Title: Physical activity, screen time and the risk of subjective health complaints in school-aged children

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Abbreviations:

HBSC: Health Behaviour in School-aged Children

METS: Metabolic equivalent units

MVPA: Moderate-to-vigorous physical activity

TST: Total screen time

WHO: World Health Organisation

Abstract

Internationally, subjective health complaints have become increasingly prevalent in children. Thus, a comprehensive understanding of the determinants of health complaints is needed to inform effective policies and strategies. This study explores if meeting physical activity and total screen time (TST) recommendations is associated with the risk of reporting health complaints weekly or more. The 2014 Irish Health Behaviour in School-aged Children study collected questionnaire data from 10474 10-17 year olds. Children reported how often they experienced eight health complaints as less than weekly or weekly or more. Children who met moderate-to-vigorous physical activity recommendations were active for 60 minutes/day in the past seven days. Three types of screen based activity were categorised to reflect if children met TST recommendations of <2 hours/day. Poisson regression examined the association between meeting recommendations and the risk of health complaints. The prevalence of individual health complaints ranged from 20.4-44.3% in girls and from 10.1-35.4% in boys. Overall, 5.1% (4.5-5.6%) of girls and 8.7% (7.8-9.5%) of boys met both (physical activity and TST) recommendations, while two thirds of girls (67.3%, 66.1-68.5%) and over half of boys (55.0%, 53.5-56.6%) met neither recommendation. Not meeting TST recommendations were significantly associated with the risk of reporting health complaints while associations with physical activity were less apparent. Children who did not meet either recommendation had a significantly increased risk for six of the health complaints when compared to those who met both recommendations. As health complaints and poor lifestyle behaviours were common in children, population level measures are warranted.

Keywords: health complaints; physical activity; screen time; children

1. Introduction

Regular physical activity is essential for normal growth and development (Hills et al., 2007; Trost, 2007) and has several benefits for health and wellbeing (Janssen and LeBlanc, 2010). The World Health Organisation (WHO) recommends that children engage in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) daily (World Health Organization, 2010). Recent evidence from 32 countries in Europe and North America suggests that 14.0% of girls and 23.1% of boys aged 11-15 years currently meet MVPA recommendations (Kalman et al., 2015).

Sedentary behaviour can be defined whereby little energy is being expended (≤1.5 metabolic equivalent units [METS]) during waking time and can include sitting or lying down (Tremblay et al., 2011a). Children have become increasingly sedentary and a study from nine European countries has estimated that children aged 12-18 years spend approximately 70% of their waking time sedentary (Ruiz et al., 2011). Screen time is a distinct type of sedentary behaviour (Sigman, 2012). With technological advances, many children now have access to multiple types of screens which can be used for activities including leisure time (Sigman, 2012). There is a dose-response relationship between sedentary behaviour and poor outcomes in childhood including obesity, markers of cardiovascular disease, and low self-esteem (Tremblay et al., 2011b). Current recommendations by the American Academy of Paediatricians suggest that children should limit total screen time (TST) to no more than 2 h per day (Barlow, 2007). However, based on a global sample of 9-11 year olds and a sample of 6-11 year olds from the US over half of all children exceed TST recommendations (Fakhouri et al., 2013; LeBlanc et al., 2015).

Recent arguments suggest that physical activity and sedentary behaviours are separate constructs each having an independent impact on health outcomes and that there is an interplay between them Pearson et al., 2014). Understanding the relationship between physical activity and sedentary behaviour may help inform the design of strategies to tackle poor lifestyles and health outcomes in children. Furthermore, there is evidence to suggest that health behaviours including physical

activity and screen time can track as individuals age (Biddle et al., 2010; Craigie et al., 2011) and this may have negative consequences for health outcomes (Lee et al., 2012).

A recent study investigated behavioural and social context factors associated with health complaints in the Health Behaviour in School-aged Children (HBSC) study and found an association between sedentariness and health complaints (Ottová-Jordan et al., 2015). Torsheim and colleagues found that three different types of screen based activities (TV viewing, computer gaming and computer use) were each associated with headaches and backache in adolescents from Nordic European countries (Torsheim et al., 2010). Similar findings have been reported in other countries including Iceland (Taehtinen et al., 2014), Portugal (Marques et al., 2015), and Slovakia (Brindova et al., 2014), with some studies reporting that the association persists independent of physical activity.

