



Exploring the effect of parental influence on children's physical activity: The mediating role of children's perceptions of parental support

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ABSTRACT

The purpose of this study was to test a conceptual model linking parental support and parental physical activity (PA), with children's perception of parental support and children's PA. Baseline data were drawn from the Grade 5 ACT-i-Pass community-based PA intervention conducted in London, Ontario between May and October 2014. Parent and child PA were measured using the International Physical Activity Questionnaire and Physical Activity Questionnaire for Children, respectively. Questions pertaining to parental support and children's perception of that parental support were obtained via questionnaires. We employed structural equation modeling techniques to test the conceptual model. In total, 467 boys and 469 girls were included in the study. The model provided an acceptable model fit. Child's perception of parental support for PA had a positive effect on boys' ($b = 0.319$) and girls' ($b = 0.326$) PA. Parental PA was not significantly related to child's perception of parental support for PA. However, parent reported support for PA had a significant, positive effect on child's perception of parental support for boys ($b = 0.352$) and girls ($b = 0.584$). In terms of the indirect effects, the effect of parental PA on child's PA was not statistically significant; however, as expected, parental support for PA had a statistically significant indirect effect on child PA level in both groups. The findings of this study demonstrate the importance of children's perceptions of parental support in relation to their PA behaviours. Developing a better understanding of factors related to children's PA and identifying determinants and mediators of activity behaviours will help inform PA interventions.

1. Introduction

Routine participation in physical activity (PA) is essential for the maintenance of health and well-being throughout the lifespan. Despite well-known health benefits associated with being physically active (Janssen and LeBlanc, 2010), many children, particularly girls, do not accumulate sufficient levels of activity to obtain such benefits (Sallis et al., 2000). A Canadian national survey estimated that only 9% of children and youth (5–17 years) met the recommended guideline of 60 min of moderate-to-vigorous PA per day (Statistics Canada, 2015). Similar rates of inactivity have been found worldwide; with approximately 80% of adolescents (13–15 years) not meeting public health

recommendations for PA (Hallal et al., 2012).

The determinants of PA are complex, as there are numerous factors at multiple levels (e.g., individual, interpersonal, environmental) that can affect the behaviours of children and youth (Biddle and Asare, 2011; Mitchell et al., 2016). Developing effective interventions and policies requires an examination of the interrelationships between these factors and the mechanism through which they influence PA (Smith et al., 2010).

Interpersonal or social factors have been known to influence PA and may be the most important and modifiable determinants of PA (Gustafson and Rhodes, 2006). In particular, parents play an important role in the development of children's health behaviours (Taylor et al.,

Abbreviations: PA, physical activity; G5AP, Grade 5 ACT-i-Pass; PAQ-C, Physical Activity Questionnaire for Children; IPAQ, International Physical Activity Questionnaire; SEM, structural equation modeling; DA, census dissemination areas

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1994). Parents can affect the PA behaviours of their children through a variety of mechanisms (Maatta et al., 2014; Trost and Loprinzi, 2011), and have been described as *gate-keepers* for opportunities to be active (Welk et al., 2003). Parental support to be active and parent's own PA, in particular, are two modifiable factors that can affect activity-related behaviours among children (Tandon et al., 2014; Trost and Loprinzi, 2011; Yao and Rhodes, 2015).

Per Beets and colleagues, parental support “represents the functional characteristics associated with the interactions between a parent and his or her children in the context of intentionally participating in, prompting, discussing, and/or providing activity-related opportunities” (Beets et al., 2010, p. 624). More specifically, parental support has been previously defined as providing encouragement, transportation to PA opportunities, watching children participate in activities, and engaging with children in PA (Beets et al., 2006; Trost and Loprinzi, 2011; Welk et al., 2003). Supportive behaviours have been positively associated with PA of children under the age of 18 years in several systematic reviews and meta-analyses (Gustafson and Rhodes, 2006; Pugliese and Tinsley, 2007; Van Der Horst et al., 2007; Yao and Rhodes, 2015). In general, boys have been found to receive more support to be active than girls (Gustafson and Rhodes, 2006; Lau et al., 2015).

One potential mediator of the relationship between parental support and children's PA is children's perception of this support (Barr-Anderson et al., 2010; Heitzler et al., 2006). However, the role of children's perceptions is not well established (Forthofer et al., 2016). There is also limited research exploring the association between parent-reported support and child perception of that support and how these two factors relate to children's PA levels (Barr-Anderson et al., 2010; Forthofer et al., 2016; Heitzler et al. 2006). In a meta-analysis, Pugliese and Tinsley (2007) reported that children and adolescents were more likely to be inactive if they perceived that their parents did not provide support for PA. Thus, there is a need to determine if child's perception of support mediates the relationship between parent support and child PA.

