Physical activity, well-being and needs satisfaction in eight and nine-year-old children from areas of socio-economic disadvantage

Physical Activity, Wellbeing and Needs Satisfaction in 8 – 9 Year Old Children From Areas of Socio-Economic Disadvantage

Child Care in Practice

Abstract

Background: Need-supportive environments have been shown to contribute to children's physical activity levels, and in a few cases, well-being. Grounded in Self-Determination Theory (SDT), the aim of this study was to determine the influence of psychological needs (competence and social relatedness) satisfaction on physical activity levels and well-being in children from areas of social and economic disadvantage.

Method: A total of 211 children aged 8-9 years from areas of low socio-economic status wore an accelerometer for one week, and completed a questionnaire assessing psychological needs satisfaction and well-being. Confirmatory Factor Analysis (CFA) and path analysis was conducted to assess the factor structure of the measures, and test for theory predicting significant relationships between psychological needs, physical activity and well-being.

Results: The factor structure of the instruments was supported, and a significant positive relationship was found between athletic competence and physical activity (β=.19). Athletic competence (β=.19), along with parental relatedness (β=.32), positively predicted children's well-being. Physical activity alone, did not predict well-being

Conclusions: Practitioners may want to consider components of SDT, reflective of need-supportive environments, when designing physical activity interventions. Interventions aimed at supporting children's perceptions of competence, and the involvement of parents, may offer the opportunity to increase well-being.

Introduction

Well-being is defined as 'optimal psychological functioning and experience' (Ryan and Deci, 2001, pg142). As such, researchers (Ryan, Huta and Deci, 2008; Huta, 2016) integrating eudaimonic and hedonic well-being perspectives consider well-being a dynamic and evaluative concept, wherein the contents and behaviours of one's life influence how one subjectively evaluates their well-being. Therefore, well-being conceptually reflects how one's way of living (i.e. dynamic eudaimonic perspective) influences one's subjective evaluation of their well-being (i.e. evaluative hedonic perspective).

Research with childhood populations has shown positive relationships between physical activity and psychological well-being (Biddle and Asare, 2011), and suggests that those who meet the World Health Organisation's (WHO, 2010) guideline of 60 minutes of moderate-to-vigorous intensity physical activity (MVPA) per-day are more likely to have higher well-being (Breslin et al., 2012). Yet, despite these potential positive benefits to health, studies conducted on global (Hallal et al., 2011) and European (Verlogine et al., 2012) samples of children indicate the majority are not active enough to meet the WHO's (2010) MVPA guideline for health. Many interventions exist which aim to increase physical activity levels in youth, with varying degrees of success (Salmon et al. 2007; Strong et al., 2005; Van Sluijs et al., 2008). Promotional strategies to increase physical activity may be enhanced through the application of behaviour change theory (Moore et al., 2015). Embedded within Self-Determination Theory (SDT; Deci and Ryan, 2000), Basic Needs Theory (BNT; Ryan

and Deci, 2008) is a framework that can be applied to children's behaviour change because it describes how and why need-supportive social environments can motivate participation in physical activity; however, few studies have explored their relationship with well-being.

The aim of the current study was to theoretically test components of BNT (Ryan and Deci, 2008) concomitantly with physical activity and well-being in a statistical model. Central to the model is the hypothesis that children's perceptions of their own physical competence and social relatedness will influence their physical activity and well-being. The findings will be discussed with reference to previous research and health recommendations for children. As there has been limited research on children from areas of social and economic disadvantage, the goal is to contribute to a growing body of literature examining links with theory, physical activity and well-being. Given such evidence is useful for the development and design of health improvement interventions, recommendations for intervening with children along with future research ideas are provided.

Self-determination theory

Theory-based models of behaviour change have demonstrated predictive validity in investigating the antecedents, mediating mechanisms and outcomes involved in physical activity participation (Quaresma, Palmeria, Martins, Minderico and Sardinha, 2014; Hagger and Chatzisarantis, 2014). One such approach used to guide hypotheses pertaining to children's physical activity and well-being is SDT. SDT is a meta-theory that explains the effects of social environments on human motivation, behaviour and well-being. Collectively, sub-theories within the SDT framework propose that social environments that support the satisfaction of humans' innate psychological needs for autonomy, competence and social relatedness are essential for optimising self-determined motivation and well-being (Deci and Ryan, 2002). Equally, social contexts that thwart psychological needs are hypothesised to

negatively influence motivation and well-being. Competence refers to an individual having the capacity to have an effect on their environment; autonomy refers to behaviour being experienced as volitional; and social relatedness refers to caring for and feeling cared for in one's social environment (Deci and Ryan, 2002).

A social context that is need-supportive provides the opportunity for self-directed behaviour (i.e. autonomy support), optimal challenge (i.e. competence support) and social belongingness (i.e. relatedness support) (Reeve, 2015). In Ryan and Deci's (2000) SDT motivational continuum, they propose social contexts that support and subsequently satisfy these needs will facilitate autonomous motivation (i.e. intrinsic or self-determined extrinsic motivation) which predicts lasting behaviour change (Fortier, Duda, Guerin and Teixeira, 2012). Further in BNT, a sub-theory within the SDT framework, Ryan and Deci (2008) suggest that psychological need satisfaction facilitates growth-orientated eudaimonic well-being. As described above, the interrelationship between eudaimonic and hedonic well-being is proposed to be a dependent relationship, wherein eudaimonic well-being yields positive hedonic well-being outcomes such as positive affect and happiness, and protects against negative outcomes such as anxiety (Ryan, Huta and Deci, 2008).

Research with self-determination theory

Studies have empirically tested components of SDT with most focusing on the role of psychological needs influencing motivation for physical activity. The role of autonomy need support has received extensive attention by researchers and demonstrates positive relationships with physical activity through motivation (Hagger et al., 2009). A meta-analysis of 64 studies (Babic et al., 2014) revealed that in comparison to other self-concept constructs, perceived physical competence was the strongest predictor of physical activity. Yet, the influence of relatedness to physical activity has received less research attention than

competence and autonomy. That said, the studies that have been conducted from integrated theoretical perspectives demonstrated a significant positive relationship between physical activity and peer support (Seabra et al., 2010), and between physical activity and parental support (Trost and Loprinzi, 2011). Taking the evidence collectively, there is empirical support for a positive correlation between psychological needs, motivation and physical activity (Sebire, Jago, Fox, Edwards and Thompson, 2013). As outlined below however, the degree to which needs satisfaction facilitates well-being is less clear.

