drawings were used as one data set. Parallel nodes were created in QSR N5® qualitative software to receive and sort focus group data and drawing data for activity type drawn in blue, activity intensity drawn in red, and activity duration drawn in green. Collect vector matrices were created within QSR N5® qualitative software and exported to SPSS to generate descriptive statistics, and to Excel to create charts and tables. For generating an exhaustive list of activities, the focus group was the unit of analysis (n = 15). Given that each child's drawings was used to generate depictions of activity intensity and activity duration, the unit of analysis for these indicators is the drawing (n = 66).

Results

Activity type

Content analysis of focus group responses and the drawings generated a list of 62 activities classified under the dimensions of "physical" and "non-physical". Analysis of verbatim and drawings showed that children engaged in a wide variety of activities. Table 1 presents the three higher order groupings for "Type of involvement" under the physical activity dimension only. Given that qualifying non-physical activities was beyond the scope of our main focus, we did not further analyse this activity type to the next sub-group of "type of involvement". Children reported engaging in: Non-physical activities (e.g., TV watching), Play (e.g., biking), Team sports (e.g., baseball), and Individual sports (e.g., karate). Team and individual sports were based on the definition provided by Anshel and colleagues [[33]; p.143]: "Organized play that is accompanied by physical exertion, guided by a formal structure, organized within the context of formal and explicit rules of behaviour and procedures, ...". Play was considered to be "Physical activity that is free (i.e., unstructured), voluntarily begun, voluntarily continued and voluntarily terminated" [[33]; p.114]. This latter category represented the most popular form of physical activities reported by the children who participated in 31 different free play activities.

Activity intensity and activity duration

Indicators of activity intensity and activity duration depicted in the drawings (i.e., added annotations) and reported in the verbatim were analysed separately. As shown in Table 2, this analysis resulted in the same three dimensions for each activity intensity and activity duration: Somatic (i.e., indicator related to a physiological response/symptom of energy expenditure); Environmental (i.e., indicator related to a change in or addition to the physical environment); and Symbolic (i.e., indicator related to popular North American depictions of movement and time). Movement lines associated with an activity were often used as symbolic depictions of activity

Table 1: Frequency and description of activity type: five most frequent activity types reported by first – to sixth-grade children during 15 focus group discussions (n = 66)

Activity type	Type of involvement	Description of type of involvement	Total activities Cited	Five most frequently cited activities	Number and percentage of focus groups in which activity was mentioned	
					N/15	%
Non-physical activities*		Activities not requiring physical exertion	19	TV/video watching	11	73.3
				video games	5	33.3
				playing with toys	4	26.7
				listening to music	4	26.7
				Computer	3	20
Physical activities	Play	Unstructured physical activity characterized by physical exertion	31	Biking	14	93.3
				Swimming	9	60
				running	9	60
				swinging	7	46.7
				skipping rope	7	46.7
	Team sports	Organized and structured group play characterized by physical exertion	9	hockey	8	53.3
				basketball	6	40
				soccer	6	40
				baseball	5	33.3
				football	3	20
	Individual sports	Organized and structured play characterized by physical exertion	3	wrestling	3	20
				karate	3	20
				gymnastics	2	13.3

Note: A total of 307 responses were elicited (verbally and/or drawn) from 66 children in response to the questions: "What do you like to do when you play alone or play with your friends?" and "What types of moving your body activities do you do when you're alone or with a friend?" and to the statement: " Using the blue marker, I'd like you to draw me a picture of yourself doing your favourite moving your body activity." * Given that qualifying non-physical activities was beyond the scope of our main focus, we did not further analyze this activity type to the next sub-group of "type of involvement".

intensity. By far the most popular depiction of both intensity and duration was an accumulation of sweat. There was further overlap between the Somatic indicators of intensity and duration (i.e., soreness, panting) suggesting that children perceive many physical symptoms as indicative of both of these parameters of physical activity involvement. After sweat, the most often drawn representation of duration was time, either in the form of a watch or clock. This portrayal of time was most popular with older children (11–13 years) and was rarely found in drawings by the younger children. Environmental depictions of activity intensity and activity duration were less common in the drawings and the focus groups across all age groups. Finally, we discarded any drawn annotation that seemed "random" (i.e., not conforming to task instructions or un-interpretable) and for which the child confirmed that it was random (e.g., "I was just drawing"), or for which an explanation of the annotation was absent from the verbatim. A total of 27 annotations were discarded using this method.