Parental PA, another modifiable determinant of activity-related behaviours among children, may also affect the development of children's PA behaviours. Evidence from a recent meta-analysis suggested that there is a small effect of parental PA on children's PA (Yao and Rhodes, 2015). However, findings from older systematic reviews suggest that this effect is inconsistent (Biddle and Asare, 2011; Trost and Loprinzi, 2011). Though the relationship between children's perception of support and parent PA has not previously been assessed, it is possible that Parental PA would affect perceived support. Previous work has indicated that there may be a discrepancy between parental activities and children's perceptions regarding the extent to which parents engage in behaviours such as encouragement to be active, transportation to places to be active, or their own PA (Pugliese and Tinsley, 2007).

Given the influence parents have on their children's PA (Garriguet et al., 2017; Gustafson and Rhodes, 2006; Yao and Rhodes, 2015) and the lack of knowledge on the nature of this influence, additional research is needed to understand the mechanism through which parental support and parental PA affect children's PA participation as well as the role of children's perception of parental support as a potential mediator of this relationship. Thus, the purpose of this study was to test a conceptual model linking parental support and parental PA with children's PA and the role of children's perception of parental support as a potential mediator of this relationship. To our knowledge, there are no studies examining this relationship. It was hypothesized that the relationships between parental support and parental PA with children's PA would be mediated by children's perception of parental support. Factors related to parental education, household income, family structure, and geographic accessibility (e.g., distance to the nearest recreational facility, school playground, and park) were also included in the model as exogenous variables and were hypothesized to affect parents support and parental PA levels.

2. Methods

2.1. Participants and recruitment

Data were drawn from the Grade 5 ACT-i-Pass (G5AP) community-based PA intervention conducted in London, Canada (Gilliland et al., 2015; Clark et al., 2017). Children were recruited from all elementary schools within the city limits (n = 99 [93 English-speaking schools, 5 French-speaking schools, and 1 private school]) and were 9–11 years old at the time of data collection. Baseline data on children and their parents were collected in two waves, when the registration forms for the G5AP were initially distributed in May 2014 and, for late registrants, at the beginning of the school year (October), when the students entered grade 5. Further details pertaining to the study protocol are published elsewhere (Gilliland et al., 2015; Clark et al., 2017). Ethical approval for this study was obtained from the University's non-medical research board and from participating school boards.

For the purposes of this study, we only included baseline data from the G5AP study. In total, 1440 parents and 957 children completed the baseline survey, with response rates of 84.3% to parent and 56.0% to child survey. Twenty-six families did not meet the inclusion criteria as their home addresses were not available or were outside of the city limits. The final sample consisted of 936 child/parent matches.

2.2. Measurement instruments

The Physical Activity Questionnaire for Children (PAQ-C) was used to assess children's PA (Kowalski et al., 1997). The PAQ-C is a valid and reliable self-report measure for children in grades 4–8 (Kowalski et al., 1997). The PAQ-C includes nine items and asks individuals to rate how much PA they have done over the past week. This instrument was modified by combining the three items measuring school-related PA during physical education classes (item 2), recess (item 3), and lunch (item 4) and the three items measuring PA right after school (item 5), in evenings (item 6), and on weekends (item 7) into two subscales or parcels. We used the two parcels and the three remaining items measuring type of spare time PA (item 1), level of engagement in PA over 7 days (item 8), and average daily frequency of PA (item 9) as indicators of the latent variable *Child PA*.

Four questions measured children's perception of parental support for PA: parents watched their child participate in PA (item 10), parents encouraged their child to be active (item 11), parents provided transportation to a place to be physically active or play sports (item 12), and parents participated in PA or played sports with their child (item 13). The responses were captured on a 5-point Likert scale, with endpoints ranging from ‘never’ to ‘daily’ (Robbins et al., 2008; Welk et al., 2003). These four items were used as indicators of a latent variable *Perception of Support*.

Parent-reported support for PA was elicited from a series of questions on the parent survey pertaining to the weekly frequency parents: encouraged children to be physically active (item 14), provided transportation to places to do physical activities or sports (item 15), watched children participate in PA (item 16), and were active with children (item 17) (Beets et al., 2006; Trost and Loprinzi, 2011; Welk et al., 2003). The questions were captured on a 5-point Likert scale with endpoints ranging from ‘none’ to ‘daily’ and were specified as indicators of a latent variable *Parental Support*.