Although researchers have explored the link between physical activity and well-being (Biddle and Asare, 2011), there are few studies investigating this relationship from a BNT perspective. Deci and Ryan (2002) propose that the social environment in which a given behaviour (i.e., physical activity in this case) is experienced needs to be supported by competence, autonomy and relatedness to be conducive to well-being. In the social context of physical activity, a small number of studies have demonstrated positive correlations with psychological needs satisfaction and well-being. These studies reveal that need-supportive climates predict well-being in children (Reinboth, Duda and Ntoumanis, 2004; Gillison, Standage and Skevington, 2008; Quaresma et al., 2012; Standage, Gillison, Ntoumanis and Treasure, 2012) and adolescent boys (Lubans et al., 2016); and also result in positive affective responses to gymnastics training (Gagne, Ryan & Bargmann, 2003) and dancing practice (Hancox, Quested, Ntoumanis, & Duda, in press).

Despite these studies, research incorporating BNT could be extended further. Firstly, most of the studies have used self-report measures of physical activity. Objective measures of physical activity could be included to improve the reliability of physical activity assessment. Secondly, aside from some of the aforesaid studies (Gagne, Ryan and Bargmann, 2003; Reinboth et al., 2004; Gillison et al., 2006; Standage et al., 2012) SDT research with youth

has focused on correlating physical activity with motivation variables, but has overlooked the well-being component of the SDT model. Finally, most research has been conducted on the general population, with adolescents, and in specific contexts such as the physical education setting (e.g. Hagger et al., 2009; Lonsdale, Sabiston, Raedeke, Ha and Sum, 2009).

Hagger and Chatzarntis (2014) propose that theory-based models should be tested in multiple populations to determine if the hypothesised effects are generalizable. However, no research has studied a BNT model in populations of low social economic status (SES). Therefore, although motivational studies have been efficacious in predicting physical activity, available studies cannot be extrapolated to children of low SES, and the empirical links between needs satisfaction, objective physical activity and well-being in children from low SES is non-existent. The current study addresses many of the evident research gaps in this area by presenting the first study exploring a BNT model with children from low SES.

Study hypotheses

First, in accordance with the motivational perspective described in SDT (Ryan and Deci, 2000), we hypothesised that needs satisfaction would directly and positively predict physical activity (Hypothesis 1, H1). Second, congruent with the assumptions in BNT (Ryan and Deci, 2008), we hypothesised that needs satisfaction would directly predict well-being (Hypothesis 2, H2). Third, we hypothesised an indirect relationship with needs satisfaction and well-being through the mediation of physical activity (Hypothesis 3, H3). Fourth, H3 was proposed as a consequence of Hypothesis 4 (H4), which is that, in support of previous research (Biddle and Asare, 2011), physical activity would directly and positively predict well-being. The purpose of developing the hypothesised model is to determine the role of children's needs satisfaction on their physical activity levels and well-being. Extending previous research (Standage et al., 2012; Seibre et al., 2013), the model presented here was developed using a two-step model

building approach to ensure factorial validity of the instruments in this population before conducting a path model to test for theoretically significant relationships.

Method

Participants and Procedure

Participants of this study were 211 children (116 male, 95 female) aged 8-9 (M=8.74, SD=.50) from both Northern Ireland and the Republic of Ireland. Geographically the sample was selected from across the four Irish provinces with 70 participants from Ulster, 80 from Leinster, 30 from Munster, and 31 from Connacht. In Northern Ireland participants were recruited from urban schools in areas of social and economic disadvantage based on the Multiple Deprivation Measure in Northern Ireland (2010). This database consists of seven domains of deprivation including: income, employment, health, education, proximity to services, living environment and crime. In the Republic of Ireland the Delivering Equality of Opportunity in Schools (DEIS) programme was used to identify schools in areas of social disadvantage. Socio-economic variables included in the DEIS database which includes: local authority accommodation, lone parenthood, Travellers, large families (defined as 5 or more children) and pupils eligible for free books (Department of Education, 2005). A sample of the schools (n=27) was chosen via a manual random number generator.

School Principals were contacted. All Principals agreed and distributed information sheets about the study to the classroom teacher, and to children's parents. Only participants who provided written assent and consent from their parents participated in the study. To ensure anonymity participants were given a unique code for the questionnaire. The questionnaires were administered to the participants under quiet classroom conditions. Instructions and information regarding the completion of the questionnaire were explained by

a lead researcher and minor details such as word pronunciation were described to the children in groups of 5-10 with one researcher accompanying each group. Questionnaire completion took no more than one hour with each class group. Accelerometers were secured to the participants' waists with an elasticated belt and positioned on the midaxillary line above the right hip. Participants were asked to wear the device for 8 days and asked to remove the device for water based activities and before bed-time.

Outcome Measures

Physical Activity

Objective physical activity was measured using Actigraph GT3x accelerometers to estimate daily duration, frequency, and intensity of the children's physical activity. Accelerometers are valid and reliable measures of physical activity with children (Trost, Loprinzi, Moore and Pfeiffer, 2011). The criteria chosen to define valid wear-time were at least 10 hours on a minimum of 3 weekdays and 1 weekend day, as were used in a previous study of children of this age and SES (Breslin and Brennan, 2012). The devices were set to record data in 5 second epochs which is considered a valid capturing period for children's movement patterns at this age (Mattock's et.al, 2007; Trost et al., 2011). The first day of data was excluded to account for the children's subjective reactivity to wearing the device (Trost et al., 2011) and the remaining data were then processed using Actilife software. Time spent in light, moderate and vigorous physical activity was calculated using Mattock's et al's (2007) physical activity cut-off points. Non-wear time was defined as 20 minutes of consecutive zeros which was then excluded from the data file. This parameter estimates that it is unlikely that children will record no movement for longer than 20 minutes and has been used in previous studies with children (Breslin et al., 2012; Griffiths et al., 2013).