Phase II

Development and pilot-testing the Physical Activity Interactive Recall

PAIR development

Focus group results, together with an examination of the physical activity assessment literature, were used to design PAIR. A local Kahnawake multimedia firm was hired to develop PAIR in collaboration with project staff. Local artists provided original drawings and traditional music. Community settings where children can engage in activity were filmed (e.g., school yards). A child from the community was hired to narrate the script.

Table 2: Frequency of illustrated representations of activity intensity and activity duration as drawn and commented by first – to sixth-grade children (n = 66) during 15 focus group discussions

Category type	Activity intensity indicator	n/66	Activity duration indicator	N/66
Somatic	sweat	30	sweat	23
	red face	6	sore legs	5
	heart beating	5	panting	3
	soreness	2	shaking	2
	panting	1	purple lips	1
	radiating heat	1	wrinkled hands	1
	getting stronger	1	yawning	1
Environment	sun shining	5	night falling	5
	water bottle	2	changes to equipment/field	4
	smoking shoes/skates	2	wearing of surface	3
	accumulation of items over time	1	accumulation of items over time	2
	water splashing	1	changes to ball	2
			raising dust	1
Symbolic	movement lines	33	watch/clock	19
	arrows showing route	2	track lines (laps or distance)	3
	game time expiring	1	expressions of fatigue	2
			movement lines	2
			game score	1
			"come in!" caption	1

PAIR was developed as a multimedia CD-ROM, written as a Director 7 (Macromedia Inc, 1999) vector graphics interactive movie. This program can be easily adapted and adjusted to accommodate trends in physical activity for diverse populations, different seasons, different contexts, etc. Unique identifying information and child response data is written to a computer text (.txt) file automatically created at each instance of the tool's use and is readable through any text editor or word processor. Data from the text files is then verified for completeness and manually entered into an SPSS database.

We designed PAIR as a 24-hour recall because young children are able to better recall recent activity [11,12,34]. Given that physical activity patterns are different on weekdays and weekends [35], two versions of PAIR were developed to separately assess school-day physical activity and non-school-day physical activity. Each version was broken down into different time frames to reflect the different structures of the school day and the non-school day [17,36]. Table 3 illustrates the time frame and accompanying questions for the school day and non-school day versions of PAIR. Additional questions included in the school-day PAIR ask about travel to and from school (e.g., "This morning, this is how I got to school"; response options are: walk/run, bike, car, bus, rollerblade, 4-wheeler), and whether or not the child attended gym class.

We sought to contextualise activity by showing a video of the community and the various locations where children could be active (e.g., schoolyard, youth center, etc). In order to stimulate recall and to enhance the respondents' identifying with the characters, a variety of activities performed by Aboriginal children of a similar age to the respondents were included. Drawing from the 62 activities identified in the focus groups, 44 different activity choices (30 physical and 14 non-physical activities) were used to prepare different activity response screens. Figure 1 illustrates 19 of these activities and includes two of the more traditional physical activities practiced by many children in Kahnawake (i.e., traditional dancing and lacrosse). Four different activity response screens are used for the school-day version of PAIR. Activity response options vary according to the context of the question being asked. For example, when asked about what they did during recess one of the choices is jumping rope; biking is not presented as a response option for this question because children do not have access to bikes during recess (see Figure 2). Further, given the limited space on the computer screen, certain activity categories were collapsed and made generic to allow for several possible options. For example an illustration of two children playing checkers has a mouse roll-over of "having a quiet time" to leave open the option of clicking on this response if another type of quiet activity was pursued. Although we tried to avoid collapsing physical activity categories, given that we were interested in distinguishing activity type, some were