Parental PA levels were assessed using the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003). The IPAQ provides information on the amount of time parents spent per week in moderate (item 19) and vigorous (item 18) intensity PA and walking (item 20). Responses to the three items were scored and normalized as per the scoring protocol and then used as indicators of a latent variable *Parental PA*. Total score for each activity ranged from 0 to 240 min of PA per week and it was converted into a 0–4 scale (hours per week of PA).

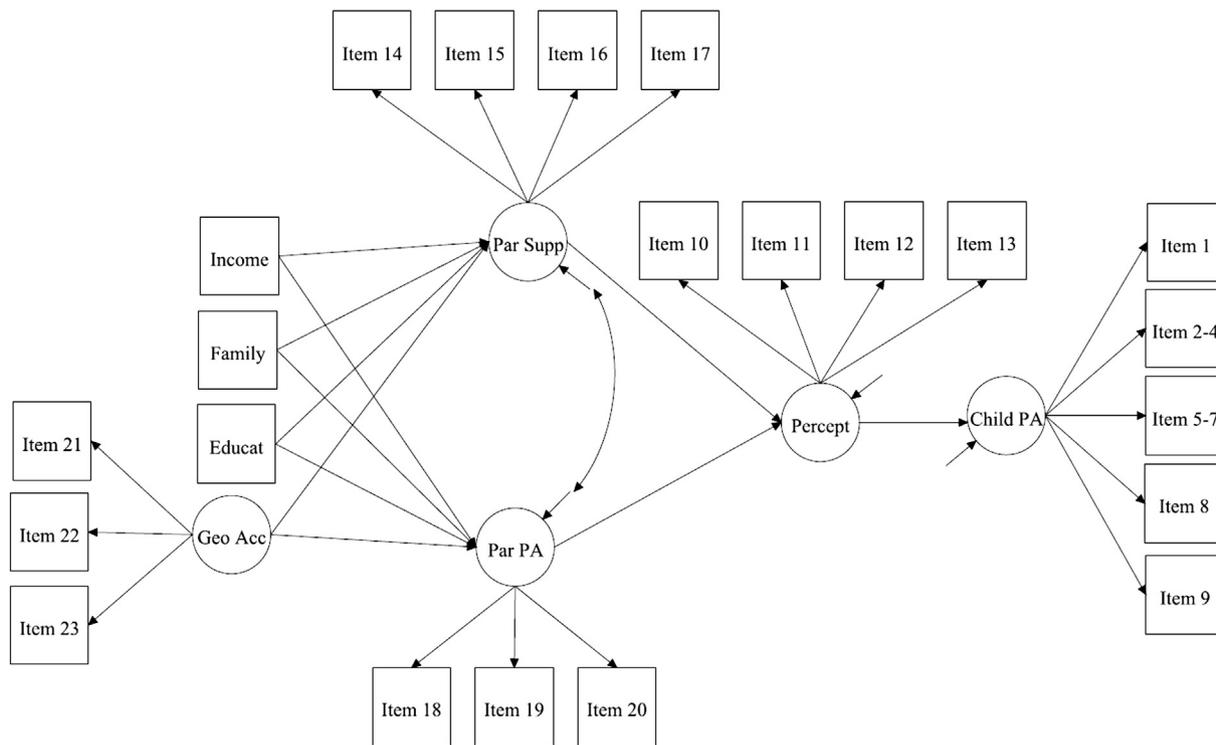


Fig. 1. Conceptual model linking parental support and parental PA, with children's perception of parental support and children's PA.

The following socio-demographic exogenous variables were derived from the parent survey: parental level of educational attainment (high school or less versus college/university degree); household income (a 15-point scale ranging from 'less than \$20,000' to '\$150,000 or more'); and family structure (lone parent versus two parent family). Finally, geographic accessibility was measured by a latent variable *Geographic Accessibility* derived from three proximity measures: distance to the nearest recreational facility (item 21); distance to the nearest school playground (item 22); and distance to the nearest park (item 23). These measures were assessed objectively in ArcGIS 10.1 (ESRI, 2011) as the shortest distance (along the street network) between child's home and the nearest site in each of the three categories.