Well-being

Kidscreen-27 (Ravens-Sieberer et al., 2007) was used to assess well-being. As no eudaimonic measures of well-being exist for pre-adolescent children, Kidscreen-27 aligns with the hedonic well-being perspective by subjectively evaluating physical, social and psychological health functioning which is theorised to be directly influenced by psychological needs satisfaction (Ryan and Deci, 2008). Kidscreen-27 was developed by the Kidscreen Group as part of the first cross-cultural attempt to standardise the measurement of children's well-being in Europe (Ravens-Sieberer et al., 2014). Kidscreen-27 has been shown to be a valid and reliable well-being measure for children (Ravens-Sieberer et al., 2007). Recently, Kidscreen-27 was shown to have a 7-factor structure for children aged 8-9 from areas of low socio-economic status in Ireland (Shannon, Breslin, Fitzpatrick, Hanna and Brennan, 2016). The measure was developed in three stages: (a) following a Delphi procedure, (b) focus groups with children, and (c) criterion and construct validity assessments from a European-wide sample of 22,827 children (Ravens-Sieberer et al., 2014). In the development of Kidscreen-27, Ravens-Sieberer et al. (2007) produced five well-being dimensions: *Physical Well-being* (5 items) measures the children's perceptions of their physical health and vitality; *Psychological Wellbeing* (7 items) assesses feelings of positive and negative affect and life satisfaction; *Parent Relations and Autonomy* (7 items) includes items on relationships with parents, availability of free-time and satisfaction with their financial resources; *Social Support and Peers* (4 items) examines the quality of the children's interactions with their peers; *School Environment* (4 items) measures perceptions of their cognitive functioning and relationship with teachers. Items were answered on a 5 point likert scale ranging from 'never,' 'seldom,' 'quite often,' 'very often,' to 'always'.

Basic Psychological Needs

Subscales from the Youth Physical Activity Promotion model (YPAP; Rowe, Raedeke, Wiersma and Maharl, 2007) were used to measure psychological needs satisfaction. A

modified version of Harter's (1982) Perceived Physical Competence scale (7 items) was used as a context-specific measure of athletic competence, and the Physical Self-Worth Scale (6 items) (Whitehead, 1995) was used as it represents a domain-level measure of physical competence. Relatedness during physical activity from peers and parents was measured using a subscale from Brustad's (1993) Children's Attraction to Physical Activity (CAPA) scale (5 items) and Brustad's (1996) Parent Encouragement subscale (6 items). Although these measures give a diverse picture of competence and relatedness satisfaction, the YPAP questionnaire does not include a measure of autonomy satisfaction, thus restricting full testing of BNT. All of the subscales have a structured alternative response format where the children select which statement is most relevant to them (e.g. 'some kids have parents who really help them to be good at games and sports BUT other kids have parents who don't help them very much at games and sports'). The children select which side of the statement is most true for them, and if it is 'sort of true' or 'really true' for them. Scores for each item are then calculated on a 4 point Likert scale.

Data Analysis

The mean and standard deviation scores were calculated for minutes spent in total (light + moderate + vigorous) and MVPA (moderate + vigorous) physical activity intensities per-day by dividing the total minutes accumulated by the amount of valid days the child wore their accelerometer. We then dichotomised MVPA to determine the percentage of children who achieved the WHO's (2010) physical activity recommendations ($\geq$60 minutes) and those who did not (<60 minutes). Mean and standard deviation scores were also calculated for each of the well-being dimensions (total scale score) and total well-being (combined score for 27 items, see Table 1). For the demographic variable gender a series of one-way between groups analyses of variance (ANOVA's) were conducted to test for differences in total and MVPA,

and for each of the well-being dimensions, and total well-being. Alpha significance was set to $p<.05$, and partial eta squared (η_p^2) was calculated as a measure of effect size.

A two-step approach for Structural Equation Modelling (SEM) involved testing a Confirmatory Factor Analysis (CFA) measurement model followed by a structural path model (Schumaker and Lomax, 1996). A range of goodness-of-fit indices were used as a guideline to assess model fit. The Chi-Square ($\chi 2$) goodness-of-fit index was reported with a small non-significant $\chi 2$ statistic indicating good model fit. This value was approached with caution given that large sample sizes tend to result in statistically significant Chi-Square values (Schumaker and Lomax, 1996). The comparative fit index (CFI), the Tucker-Lewis Index (TLI), and the goodness of fit index (GFI) were reported with values of .90 or .95 considered as acceptable or good model fit respectively (Bentler, 1990; Byrne, 2001). The root mean square error of approximation (RMSEA) was reported as a badness of fit index, with values of 0.8 or below considered acceptable. Cronbach's alpha, as a measure of internal consistency, were conducted with values of above .6 considered acceptable for measures with fewer than 10 items (Field, 2013). Two specifications to improve model fit were made including: applying a covariance path to two observed variables on one factor (physical self-worth) because of a methodological similarity in wording that the other items did not share, and trimming an item with a low factor loading (athletic competence) (Brown, 2015).

A CFA was conducted on the BNT scales to examine factorial validity. Also, a CFA on a 5 (Detmar et al., 2006) and 7-factor structure of the Kidscreen-27 instrument, based upon mixed success for the original 5-factor structure, were calculated (see, Ng, Burnett, Ha, & Sum, 2015; Shannon et al., 2016). Results of the CFA analysis were largely successful with some minor modifications to the physical self-worth and athletic competence factors. To this end, the total scale score for BNT scales, total physical activity, and total well-being, were treated as observed variables to conduct path analysis on the hypotheses for model 1

(H1, H2, H3 and H4, see figure 1). Covariance paths were applied between each of the psychological needs as previous research suggests that these variables share covariance with each other (Seibre et al., 2013). For H3 analyses using a bootstrapping technique using 1000 samples was conducted to examine indirect effects of competence and relatedness, through physical activity, on well-being (Brown, 2015). The analyses and hypotheses for model 2 was repeated using MVPA instead of total physical activity, as MVPA is deemed to have an effect on health (O'Donovan et al., 2010). Statistical Package for the Social Sciences (SPSS) Version 21 and AMOS Version 21 were used to analyse the data.