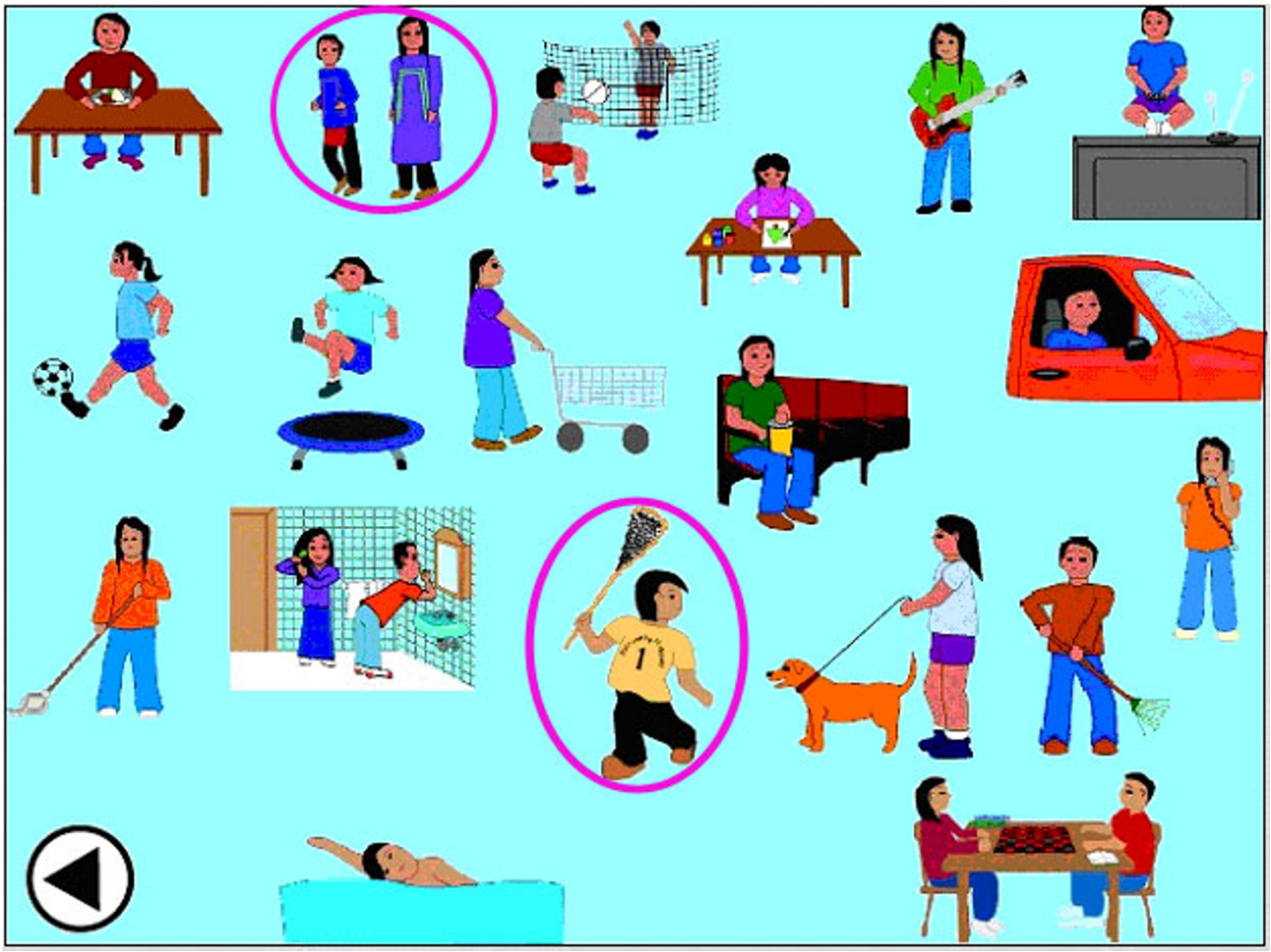

Figure 1
Activity response screen including traditional dancing and lacrosse (circled) in non school day version of PAIR

nonetheless grouped. For example, only one illustration is used to represent both baseball and softball; an image of a child playing hopscotch rolls over as "schoolyard games" and is meant to encompass focus-group responses such as "four squares", "red rover", hopscotch, etc. To make the program fun and interesting for the children, we included music, bright colours, movement, and different sounds (e.g., toilet flushing in bathroom to provide context of morning time).