2.3. Statistical analysis

To assess the fit of the hypothesized model to the data, we employed structural equation modeling (SEM) techniques. SEM estimates the relationships between the observed and the latent variables in the measurement model and, at the same time, the direct and indirect effects among the latent and observed variables in the construct model. The proposed conceptual model is presented in Fig. 1. Sex-specific multiple group framework were used to assess potential differences between boys and girls. That is, we assessed the overall role of children's perception of parental support as a mediator of the relationship between parental support and parental PA with child-level PA and then we determined the across-group differences in these effects. We also estimated a latent mean structure to test the across-group differences in the means of the four focal latent variables (*Child PA*, *Perception of Support*, *Parental Support*, and *Parental PA*), using girls as a reference group. Correlations were specified between the four exogenous variables and between *Parental Support* and *Parental PA*. To test across-group differences, we imposed across-group equity constraints on factor loadings and item intercepts (thresholds) and fixed the intercepts of latent variables in the reference group (girls) to the value of zero.

The robust weighted least squares estimator with delta parameterization was used for data analysis as all indicators of the

continuous latent variable that were measured on a Likert scale were specified in the measurement model as categorical variables. Since the recruitment for the G5PA was conducted in schools, we used a sandwich estimator to adjust standard errors for the data collection design. Non-response weights were also used to adjust for the differential response rates across census dissemination areas (DA). To compute these weights, we divided the sample counts of children in each of the 452 DA by the total number of children in each DA. Missing data were handled by full-information techniques. Model fit was assessed based on four fit indices: chi-square, CFI, TLI, and RMSEA. A change in chi-square value between nested models was used to assess differences between groups. To permit comparisons between boys and girls and within each group, both the unstandardized (b) and standardized (β) coefficients were computed. The statistical significance was determined at $p < 0.05$. Data cleaning and assumptions testing were performed in SAS 9.4 (SAS Institute Inc., 2016) and model testing was conducted in Mplus 7.4 (Muthen and Muthen, 2015).

3. Results

3.1. Descriptive statistics

Table 1 presents the weighted descriptive statistics for the variables included in the analysis, separately for 467 boys (49.9%) and 469 girls (50.1%). 15.8% of boys and 19.2% of girls reported living in single parent families. For most boys (87.9%) and girls (89.1%), at least one parent had a university degree or diploma. Average household income was between \$70,000 and 79,999. The correlation matrices for the observed variables are reported in Table 2.

3.2. Model fit

The goodness of fit statistics met the criteria for an adequate model fit with the RMSEA (0.024; CI: 0.017–0.030), CFI (0.976), and TLI (0.975), all falling within the recommended ranges. The chi-square of 547.656 (df = 434) was almost evenly distributed between the two

Table 1
Weighted descriptive statistics.

Construct/item	Boys						Girls					
	N	Missing	Mean	Std dev	Min	Max	N	Missing	Mean	Std dev	Min	Max
<i>Child PA</i>												
Type of spare time PA (item 1)	458	12	1.03	0.64	0.00	3.82	452	15	0.92	0.54	0.00	3.27
PA during PE classes, recess, lunch (items 2–4)	468	1	2.87	0.91	0.00	4.00	465	2	2.67	0.92	0.00	4.00
PA after school, evenings, weekends (items 5–7)	467	2	2.36	1.08	0.00	4.00	462	4	2.17	1.03	0.00	4.00
PA over 7 days (item 8)	464	5	2.52	1.22	0	4	462	4	2.33	1.15	0	4
Average daily frequency of PA (item 9)	443	26	2.52	1.00	0.00	4.00	445	22	2.30	0.98	0.00	4.00
<i>Perception of Support</i>												
Parents watched child participate in PA (item 10)	458	11	1.99	1.40	0	4	455	12	1.88	1.37	0	4
Parents encouraged child to be active (item 11)	459	10	2.47	1.44	0	4	454	12	2.48	1.49	0	4
Parents provided transportation to be active (item 12)	458	11	2.31	1.49	0	4	452	15	2.32	1.50	0	4
Parents participated in PA/sports with child (item 13)	458	11	1.88	1.38	0	4	454	12	1.74	1.34	0	4
<i>Parental Support</i>												
Encouraged children to be physically active (item 14)	383	86	3.03	0.91	0	4	407	60	2.92	0.91	0	4
Provided transportation to places to be active (item 15)	383	86	2.02	0.95	0	4	406	60	1.96	0.97	0	4
Watched children participate in PA (item 16)	381	88	2.35	1.18	0	4	403	63	2.36	1.12	0	4
Active with children (item 17)	384	85	2.37	1.10	0	4	403	64	2.43	1.05	0	4
<i>Parental PA</i>												
Vigorous intensity PA per week (item 18)	376	93	0.81	0.95	0.00	4.00	390	76	0.87	1.01	0.00	4.00
Moderate intensity PA per week (item 19)	376	93	0.94	1.07	0.00	4.00	390	76	0.96	1.06	0.00	4.00
Walking (item 20)	376	93	1.09	1.17	0.00	4.00	390	76	1.11	1.14	0.00	4.00
<i>Exogenous variables</i>												
Lone parent	467	2	0.16	0.37	0	1	465	2	0.19	0.39	0	1
Household income	467	2	6.45	4.10	0	14	466	1	6.35	4.33	0	14
Parental education	412	57	0.89	0.31	0	1	420	47	0.88	0.33	0	1
Distances to recreation facility (item 21)	469	0	1.98	1.03	0.01	5.44	466	0	1.99	0.96	0.15	5.35
Distance to school playground (item 22)	469	0	1.00	0.68	0.01	3.78	466	0	1.00	0.68	0.00	3.61
Distance to park (item 22)	469	0	0.74	0.49	0.00	3.15	466	0	0.72	0.48	0.00	3.05