Figure 1: Hypothesised path model

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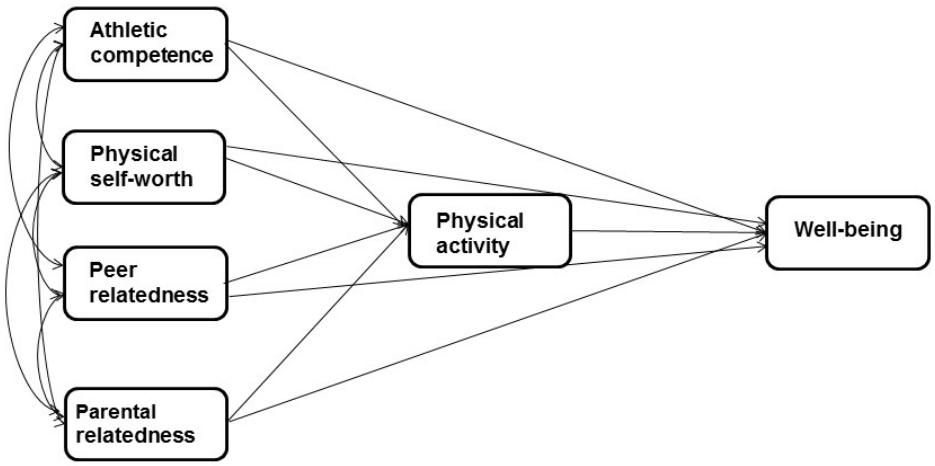

Note: H1 = paths from psychological needs to physical activity; H2 = paths from psychological needs to well-being; H3= path from physical activity to well-being; H4 = indirect effects of psychological needs on well-being through physical activity.

~~Figure 1 here~~

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Results

Descriptive statistics

Accelerometer data for average MVPA per-day was dichotomised to calculate the percentage of children achieving the WHO's (2010) physical activity guidelines for health. A total of 6.8% of the children met the recommendation (M: 35.12; SD: 15.03). Boys (M: 38.12; SD: 16.60) were significantly more active than girls (M: 31.45; SD: 11.95) ($F(1,209) = 10.736$, $p<0.01$, $\eta_p^2 = .049$) in terms of MVPA per-day, however no significant difference between boys and girls for total physical activity was found.

The mean score for total well-being was 116.81 (SD: 10.99) out of a possible score of 135. A series of one-way between groups ANOVA statistical tests revealed no significant differences between boys and girls on each of the well-being dimensions, or for total well-being ($p \geq .05$). See Table 1 (appendix) for a description of the data.

Confirmatory Factor Model for BNT and Well-being

The model fit indices are presented in Table 2. The fit indices ranged from unacceptable to good fit. The athletic competence scale had good fit indices after the removal of 1 item which

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had a low factor loading (β=.12). The physical self-worth factor had an acceptable model fit after two items on the model were correlated because of a methodological similarity in wording (i.e. other kids feel really confident about themselves physically; other kids always seem to feel good about themselves physically). Peer relatedness and parental relatedness had acceptable to good fit indices and required no modifications. The Kidscreen-27 original 5-factor model was not an acceptable fit, however, the Kidscreen-27 7-factor model revealed a good fit to the data.

Path Models

The first model examining BNT constructs with total physical activity and well-being is presented in Figure 2 and demonstrated a good fit to the data ($\chi 2$ (1) .744, p=.33; CFI≈1.00; TLI=1.014; GFI.999; RMSEA≈.00 (90% CI=.00 to .17). Regarding structural relations detailed in H1, the hypothesis had some support. Athletic competence had a significant positive relationship with physical activity (β=.19; p<.05). There was no statistically significant relationship with physical activity and any of the three BNT variables of parental relatedness (β=.13; p≥.05), physical self-worth (β =-.14; p≥.05) and peer relatedness (β= -.11; p≥.05). H2 also had some support. There was a significant positive relationship between athletic competence and well-being (β=.19; p<.05), and parental relatedness and well-being (β=.32; p<.001). There was no significant relationship between well-being and physical self-worth (β=.06; p≥.05) or peer relatedness (β=.09; p≥.05). For H3 there were no significant effects present for BNT constructs on well-being through the mediation of physical activity (β ranges= -.01 to .01; p≥.05). For the final hypothesis (H4), there was a positive relationship between physical activity and well-being (β=.09) but this was not significant (p≥.05).

The second model that examined BNT constructs with MVPA, and well-being demonstrated a good fit to the data ($\chi 2$ (1) .948, p=.39; CFI≈1.00; GFI=.999; TLI=1.003;

RMSEA≈.00 (90% CI=.00 to .18). All correlations were in a positive direction, but only one hypothesis (H2) had support as there was a significant positive relationship between parental relatedness and well-being (β=.32; p<.001); and athletic competence and well-being (β=.21; p<.05). The relationship between well-being and peer relatedness (β=.07; p≥.05), and well-being and physical self-worth (β=.04; p≥.05) was not significant. There was no significant relationship between BNT constructs on MVPA (H1; β ranges=.02 to .07; p≥.05) and on well-being through the mediation of MVPA (H3; β ranges= .00 to .00; p≥.05). There was no statistically significant relationship between MVPA and well-being (H4; β =.07; p≥.05).

Figure 2: Path Model 1 Results

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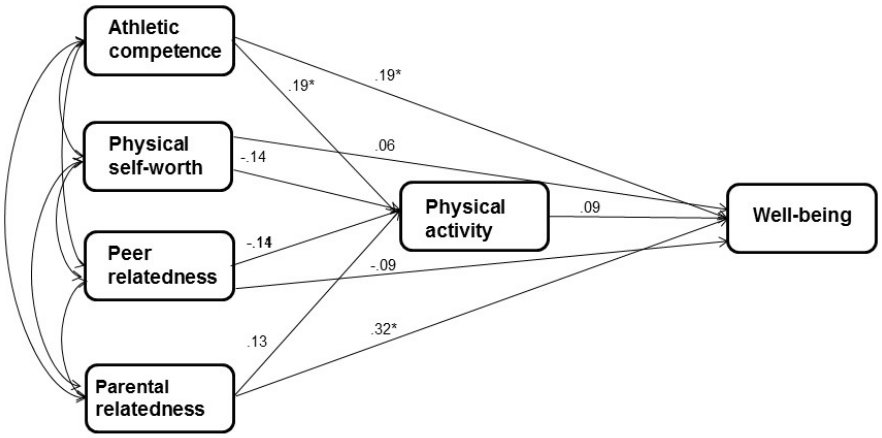

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Note: * refers to significant paths (p<.05)

Discussion

The purpose of this study was to test a BNT-based model that incorporates needs satisfaction, physical activity and well-being. This study is the first to present a BNT model with children of low socio-economic status with an objective measure of physical activity and a holistic measure of well-being. Support was provided for some of the hypotheses. Psychological needs were shown to have a significant positive influence on children's physical activity levels and well-being. Such findings reinforce the SDT position that need-supportive social contexts can facilitate positive health behaviour and improved psychological functioning (Fortier et al., 2012).