Subjective health complaints are somatic (e.g., headache, backache) and psychological (e.g., feeling low, feeling nervous) symptoms that cannot be explained by an underlying illness (Brown, 2007). Subjective health complaints are thought to reflect a significant dimension of wellbeing. Health complaints are prevalent in children, particularly in girls (Inchley et al., 2016), and symptoms can co-occur (Inchley et al., 2016; Ravens-Sieberer et al., 2009). Health complaints are associated with medicine use (Gobina et al., 2011), primary care service use (Vingilis et al., 2007) and absenteeism from school (Saps et al., 2009).

Examining overall screen time rather than time spent at individual screen based behaviours may be useful for policymakers. Further, as many children do not meet physical activity or TST recommendations, understanding the interplay between physical activity and TST may help inform the design of polices and interventions to tackle poor lifestyle behaviours. We hypothesised that children who met neither recommendation would have an increased risk of health complaints compared to those who met both recommendations. This study describes the prevalence of eight subjective health complaints (including headache, stomach-ache, feeling low and irritability) in a large, nationally representative sample of girls and boys aged 10-17 years. This study also examines the separate and independent associations of

meeting physical activity and TST recommendations on the risk of reporting health complaints weekly or more frequently. Finally, this study explores if meeting both, one or neither recommendation (physical activity and TST) is associated with the risk of reporting health complaints weekly or more frequently.

2. Methods

2.1 Study design and sample

The study sample for this analysis comprises of 10474 children aged 10-17 years who participated in the 2014 Irish HBSC study which is part of the World Health Organisation (WHO) collaborative HBSC study. The Irish HBSC study is a nationally representative study of children aged 9-18 years residing in the Republic of Ireland. A two-stage sampling process was used with schools as the primary sampling unit. In the first stage, primary (aged approximately 10–12 years) and post primary (aged approximately 12–18 years) schools were randomly selected from the national total across eight geographical regions. At the second stage, individual classrooms within participating schools were randomly selected to partake. Schools were recruited during school term time between April 2014 and October 2014. At the school level, a response rate of 59% was achieved, while 84.5% of invited children participated in the study.

Participating children were asked to complete a self-reported questionnaire within the classroom including questions on health outcomes, health behaviours and socio-demographic factors. Only children who provided informed consent (either active or passive consent) were invited to take part. The consent process was dependent on each individual schools requirement. Ethical approval was granted from the Research Ethics Committee, NUI Galway, Ireland.

3. Dependent variables

3.1 Subjective health complaints

Children were asked to report how often they experienced eight health complaints: (1) headache, (2) stomach-ache, (3) backache, (4) feeling dizzy, (5) feeling low, (6)

irritability or bad temper, (7) feeling nervous, and (8) difficulties in getting to sleep. The first four health complaints are defined as somatic and the latter four as psychological health complaints. The five response options for each health complaint were (1) about every day, (2) more than once a week, (3) about every week, (4) about every month, and (5) rarely or never. The response options were dichotomised for each health complaint as either (1) less than weekly, or (2) about weekly or more frequently.

A multiple health complaints variable was created and coded as 'yes' for those who reported two or more complaints about weekly or more or as 'no' for those who report none or one complaint about weekly or more.

4. Independent variables

4.1 Physical activity

Children were asked how many days in the past seven had they been physically active for at least 60 minutes. This question is recommended for use as a brief surveillance tool (Biddle et al., 2011). The measure was adapted from a measure developed to identify individuals not meeting physical activity guidelines (Prochaska et al., 2001). Previous studies have shown that the measure has acceptable reliability and validity (Liu et al., 2010). To reflect WHO recommended guidelines for MVPA, children were coded as meeting recommendations if they were active on 7 days, and as not meeting MVPA recommendations if they were active for 6 days or less.