Table 2
Correlation matrices for the indicators of the focal latent variables.

Items	<i>Child PA</i>					<i>Parental Support</i>				<i>Perception of Support</i>				<i>Parental PA</i>	
	Item 1	Items 2–4	Items 5–7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18	Item 19
Items 2–4	0.31														Girls
Items 5–7	0.55	0.27													
Item 8	0.50	0.31	0.58												
Item 9	0.56	0.37	0.59	0.52											
Item 10	0.27	0.14	0.20	0.19	0.16										
Item 11	0.13	0.11	0.11	0.04	0.10	0.49									
Item 12	0.19	0.17	0.12	0.13	0.15	0.52	0.34								
Item 13	0.20	0.22	0.12	0.16	0.15	0.51	0.37	0.79							
Item 14	0.44	0.27	0.39	0.37	0.42	0.25	0.07	0.29	0.32						
Item 15	0.20	0.12	0.20	0.19	0.22	0.21	0.00	0.21	0.22	0.48					
Item 16	0.29	0.18	0.30	0.31	0.32	0.30	0.11	0.34	0.35	0.59	0.55				
Item 17	0.43	0.19	0.41	0.31	0.39	0.17	0.21	0.15	0.20	0.55	0.49	0.43			
Item 18	0.13	0.04	0.06	0.09	0.05	0.09	0.07	0.16	0.17	0.12	0.08	0.11	0.09		
Item 19	0.05	–0.12	–0.02	0.06	–0.03	0.17	0.18	0.10	0.11	–0.09	–0.04	–0.05	0.03	0.33	
Item 20	0.01	0.04	0.00	0.08	–0.02	0.05	0.12	0.07	0.05	0.04	–0.01	0.04	0.04	0.09	0.26
Items 2–4	0.24														Boys
Items 5–7	0.44	0.23													
Item 8	0.48	0.39	0.61												
Item 9	0.51	0.35	0.60	0.57											
Item 10	0.08	0.16	0.00	0.07	0.06										
Item 11	0.03	0.07	0.00	–0.02	0.05	0.41									
Item 12	–0.01	0.03	0.06	0.06	0.07	0.47	0.49								
Item 13	0.01	0.12	0.10	0.10	0.08	0.51	0.55	0.85							
Item 14	0.43	0.32	0.39	0.44	0.41	0.16	0.17	0.24	0.32						
Item 15	0.33	0.22	0.27	0.29	0.31	0.23	0.24	0.15	0.21	0.52					
Item 16	0.29	0.18	0.21	0.25	0.30	0.30	0.17	0.26	0.30	0.58	0.57				
Item 17	0.41	0.13	0.33	0.35	0.26	0.11	0.16	0.04	0.11	0.48	0.50	0.46			
Item 18	0.05	0.07	–0.06	–0.07	–0.03	0.09	0.32	0.20	0.19	0.00	0.07	0.10	0.07		
Item 19	0.07	0.09	0.01	0.04	0.04	0.12	0.22	0.11	0.11	0.05	0.06	0.14	0.12	0.34	
Item 20	0.05	0.04	–0.08	–0.04	0.00	–0.01	0.08	–0.05	0.02	–0.02	–0.04	–0.06	0.01	0.24	0.30

Table 3
Factor loadings for latent variables.