Specifically, this study demonstrates that physical activity is influenced by gender (Sallis et al., 2000), which is consistent with other studies in Europe (Griffiths et al., 2013; Verloigne et al., 2012), wherein boys are more active than girls. Only 6.8% of children in this study met the WHO's recommended guideline of at least 60 minutes of MVPA per-day. Trost et al. (2011) have previously discussed how cut-points influence the results of physical activity studies. The use of cut points aside, this low figure is not exclusive to Ireland, with studies in England demonstrating similar adherence rates (Basterfield et al., 2014). Children's behavioural patterns decline as they reach adulthood (Telema et al., 2009) and as such, the implications of physical activity levels as low as these in the current study are significant for the potential negative effects of inactivity on children's physical health (Strong et al., 2005). How promotional strategies to positively influence physical activity and well-being can benefit from the evidence provided using an SDT model are now discussed.

Predicting physical activity

Consistent with previous studies testing SDT models, there were significant positive relationships between perceptions of physical competence and total physical activity (Moreno, 2005; Taylor et al., 2010). This supports the position that competence may play a casual role in affecting self-determined motivation for performing a behaviour (i.e. physical activity in this case) (Deci and Ryan, 2002). Contrary to other studies (Quaresma et al., 2014) this study found non-statistically significant relationships with parental and peer relatedness and physical activity. A reason for this null finding may be the sequential mediating mechanisms in SDT (Fortier et al., 2012). SDT hypothesises a casual link between needs satisfaction, motivational regulation and behaviour, and these links have received support in children's physical activity (Owen et al., 2014). Therefore the inclusion of motivation variables may potentially further strengthen and mediate the effect of need satisfaction on behaviour (Deci and Ryan, 2002).

Predicting well-being

Akin with existing BNT research, the present study revealed statistically significant positive relationships with competence satisfaction and well-being (Reinboth et al., 2004), and relatedness satisfaction and well-being (Standage and Gillison, 2007; Standage et al., 2012; Quaresma et al., 2014) (H2). This evidence can be interpreted with reference to the theoretical tenets of a hierarchical model (Vallerand, 1997) that proposes transference of effects from domain-specific measures of psychological needs (i.e. competence during physical activity) to global measures (i.e. day-to-day well-being). Accordingly, the hierarchical model suggests that psychological need satisfaction mediates a top-down, bottom-up interchange of motivational regulation at the situational, domain, and global level – resulting in different consequences for behaviour and well-being (Vallerand, 1997). Findings from this study suggest that physical activity settings that support children's

psychological needs for competence and relatedness may play a significant positive role in children's day-to-day psychological functioning.

The relationship between physical activity and well-being was not statistically significant in the current study. Previous literature has demonstrated a positive link between physical activity and psychological (Biddle and Asare, 2011), physical (Babic et al., 2015) and holistic (Breslin et al., 2012) measures of well-being. However, the authors in the aforesaid studies urged caution on these links, as most studies are restricted to single dimensions of well-being (i.e. psychological well-being; Rafferty, Breslin, Brennan and Hassan, 2016); and do not account for the psychological climate and social interactions in which physical activity is experienced (Biddle and Asare, 2011). Support for H2 adds credence to the assertion that the social environment in which physical activity is experienced may play a more prominent role in enhancing well-being than the physical activity itself (Biddle, Gorely and Stensel, 2007; Biddle and Asare, 2011).

Practical implications

Practitioners may want to be cognisant of the social environment when designing a physical activity intervention. Specifically, the model presented in this study supports the application of needs-supportive instructional strategies for increasing physical activity and well-being in children. A study by Silva et al. (2008) describes intervention strategies for promoting a need-supportive and self-determined motivational climate in a weight management intervention. Strategies include: giving positive instructional feedback to enhance competence and intrinsic motivation; providing participants with a menu of options for behaviour change to enhance autonomy, and; providing social support to participants to enhance relatedness. These strategies have been adapted and applied in different social

405 contexts including schools (see Jago et al., 2013) and the sports coaching environment (see
406 Duda, 2013).

407 **Limitations**

408 There are several limitations to the current study. As data was collected from different
409 geographical areas of Ireland, on different days the weather may have influenced physical
410 activity levels in each region. Also, while accelerometers provide objective physical activity
411 data, they do not give researchers an indication of the context of the physical activity (i.e.,
412 walking to and from school, type of activity, games played, or with whom). Future studies
413 could apply self-report measures alongside accelerometers to afford more information on
414 context providing a more complete assessment of children's physical activity. Despite our
415 data collection procedure controlling for response bias when completing the questionnaire
416 (i.e. ratio of one researcher for every five children), all socially desirable answers could not
417 be accounted for, a limitation of any self-report measure of children's well-being.
418 Motivational measures were not included in the model (e.g., external, introjected, identified,
419 integrated and intrinsic motivation) to complete the sequential process in SDT proposed by
420 Ryan and Deci (2000). The cross-sectional design does not permit causal inferences between
421 the variables. Addressing these issues, future research is currently ongoing employing
422 longitudinal experimental designs to test for causal inferences, and applying self-report
423 physical activity measures alongside accelerometers with validated motivational measures
424 designed for testing SDT with children in Ireland.