In addition to asking about activity type, a second question asks about activity intensity whenever a child selects a physical activity response. Given that children have difficulty assigning traditional intensity values such as "easy", "moderate" or "hard" to describe their perceived physical exertion during a given activity [37,38], we used an adaptation of the pictorial Children's OMNI Scale [39] to depict four levels of physical activity intensity: "not tired at all" (=1), "a little tired" (=2), "tired" (=3) and "very tired" (=4). Much like the original OMNI Scale, our intensity scale shows a cyclist ascending a hill with increasing exertion. For example, when at the bottom of the hill, our cyclist is sitting up straight, smiling and appears to be pedalling quickly with ease. In response to the statement "This is how tired I got", the corresponding mouse roll-over for this icon is "not tired at all". By contrast, the cyclist near the top of the hill is bent over the bike and pushing hard on the pedals, as the wheels of the bike seem to barely move. Indicators most frequently endorsed by the children were thus integrated into PAIR to represent activity intensity. For example, the higher intensity cyclist is shown to be grimacing, sweating and

Figure 2
Activity response screen for recess in school day version of PAIR

growing red in the face. In response to the statement "This is how tired I got", the corresponding mouse roll-over for this icon is "very tired". These cyclist icons of varying intensity were used to depict activity intensity for all activity types. This pictorial scale has been shown to be useful for assessing perceived exertion during cycling [39] and more recently, validity evidence has been provided for the walk/run version of the scale [40].

A "total daily activity score" can be computed from PAIR by multiplying each reported physical activity (whereby one activity equals one) by its reported perceived intensity (either one, two, three, or four) and adding these sums for the entire day. When a same activity is performed during more than one time period (i.e., biking in the morning and in the afternoon), each time is counted as one and multiplied by its corresponding intensity. For example, if a child reports having biked at an intensity of two, having run at an intensity of three, having walked at an intensity of one in the morning and having biked at an intensity of three in the afternoon, her total daily activity score would equal nine.

Despite our attempts to develop a PAIR that would reflect the conceptually relevant domains of activity type, activity intensity, and activity duration, we were only able to include activity type and activity intensity in the final version of the instrument. Other than increased sweating, it was difficult to use any of the children's ideas to show that time was passing without using animation. Moreover, given that children are not able to accurately estimate time

Table 3: Break-down of school-day and non school-day time-frames, corresponding questions, and response options

SCHOOL DAY		
Time of the day	**Question**	**Response options**
Before school	When I got to school, I ...	Played outside/went inside right away
Morning Recess	This is what I did during recess yesterday ...	Activities
Lunchtime	When I finished eating lunch I ...	Activities
Gym class	I had gym class yesterday	Yes/No
Before supper	Before it was time to eat supper I ...	Activities
Before bed	After supper and before going to bed, I ...	Activities
NON-SCHOOL DAY		
Time of the day	**Question**	**Response options**
Morning	After breakfast and before lunch I ...	Activities
Afternoon	After lunch and before supper I ...	Activities
Evening	After supper and before going to bed, I ...	Activities

spent involved in a specific activity [11,12], we chose not to integrate the duration parameter for each activity.

PAIR Pilot-testing

Assessing the content validity of the preliminary version of PAIR involved two waves of pilot testing. We sought to assess comprehension and appreciation by the children, instrument response time, and practicality (i.e., can be used with a large group; can be used by a child without adult assistance). PAIR was revised after the first wave.

Participants

Participants in the first pilot-test were 17 grade 1 to grade 6 students (10 girls, 7 boys, mean age = 9.2 years, SD = 1.5) all from one Kanien'kehá:ka school in Ontario. A second group of 28 children (12 girls, 16 boys, mean age = 8.3 years, SD = 1.6) attending a summer day-camp program in Kahnawake participated in the second wave. Parents of participants provided written active consent in accordance with the KSDPP Code of Research Ethics [28] and as per the requirements of the relevant university Institutional Review Board. No incentives were given although children had the option to print out a sport related drawing to colour upon completion of PAIR. In addition, two teachers, both Kanien'kehá:ka women, participated in a semi-structured interview during the second wave.