	b	se	t-Value	p-Value	β (boys)	β (girls)
<i>Child PA</i>						
Type of spare time PA (item 1)	1.000	0.000			0.768	0.680
PA during PE classes, recess, lunch (items 2–4)	0.949	0.101	9.367	0.000	0.428	0.454
PA after school, evenings, weekends (items 5–7)	1.773	0.110	16.177	0.000	0.713	0.710
PA over 7 days (item 8)	1.724	0.095	18.117	0.000	0.717	0.735
Average daily frequency of PA (item 9)	1.765	0.104	16.957	0.000	0.750	0.765
<i>Perception of Support</i>						
Parents watched child participate in PA (item 10)	1.000	0.000			0.817	0.811
Parents encouraged child to be active (item 11)	0.749	0.053	14.030	0.000	0.612	0.704
Parents provided transportation to be active (item 12)	0.890	0.045	19.837	0.000	0.727	0.730
Parents participated in PA/sports with child (item 13)	0.869	0.041	21.448	0.000	0.710	0.657
<i>Parental Support</i>						
Encouraged children to be physically active (item 14)	1.000	0.000			0.644	0.605
Provided transportation to places to be active (item 15)	0.800	0.069	11.591	0.000	0.515	0.593
Watched children participate in PA (item 16)	1.359	0.069	19.756	0.000	0.875	0.890
Active with children (item 17)	1.368	0.069	19.863	0.000	0.881	0.942
<i>Parental PA</i>						
Vigorous intensity PA per week (item 18)	1.000	0.000			0.550	0.644
Moderate intensity PA per week (item 19)	1.126	0.202	5.585	0.000	0.588	0.642
Walking (item 20)	0.658	0.134	4.928	0.000	0.320	0.343
<i>Geographic accessibility</i>						
Distances to recreation facility (item 21)	1.000	0.000			0.783	0.819
Distance to school playground (item 22)	0.496	0.082	6.035	0.000	0.550	0.621
Distance to park (item 22)	0.309	0.048	6.460	0.000	0.486	0.531

groups (270.410 for boys and 277.246 for girls). Review of the modification indices (MI) indicated that there were only two potential modifications to the proposed measurement model, both in the model for boys: the correlation between two indicators of *Parental Support* (item 10 and item 11; MI = 15.556) and a suggestion that the level of vigorous activity (item 18), hypothesized to measure *Parental PA*, should also serve as an indicator of the latent variable *Perception of Support* (MI = 10.898). Since we could not justify these changes theoretically and the MI were relatively small, we did not make these adjustments. Notably, the MI did not suggest a need for a direct path from *Parental Support* to *Child PA*. The model accounted for 41% of variance in the latent variable measuring the level of PA among girls and for 38% among boys.

3.3. Measurement model

Factor loadings for latent variables are reported in Table 3. For all observed variables (indicators), factor loadings were statistically significant with the standardized coefficients (β) between 0.320 and 0.881 for girls and between 0.343 and 0.942 for boys. Preliminary analysis suggested that when we imposed across-group equity constraints on factor loadings, the chi-square difference test for nested models ($\Delta\chi = 11.066$ at $df = 12$) indicated equivalence of the measurement model for the two groups.

3.4. Construct model

Table 4 presents the results for the relationship among the focal latent variables and they suggest that children's perception of parental support for PA had a statistically significant and positive effect on child's level of PA for boys ($b = 0.319$) and for girls ($b = 0.326$). A chi-square test for group invariance indicated that the magnitude of this effect was statistically no different across the two groups ($\Delta\chi = 0.028$; $df = 1$). The level of parental PA did not have a statistically significant effect on child's perception of parental support for PA ($b = 0.009$ for boys; $b = -0.088$ for girls); however, parent reported level of support for PA had a statistically significant and positive effect on child's perception of parental support. Although this effect appeared to be stronger for girls ($b = 0.584$) than for boys ($b = 0.352$), this difference was not statistically significant ($\Delta\chi = 3.090$; $df = 1$). In terms of

indirect effects, the effect of parental PA on children's PA was not statistically significant ($b = 0.003$ for boys and $b = -0.029$ for girls); however, parental support for PA had a statistically significant indirect effect on child PA in both groups ($b = 0.112$ for boys and $b = 0.190$ for girls). Although the magnitude of this indirect effect was approximately 70% larger for girls, the difference was not statistically significant ($\Delta\chi = 4.644$; $df = 2$).

In terms of the effects of exogenous variables on the two latent variables measuring parental involvement, girls from single parent households received less parental support for PA ($b = -0.202$) than girls having both parents; the opposite effect was found for boys ($b = 0.240$). Boys also received more parental support for PA in families with higher household income ($b = 0.041$) and, for girls, the level of parental support was positively associated with geographic accessibility ($b = 0.152$). Finally, in the girl sample, parents who received a university degree reported being less physically active than parents who did not obtain a degree ($b = -0.274$).