425 **Conclusion**

426 This study makes a contribution to children's physical activity and well-being research by
427 testing a SDT model with children of socio-economic disadvantage. The study findings
428 highlight that the vast majority of children did not meet the physical activity guidelines for

health. The tested model demonstrated that physical activity settings that support and satisfy children's psychological needs may positively contribute to increasing physical activity levels and well-being. A somewhat unexpected finding was the null relationship with physical activity and well-being, and therefore consideration should be given to the multifaceted nature of children's well-being (see Raffertty et al, 2016 for a review). It is recommended that practitioners replicate behaviour change techniques used in previous interventions that target need-supportive social environments (Silva et al., 2008; Duda, 2013; Jago et al., 2013). Such efforts can contribute to the enhancement of children's physical activity, which will have positive physical health benefits, and also positively influence well-being. As such, future research employing longitudinal designs, with the inclusion of motivational measures, would contribute to the field of behaviour change by providing further clarity on the links between psychological needs, physical activity and well-being in children.

References

Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: systematic review and meta-analysis. *Sports Medicine*, *44*(11), 1589-1601.

Basterfield, L., Jones, A. R., Parkinson, K. N., Reilly, J., Pearce, M. S., Reilly, J. J., & Adamson, A. J. (2014). Physical activity, diet and BMI in children aged 6–8 years: a cross-sectional analysis. BMJ open, 4(6), e005001.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238-246. doi:10.1037/0033-2909.107.2.238

Biddle, S. J. H., & Asare, M. (2011). Physical activity and mental health in children and adolescents: A review of reviews. *British Journal of Sports Medicine*, doi:10.1136/bjsports-2011-090185

Biddle, S. J. H., Gorely, T., & Stensel, D. J. (2004). Health-enhancing physical activity and sedentary behaviour in children and adolescents. *Journal of Sports Sciences, 22*(8), 679-701. doi:10.1080/02640410410001712412

Biddle, S., Gorely, T., & Mutrie, N. (2015). *Psychology of physical activity: Determinants, well-being and interventions* (3rd ed. ed.). Milton Park, Abingdon, Oxon; New York, NY: Routledge.

Breslin, G., & Brennan, D. (2012). A healthy lifestyle intervention delivered by aspiring physical education teachers to children from social disadvantage: Study protocol and preliminary findings. *Child Care in Practice, 18*(3), 207-225.

Breslin, G., Gossrau-Breen, D., McCay, N., Gilmore, G., MacDonald, L., & Hanna, D. (2012). Physical activity, gender, weight status, and wellbeing in 9- to 11-year-old children: A cross-sectional survey. *Journal of Physical Activity and Health, 9*(3), 394-401.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. New York; London: Guilford.

Brustad, R.J. (1993). Who will go out and play? Parental and psychological influences on children's attraction to physical activity. Pediatr. Exerc. Sci. 5(3):210-223, 1993

Brustad, R. J. (1996). Attraction to physical activity in urban schoolchildren: Parental socialization and gender influences. *Research Quarterly for Exercise and Sport, 67*(3), 316-323. doi:10.1080/02701367.1996.10607959

Byrne, B. M. (2001). Structural equation modeling with AMOS, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. *International Journal of Testing, 1*(1), 55-86. doi:10.1207/S15327574IJT0101_4

Chatzisarantis, N. L., & Hagger, M. S. (2009). Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health, 24*(1), 29-48.

Deci, E and Ryan, R. (Ed.). (2002). *Handbook of self-determination research* (1st ed.). Rochester: University of Rochester Press.

Demetriou, Y., & Höner, O. (2012). Physical activity interventions in the school setting: A systematic review. *Psychology of Sport and Exercise, 13*(2), 186-196. doi:http://dx.doi.org/10.1016/j.psychsport.2011.11.006

Detmar, S. B., Bruil, J., Ravens-Sieberer, U., Gosch, A., & Bisegger, C. (2006). The use of focus groups in the development of the KIDSCREEN HRQL questionnaire. *Quality of Life Research, 15*(8), 1345-1353.

Duda, J. L. (2013). The conceptual and empirical foundations of Empowering Coaching™: Setting the stage for the PAPA project. International Journal of Sport and Exercise Psychology, 11(4), 311-318.

493 Fortier, M. S., Duda, J. L., Guerin, E., & Teixeira, P. J. (2012). Promoting physical activity:
494 development and testing of self-determination theory-based interventions. *Int J Behav*
495 *Nutr Phys Act*, *9*(1), 20.

496 Gagne, M. (2003). Autonomy support and need satisfaction in the motivation and well-being
497 of gymnasts. *Journal of Applied Sport Psychology*, *15*(4), 372-390.
498 doi:10.1080/714044203

499 Gillison, F. B., Standage, M., & Skevington, S. M. (2006). Relationships among adolescents'
500 weight perceptions, exercise goals, exercise motivation, quality of life and leisure-
501 time exercise behaviour: A self-determination theory approach. *Health Education*
502 *Research*, *21*(6), 836-847.

503 Global Advocacy Council for Physical Activity International Society. (2010). The toronto
504 charter for physical activity: A global call to action. *Journal of Physical Activity and*
505 *Health*, *7*(3), S370-S373.

506 Griffiths, L. J., Cortina-Borja, M., Sera, F., Pouliou, T., Geraci, M., Rich, C., ... & Jebb, S. A.
507 (2013). How active are our children? Findings from the Millennium Cohort
508 Study. *BMJ open*, *3*(8), e002893.

509 Hagger, M., Chatzisarantis, N. L., Hein, V., Soós, I., Karsai, I., Lintunen, T., & Leemans, S.
510 (2009). Teacher, peer and parent autonomy support in physical education and leisure-
511 time physical activity: A trans-contextual model of motivation in four
512 nations. *Psychology and Health*, *24*(6), 689-711.

513 Hagger, M. S., & Chatzisarantis, N. L. (2014). An integrated behavior change model for
514 physical activity. *Exercise and Sport Sciences Reviews*, *42*(2), 62-69.

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *The Lancet, 380*(9838), 247-257. doi:http://dx.doi.org/10.1016/S0140-6736(12)60646-1

Hancox, J. E., Quested, E., Ntoumanis, N., & Duda, J. L. (In Press, 2016). Teacher-created social environment, basic psychological needs, and dancers' affective states during class: A diary study. *Personality and Individual Differences.*

Harter, S. (1982). The perceived competence scale for children. *Child Development, 53*(1), 87-97. doi:10.2307/1129640

Jago, R., Edwards, M., Cooper, A., Fox, K., Powell, J., Sebire, S., Spears, M., Thompson, J. and Montgomery, A. (2013) Action 3:30: protocol for a randomized feasibility trial of a teaching assistant led extracurricular physical activity intervention. *Trials,* 14 (1), 122.