Pilot-testing

During the first wave, in groups of two or three, each of the 17 children responded to PAIR on their own computer terminal in a quiet room while two observers, including the first author, watched and videotaped each session. Although the observer and child were in the same room, they did not interact until the child had finished responding to PAIR. Observers recorded response time, number of times a child clicked on the "repeat" button, number of icons the child rolled over using the mouse, etc. The observer conducted a semi-structured, one-on-one brief interview with the child once he or she had completed the recall in order to verify responses to PAIR and to get the child's general impressions. For example, if a child responded not having attended school on the previous day, he or she was asked about this. Other more general questions included "Did you understand all of the instructions?" and "Overall, what did you think of PAIR?"

In the second and final wave of pilot testing, 28 children responded to PAIR in small groups (i.e., 5 or 6 children at a time). Brief semi-structured focus group interviews were conducted, using the same questionnaire as in the first wave and children's feedback was recorded. In addition, two grade 4 teachers were interviewed after they had reviewed PAIR. Sample interview questions for the teachers included "For which age group do you think PAIR is appropriate?" and "What could be added/changed to stimulate children's recollection of the previous day's activities?"

Data analysis

A systematic review of feedback from multiple sources served to refine the instrument. The two observers viewed the videotapes from the first wave to elaborate upon their initial notes. Observation notes and interview responses were then coded according to the domains of PAIR content and format. Examples of content related feedback included child comments about the exhaustiveness of response options, comprehension of illustrations and narration, etc. Examples of format related feedback included child comments about preferences of color,

sound, movement, etc. Discussions among project staff resulted in a list of recommendations for instrument refinement.

Results

Coded data from the pilot test videotapes, observer notes, and interviews were discussed by project staff and resulted in a list of recommendations for instrument refinement. The most important finding from our pilot testing was that children under the age of nine were not able to complete PAIR without assistance (i.e., six out of six children from wave one and 13 out of 14 children from wave two required assistance). They had difficulty responding to some of the instructions (e.g., what time did you wake up yesterday?) and often clicked randomly on the response options. Several of the younger children (i.e., two out of six and five out of 14 six to eight year-olds in the first and second waves respectively), possibly intrigued by what would happen, clicked on every response item until the screen was emptied. This finding is consistent with previous research that has failed to validate self-reported physical activity measures in children younger than nine [41]. Teacher interviews corroborated this finding as both teachers considered PAIR to be appropriate for children over eight years old. Indeed, we found that with the exception of three children (one from wave one and two from wave two), most of the children age nine and older (i.e., 10 out 11 from wave one and 12 out of 14 from wave two) were able to respond completely unaided to PAIR.

Content

Children between the ages of nine and 13 reported understanding all of the instructions and illustrations as well as the meaning of the graded intensity scale. We found that our no-frills version of the intensity scale (i.e., no animation or variation in sounds) did not prevent children from understanding and distinguishing the different activity intensities. The children reported that all of their previous day activities could be found in the response options. When two or more children provided similar feedback about a same illustration, that illustration was touched-up or redrawn. For example, the trampoline jumper was deemed to be too far off of the trampoline; a touch up brought the jumper closer. Some sound adjustments were also needed to segments that were not clearly enunciated.

Format

Thirty-one of the children across the two waves said it was "fun" to answer PAIR. They especially appreciated seeing the introduction video of their own school, community and people they knew. Only two of the older children said that it was boring or "babyish". Twenty children commented that more animation would have made PAIR more fun and interesting. When asked whether they thought a boy or girl narrated the script, two-thirds of the children couldn't tell whether the narrator was a boy or girl (a 9 year-old girl was narrator). This finding is interesting because the neutrality of the narrator's gender may help both boys and girls identify with the narrator. We found that with the exception five children in all, most of whom were older (i.e., 12 – 13 years), children liked being able to print out a sport related drawing to colour upon completion of PAIR.

Appropriate modifications were made to PAIR to reflect the children's feedback after the first wave. No revisions were needed after the second pilot-test and this version was considered final. Average response time for PAIR was approximately 15 minutes, a duration deemed acceptable by the children. Overall, the children judged PAIR to be comprehensive and enjoyable.