3.5. Latent means

Analysis of latent mean structure suggested that boys were significantly more active than girls by 0.095 points, on a 5-point scale. The results also suggested that the level of parental support and the level of parental PA were lower in the boy sample than in the girl sample by the factors of 0.450 and 0.385, respectively, both measured on a 5-point scale. However, the reported level of perceived parental support was statistically no different for boys and girls.

4. Discussion

Parents play an important role in the development of their children's healthy lifestyle behaviours. The purpose of this study was to test a conceptual model linking parental support and parental PA, with children's perception of parental support and children's PA. Beets et al. (2010) indicate that although support mechanisms (e.g., encouragement) may be present, if they are not perceived by the child to be adequate, parental support will not impact their levels of PA. In the current study, a significant positive relationship was found between parental support and children's perception of parental support, which in turn was significantly related with children's PA. Moreover, we also

Table 4
Results for the direct and indirect relationship between the four focal latent variables and analysis of latent means.

			Boys					Girls				
			b	se	t-Value	p-Value	β	b	se	t-Value	p-Value	β
Direct effects												
<i>Child PA</i>	on	<i>Perception of Support</i>	0.319	0.032	9.988	0.000	0.617	0.326	0.025	12.940	0.000	0.640
<i>Perception of Support</i>	on	<i>Parental Support</i>	0.352	0.095	3.698	0.000	0.293	0.584	0.090	6.451	0.000	0.460
		<i>Parental PA</i>	0.009	0.122	0.077	0.938	0.007	-0.088	0.126	-0.703	0.482	-0.060
<i>Parental Support</i>	on	Household Income	0.041	0.010	3.951	0.000	0.241	0.010	0.008	1.193	0.233	0.067
		Lone Parent	0.240	0.102	2.344	0.019	0.126	-0.202	0.086	-2.342	0.019	-0.123
		Parental Education	0.115	0.134	0.857	0.391	0.051	-0.100	0.125	-0.801	0.423	-0.051
		<i>Geographic Accessibility</i>	0.058	0.052	1.116	0.264	0.071	0.152	0.072	2.093	0.036	0.176
<i>Parental PA</i>	on	Household Income	0.004	0.011	0.316	0.752	0.024	-0.003	0.010	-0.324	0.746	-0.026
		Lone Parent	0.124	0.124	0.997	0.319	0.074	0.089	0.088	1.018	0.308	0.063
		Parental Education	0.066	0.128	0.517	0.605	0.034	-0.274	0.107	-2.563	0.010	-0.161
		<i>Geographic Accessibility</i>	-0.079	0.068	-1.166	0.244	-0.110	0.047	0.081	0.578	0.563	0.063
Indirect Effects												
<i>Parental Support</i>	to	<i>Child PA</i>	0.112	0.031	3.628	0.000	0.181	0.190	0.028	6.727	0.000	0.294
<i>Parental PA</i>	to	<i>Child PA</i>	0.003	0.039	0.077	0.939	0.004	-0.029	0.041	-0.709	0.478	-0.038
<i>R-square</i>		<i>Child PA</i>	0.380	0.044	8.722	0.000		0.410	0.045	9.198	0.000	
		<i>Perception of Support</i>	0.087	0.037	2.346	0.019		0.198	0.055	3.602	0.000	
		<i>Parental Support</i>	0.079	0.034	2.326	0.020		0.070	0.027	2.565	0.010	
		<i>Parental PA</i>	0.016	0.020	0.801	0.423		0.036	0.029	1.253	0.210	
Latent means												
		<i>Child PA</i>	0.096	0.038	2.49	0.013						
		<i>Perception of Support</i>	0.043	0.087	0.493	0.622						
		<i>Parental Support</i>	-0.450	0.178	-2.534	0.011						
		<i>Parental PA</i>	-0.385	0.189	-2.039	0.041						

found a statistically significant indirect effect for parental support on children's PA. Heitzler et al. (2006) found similar results, with children's (9–13 years; n = 3114) perception of parental support and parent's reports of direct support strongly related to children's participation in organized PA. Additionally, in a smaller study among elementary school children, (n = 73), Barr-Anderson et al. (2010) found an association between parent reported support and child perception of support with child perception of support for PA having a stronger association with child PA than parent reported support. Forthofer et al. (2016) examined parents' (mothers) and children's (5th grade; n = 693) perceptions of parent support for PA and their relation to children's objectively measured MVPA. Unlike the results of the current study, children's perceptions of parental support were not related to PA; however, mother's reported support for PA was significantly related.