Kriemler, S., Meyer, U., Martin, E., van Sluijs, E., Andersen, L. B., & Martin, B. W. (2011). Effect of school-based interventions on physical activity and fitness in children and adolescents: A review of reviews and systematic update.*British Journal of Sports Medicine, 45*(11), 10.1136/bjsports-2011-090186. doi:10.1136/bjsports-2011-090186

Lonsdale, C., Sabiston, C. M., Raedeke, T. D., Ha, A. S. C., & Sum, R. K. W. (2009). Self-determined motivation and students' physical activity during structured physical education lessons and free choice periods. *Preventive Medicine,48*(1), 69-73. doi:http://dx.doi.org/10.1016/j.ypmed.2008.09.013

Lubans, D. R., Smith, J. J., Morgan, P. J., Beauchamp, M. R., Miller, A., Lonsdale, C., Parker, P. & Dally, K. (2016). Mediators of psychological well-being in adolescent boys. *Journal of Adolescent Health*, *58*(2), 230-236.

Mattocks, C., Leary, S., Ness, A., Deere, K., Saunders, J., Tilling, K., & Riddoch, C. (2007). Calibration of an accelerometer during free-living activities in children. *International Journal of Pediatric Obesity*, *2*(4), 218-226.

Michie, S., & Abraham, C. (2004). Interventions to change health behaviours: Evidence-based or evidence-inspired? *Psychology & Health*, *19*(1), 29-49. doi:10.1080/0887044031000141199

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011) A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. *Psychology & Health*, *26*(11), 1479-1498.

Moreno, J. A. (2005). Goal orientations, motivational climate, discipline and physical self-perception related to the teacher's gender, satisfaction and sport activity of a sample of spanish adolescent physical education students. *International Journal of Applied of Sports Science*, *17*(2), 57-68

Ng, J. Y., Burnett, A., Ha, A. S., & Sum, K. W. (2015). Psychometric properties of the Chinese (Cantonese) versions of the KIDSCREEN health-related quality of life questionnaire. *Quality of Life Research*, *24*(10), 2415-2421.

O'Donovan, G., Blazevich, A. J., Boreham, C., Cooper, A. R., Crank, H., Ekelund, U., ... & Hamer, M. (2010). The ABC of Physical Activity for Health: a consensus statement

from the British Association of Sport and Exercise Sciences. *Journal of sports sciences*, *28*(6), 573-591.

Owen, K. B., Smith, J., Lubans, D. R., Ng, J. Y., & Lonsdale, C. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive medicine*, *67*, 270-279.

Plotnikoff, R. C., Costigan, S. A., Karunamuni, N., & Lubans, D. R. (2013). Social cognitive theories used to explain physical activity behavior in adolescents: A systematic review and meta-analysis. *Preventive Medicine*, *56*(5), 245-253.

Quaresma, A. M., Palmeira, A. L., Martins, S. S., Minderico, C. S., & Sardinha, L. B. (2014). Effect of a school-based intervention on physical activity and quality of life through serial mediation of social support and exercise motivation: The PESSOA program. *Health Education Research*, doi:10.1093/her/cyu056

Rafferty, R., Breslin, G., Brennan, D., & Hassan, D. (2016). A systematic review of school-based physical activity interventions on children's wellbeing. *International Review of Sport and Exercise Psychology*, 1-16.

Ravens-Sieberer, U., Auquier, P., Erhart, M., Gosch, A., Rajmil, L., Bruil, J., . Phillips, K. (2007). The KIDSCREEN-27 quality of life measure for children and adolescents: Psychometric results from a cross-cultural survey in 13 european countries. *Quality of Life Research*, *16*(8), 1347-1356.

Ravens-Sieberer, U., Gosch, A., Abel, T., Auquier, P., Bellach, B. -., Bruil, J., . . . Bullinger, M. (2001). Quality of life in children and adolescents: A european public health perspective. *Sozial- Und Praventivmedizin*, *46*(5), 294-302.

Ravens-Sieberer, U., Herdman, M., Devine, J., Otto, C., Bullinger, M., Rose, M., & Klasen, F. (2014). The European KIDSCREEN approach to measure quality of life and well-being in children: Development, current application, and future advances. *Quality of Life Research*, *23*(3), 791-803.

Reeve, J. (2014). *Understanding motivation and emotion*. John Wiley & Sons.

Reinboth, M., Duda, J., & Ntoumanis, N. (2004). Dimensions of coaching behavior, need s atisfaction, and the psychological and physical welfare of young athletes.*28*(3), 297-313.

Rowe, D. A., Raedeke, T. D., Wiersma, L. D., & Mahar, M. T. (2007). Investigating the youth physical activity promotion model: internal structure and external validity evidence for a potential measurement model. *Pediatric exercise science*, *19*(4), 420.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68-78.

Ryan, R. M., & Deci, E. L. (2008). Self-determination theory and the role of basic psychological needs in personality and the organization of behavior. In O. P. John, R. W. Robins & L. A. Pervin (Eds.), (pp. 654-678). New York, NY, US: Guilford Press.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise*, *32*(5), 963-975.

Salmon J, Booth ML, Phongsavan P, Murphy N, Timperio A: Promoting physical activity participation among children and adolescents. Epidemiol Rev 2007, 29:144–159.

Schumacker, R. E., & Lomax, R. G. (1996). *A beginner's guide to structural equation modeling*. Mahwah, N.J: L. Erlbaum Associates.

Seabra, A. C., Maia, J., Seabra, A. F., Welk, G., Brustad, R., & Fonseca, A. M. (2013). Evaluating the youth physical activity promotion model among portuguese elementary schoolchildren. *Journal of Physical Activity & Health, 10*(8), 1159-1165.

Sebire, S. J., Jago, R., Fox, K. R., Edwards, M. J., & Thompson, J. L. (2013). Testing a self-determination theory model of children's physical activity motivation: a cross-sectional study. *Int J Behav Nutr Phys Act*, *10*, 111.