Discussion

In order to develop a culturally appropriate interactive computer program to self-report physical activity for Kanien'kehá:ka children, two phases were carried out. During phase I, we sought to understand how Kanien'kehá:ka children describe and graphically depict: activity type (i.e., activity phenotype), activity intensity (i.e., degree of perceived activity-imposed overload on physiological systems), and activity duration (i.e., temporal length of an activity bout) of physical activity involvement. In phase II PAIR software was developed and the multimedia program was pilot-tested in two waves. The main challenges to integrating our research findings into the instrument were budget and logistical constraints.

Content validity was established using several strategies, arguably the most cogent of which was the integration of deductive and inductive coding techniques. A comprehensive review of the physical activity literature clearly identified the theoretical importance of activity type, activity intensity, and activity duration in physical activity assessment. We used these deductively derived physical activity categories to guide Phase I of the study. As shown in Tables 1 and 2, content analyses of drawings and focus groups resulted in a series of inductively derived cultural and age-relevant dimensions and indicators for each deductive conceptual category. The integration of deduction with induction enhanced PAIR's content validity by capturing local physical activity types of Kanien'kehá:ka children and their representations of activity intensity for concepts which are deemed to generalize across population sub-groups. As is often the case with measurement development, the scale developer is left with more items or response options than can be utilized in the final instrument [42]. We found this to be true in this study as it became necessary to collapse certain activity types. Despite the collapsing of activity types, our pilot-tests showed that no response options were missing from

PAIR; the children could always find a representation of the activity they did. This suggests that the PAIR provides adequate indicator coverage for the different activity types.

The children's feedback from the pilot-test confirmed that the activity intensity scale adequately conveyed the four different intensity levels we strived to capture. We were able to use many of the ideas children gave us for depicting activity intensity (e.g., sweating, grimacing). The constant exchange between physical activity, evaluation professionals and interviews with the school teachers in addition to observing the children completing the PAIR during Phase II (pilot-testing) were employed as complementary strategies to enhance content relevance and content coverage of activity type and activity intensity.

PAIR does not assess activity duration and this is a limit to the content validity of this instrument. Although the children provided us with many ideas for showing the passing of time (e.g., a setting sun, the wearing of a surface, a change in game score), it was not possible to convey the passing of time without using animation. Future work could address this issue.

Given that our aim was to develop an instrument that could be administered in a group setting, it was essential that children be able to respond to PAIR without assistance. We found that only children of nine years old and above could do this and thus conclude that PAIR is appropriate for children between the ages of nine and 13. However, it should be noted that PAIR could potentially be tested and used in an interview format with younger children (i.e., assisted by an adult in a one-on-one situation).

Conclusions

In conclusion, we found that the development of a self-reported interactive physical activity recall for Kanien'kehá:ka children nine years and older can be informed by children through focus group interviews and drawings. The final instrument may thus be acceptable to children between the ages of nine and 13 years with most in this age range able to complete PAIR without assistance". However, given that administering PAIR requires access to computers, we recognize that this may be a limit for some potential users. The flexibility of the Director Macromedia programming makes PAIR an easily adaptable tool that can accommodate changing trends in physical activity involvement. We are currently using PAIR to assess physical activity involvement in children participating in KSDPP and will be able to assess PAIR's comparability with an adaptation of the Weekly Activity Checklist [35].

Further testing against accepted criterion measures for assessing energy expenditure (e.g., activity monitors) is recommended. We also encourage any work that can address the technical shortcomings of PAIR (e.g., limited animation, a feature to automatically code, tally and enter the results into a database). And finally, we encourage researchers to use PAIR as a template for the development of culturally and age appropriate instruments for other groups for whom no appropriate measures of this kind exist.

Competing interests

None declared.

Authors' contributions

LL conceived of the study, participated in its design and coordination, carried out the focus groups, participated in the content analysis and drafted the manuscript. MC participated in the content analysis and co-wrote the manuscript. JS participated in the content analysis, provided computer expertise, and drafted portions of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors wish to thank Mr. Serge Desrosiers for participating in the coordination of the data collection process and Digital Dreamcatchers of Kahnawake for multimedia services. We also extend thanks to Kahnawake Schools Diabetes Prevention Project Community Advisory Board members and staff for their insightful comments during the preparation of this manuscript. This research was supported by the Canadian Diabetes Association.

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