However, none of the above studies assessed the indirect effect of parental support on children's PA with children's perception of this support as a mediator. Although the literature on parental support is substantive, our study is unique in that by building on past research, it assessed the mechanism by which parental support influences children's PA while utilizing a more advanced statistical technique and relying on a large sample of children. Our finding that this indirect effect is larger, although not significantly different, for girls compared to boys (by approximately 70%) is consistent with Lau and colleagues' suggestion that parental support may be an important component of interventions targeting girls' PA. It is possible that there are sex-related differences in the provision of support from parents which may be attributed to the differences in PA among boys and girls, although we were unable to assess differences in parental support or parental PA among mothers and fathers. Additional research is needed to test these relationships.

In this study, the level of parent reported support and parental PA were lower among boys than girls. Lau et al. (2015) found that girls received less support to be active than boys; however, girls who received more parental support were more active and spent less time in sedentary pursuits. Contrary to our findings, child perceived support for PA has been identified to differ between sexes, with boys reporting receiving more support to be active than girls (Gustafson and Rhodes, 2006; Lau et al., 2015; Trost et al., 2003). This inconsistency may be

due to the fact that we employed a number of exogenous variables that may potentially contribute to these differences.

Parental PA was not found to be directly or indirectly related to children's PA. This finding was mirrored by Trost et al. (2003), who tested a conceptual model linking parental PA orientations, parental support for PA, and children's self-efficacy perceptions with participation in PA. However, parental PA behaviour was found to be positively associated with parental support, which in turn was directly and indirectly (through child self-efficacy perception) related to child PA (Trost et al., 2003). Trost et al. (2003) propose that for youth (grades 7–12; n = 380), parental PA does not remove barriers (e.g., transportation, contact with peers, skill development) to being physically active. Moreover, Welk et al. (2003) suggest that because children spend most of their day out of direct parent contact, parental influence through the modelling of active behaviours may not frequently occur. Further research on the role of parental PA is necessary to develop a better understanding of the relationship between parental PA and children's activity levels.

The assessment of both parent reported and child perceived support for PA using a large representative sample was strengthened through the use of SEM techniques to model indirect effects and to account for the measurement error. Additionally, in an attempt to increase the generalizability of the results, non-response weights were incorporated and the problem of missing data was explicitly addressed. Yet despite the study's strengths, there are some limitations that should be noted. First, the baseline data from the G5AP intervention used in this study were cross-sectional. Second, as the data were self-reported, the accuracy of the PA levels and other constructs used in this study should be considered with caution, as they are subject to reporting bias (LeBlanc and Janssen, 2010). Third, although we examined sex differences among children, we were not able to access differences in parental support and parental PA among mothers and fathers separately, which may lend to sex-related differences in children's PA (Gustafson and Rhodes, 2006; Maatta et al., 2014).

5. Conclusion

Similar to other studies among children (Gustafson and Rhodes, 2006; Pugliese and Tinsley, 2007; Van Der Horst et al., 2007; Yao and Rhodes, 2015), parental support for PA was associated with children's PA, with children's perception of this support as a mediating factor. The findings of this study demonstrate the importance of children's perceptions of parental support in relation to their PA behaviours. To improve the health of children, health promotion efforts should be aimed at promoting the benefits associated with being active and the importance of parental support. Parents are one of the primary providers of opportunities to be active, and therefore, have the potential to increase the activity levels of their children (Beets et al., 2010). In subsequent studies it would be beneficial to further investigate facilitators and barriers that parents encounter with regard to providing support to be active. Also, as there may be differences in the provision of support by mothers and fathers, additional research is needed to better clarify support mechanisms based on the sex of the parent. Finally, given that girls tend to be less active than boys (Biddle and Asare, 2011), more attention should be focused on increasing parental supportive behaviours for girls. Our findings support the involvement of parents in interventions focused on increasing the PA levels of children. Given that children's perception of parental support was significantly related to their PA levels, parents should be encouraged to provide any form of support (e.g., transporting them to places to be active or watching and motivating them to be active), as this may lead to increased PA levels. Moreover, further qualitative research is warranted to explore the role of children's perceptions of parental support (Tucker et al., 2008). Developing a better understanding of factors related to children's PA and identifying modifiable determinants and mediators of activity behaviours will help inform PA interventions.

Conflict of interest statement

The authors declare there is no conflict of interest.

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