Shannon, S., Breslin, G., Fitzpatrick, B., Hanna, D., & Brennan, D. (2016). Testing the psychometric properties of Kidscreen-27 with Irish children of low socio-economic status. *Quality of Life Research*, 1-9.

Silva, M. N., Markland, D., Minderico, C. S., Vieira, P. N., Castro, M. M., Coutinho, S. R. Teixeira, P. J. (2008). A randomized controlled trial to evaluate self-determination theory for exercise adherence and weight control: rationale and intervention description. *BMC Public Health*, *8*, 234. http://doi.org/10.1186/1471-2458-8-234

Standage, M., Gillison, F. B., Ntoumanis, N., & Treasure, D. C. (2012). Predicting students' physical activity and health-related well-being: A prospective cross-domain investigation of motivation across school physical education and exercise settings. *Journal of Sport & Exercise Psychology*,*2012*(34), 37-60.

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., ... & Rowland, T. (2005). Evidence based physical activity for school-age youth. *The Journal of pediatrics*, *146*(6), 732-737.

Taylor, I. M., Ntoumanis, N., Standage, M., & Spray, C. M. (2010). Motivational predictors of physical education students' effort, exercise intentions, and leisure-time physical activity: A multilevel linear growth analysis. *Journal of Sport and Exercise Psychology*, *32*(1), 99-120.

Telama, R., Yang, X., Viikari, J., Välimäki, I., Wanne, O., & Raitakari, O. (2005). Physical activity from childhood to adulthood: A 21-year tracking study. *American Journal of Preventive Medicine, 28*(3), 267-273.

Trost, S. G., McIver, K. L., & Pate, R. R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine and Science in Sports and Exercise*, *37*(11), S531.

Trost, S. G., & Loprinzi, P. D. (2011). Parental influences on physical activity behavior in children and adolescents: A brief review. *American Journal of Lifestyle Medicine, 5*(2), 171-181. doi:10.1177/1559827610387236

Vallerand, R. J. (1997). Toward A hierarchical model of intrinsic and extrinsic motivation. *Advances in Experimental Social Psychology, 29*, 271-360.

Van Sluijs EMF, McMinn AM, Griffin SJ. (2008) Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. British Journal of Sports Medicine, 42:653–657.

Verloigne, M., Van Lippevelde, W., Maes, L., Yildirim, M., Chinapaw, M., Manios, Y., . . . De Bourdeaudhuij, I. (2012). Levels of physical activity and sedentary time among 10- to 12-year-old boys and girls across 5 european countries using accelerometers:

An observational study within the ENERGY-project. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 34.

Whitehead, J.R. (1995) A study of children's physical self-perceptions using an adapted Physical Self-Perception Profile questionnaire. *Pediatr. Exerc. Sci.* 7(2):132-151, 1995.

World Health Organisation (2010). *Global Recommendations on Physical Activity for Health*. Geneva

Table 1: *Descriptive statistics for physical activity and well-being*

	Total Physical Activity	MVPA	*Physical Well-being*	Psychological Well-being	Moods and Emotions	*Parent Relations and Autonomy*	*Financial Resources*	*Social Support and Peers*	*School Environment*	*Total wellbeing*
Sample	49.52 (14.39)	35.12 (15.03)	19.94 (2.77)	17.09 (2.62)	13.60 (1.93)	21.06 (3.14)	7.68 (2.29)	17.95 (2.97)	18.03 (2.51)	116.81 (10.99)
Gender										
Male	49.89 (15.29)	38.12 (16.60)*	19.80 (2.86)	17.02 (2.55)	13.77 (1.71)	21.43 (3.13)	7.47 (2.45)	17.90 (3.02)	17.80 (2.48)	116.27 (11.45)
Female	49.52 (14.39)	31.45 (11.95)	20.12 (2.65)	17.17 (2.72)	13.38 (2.16)	21.80 (3.14)	7.94 (2.07	18.01 (2.91)	18.31 (2.53)	117.47 (10.41)

Table 2: *Summary of Fit Indices and Loadings; original (O) and modified (M) factors*

Model	df	χ2	α	CFI	GFI	TLI	RMSEA	Factor Loadings
SDT Scales								
Athletic competence (M)	9	22.206, p=.009	.63	.970	.989	.950	.047 (90% CI=.022-.072)	.37, .49, .29, .14*, .57, .59, .63
Physical self-worth (M)	7	15.854, p=.026	.58	.975	.992	.946	.044 (90% CI=.41 -.073)	.56, .46, .36, 46, .26, .40
Parental relatedness (O)	9	31.987, p=.000	.70	.966	.983	.943	.062 (90% CI=.040 - .086)	.26, .67, .60, .37, .75, .96
Peer relatedness (O)	5	9.082, p=.106	.59	.987	.995	.973	.035 (90% CI=.000 - .071)	.48, .55, .61, .56, .19
Kidscreen-27			α ranges					Factor loading ranges
5 Factor model	314	793.005, p=.000	.65-.72	.863	.917	.847	.048 (90% CI=.044 - .052)	PH(.48 to.61); PsyWB (.26 to .66); P&A (.40 to .54); SS (.56 to.74); SC (.61 to .67)
7 Factor model	303	534.089, p=.000	.65-.72	.934	.944	.924	.034 (90% CI=.029 - .039)	PH (.49 to .60); PsyWB (.46 to .63); M (.48 to .61); P&A (.44 to.53); F (.67 to .78); SS (.56 to.74); SC (.61 to .67)
Path models								
								Factor loading ranges
Model 1	1	.744, p=.33		1.00	.999	1.01	.00 (90% CI= .00 to .17)	PsyN > PA (-.14 to .19); PsyN >PA > WB (-.01 to .01); PA > WB (.09)
Model 2	1	.948, p=.39		1.00	.999	1.00	.00 (90% CI= .00 to .18)	PsyN > MVPA (.02 to .07); PsyN >MVPA> WB (.00 to .00); MVPA> WB (.07)

**=subsequently deleted; PH= Physical well-being; PsyWB = Psychological well-being; M=Moods; P&A= Parent relations and autonomy; F= Finance; SS= Social support and peers; SC= School environment; PsyN = Psychological needs; PA= Physical activity; MVPA= moderate-to-vigorous physical activity; WB= Well-being*

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