4.2 Screen time

Data on three types of screen time behaviours on week and weekend days were available. Previous studies have suggested that these screen based questions have acceptable test-retest reliability (Bobakova et al., 2015; Liu et al., 2010). The questions were (1) watching TV, videos (including YouTube or similar services), DVDs and other entertainment on a screen, (2) playing games on a computer, games console, tablet (like iPad), smartphone or other electronic device (not including moving or fitness games), and (3) use electronic devices such as computers, tablets (like iPad) or smartphone for other purposes, including homework, emails, tweeting etc. Nine response options were available for each question and the response options ranged

from 'none at all' to ‘about 7 or more hours a day’. Reponses were summed separately for week and weekend days to calculate average daily screen time. To reflect current screen time guidelines, a TST variable was created and coded as <= 2 h per day (meeting recommendations), and > 2 h per day (not meeting recommendations).

4.3 Socio-demographic characteristics

Children were asked to report their gender as boy or girl. The age of each child was calculated using the survey administration date and self-reported month and year of birth. Age group categories were created and were 10-11 years, 12-14 years and 15-17 years. Children were asked to record whether their mother and/or father have a job, where their parent(s) work and what exact job their parent(s) have. From these data, each parent was assigned to a social class group as professional managers, managerial, non-manual, skilled manual, semi-skilled and unskilled, and unknown/unclassified. The higher reported level of parental social class was used if parental social classes differed. Social class was then further recoded into three groups as high (professional managers, managerial), medium (non-manual, skilled manual) or low (semi-skilled and unskilled). Family structure was defined based on who the children reported live with them, in their main family home. Family structure is coded as two parents (including step-parents), one parent or other.

5. Statistical analysis

Statistical analysis was conducted in Stata 12 IC (StataCorp LP, USA). Prevalence estimates were estimated with 95% confidence intervals. Chi squared tests were used to test for significant differences in socio-demographic and lifestyle factors (physical activity and TST). All descriptive analysis was stratified by gender.

Possible interactions between gender and physical activity, and gender and TST were tested. As interactions were not statistically significant, data for girls and boys were pooled for regression analysis. To assess if meeting (1) physical activity recommendations and (2) meeting TST recommendations were associated with the

risk of health complaints, separate univariate Poisson regression analysis were examined. The models were then adjusted for gender, age group, social class and family structure. Finally, models were mutually adjusted and included gender, age group, social class, family structure, physical activity and TST to assess independent associations.

To assess the combined impact of low levels of physical activity and high TST on the risk of health complaints in children, children were categorised into four groups based on MVPA and TST recommendations. The four groupings for compliance to recommendations were (1) met both recommendations, (2) met TST recommendations only, (3) met MVPA recommendations only, and (4) met neither recommendation. Poisson regression examined whether meeting both recommendations, physical activity only, TST only, or meeting neither recommendation was associated with the risk of reporting health complaints, whilst adjusting for gender and age group, social class and family structure. To account for the possible clustering of children within schools, robust standard errors were calculated.

6. Results

Table 1 describes the characteristics of the study population, by gender. Overall, 83.7% (95% CI, 82.8-84.6%) of girls and 69.9% (95% CI, 68.5-71.3%) of boys did not meet MVPA recommendations (P<0.001). Over three quarters of girls (78.2%, 95% CI, 77.2-79.3%) and boys (75.6%, 95% CI, 74.4-76.9%) exceeded TST recommendations (P=0.002). Furthermore, 5.1% (95% CI, 4.5-5.6%) of girls and 8.7% (95% CI, 7.8-9.5%) of boys met both recommendations while two thirds of girls (67.3%, 95% CI, 66.1-68.5%) and over half of boys (55.0%, 95% CI, 53.5-56.6%) met neither recommendation.

Table 1 here

Figure 1 presents the proportion of children reporting health complaints weekly or more frequently, by gender. For girls, the prevalence ranged from 20.4% for stomach-

aches to 44.3% for feeling nervous while in boys the prevalence ranged from 10.1% for stomach-aches to 35.4% for irritability. A significantly higher proportion of girls reported experiencing each health complaint than boys (P<0.001 for each). Overall, 58.1% (95% CI, 56.8-59.4%) of girls and 43.0% (95% CI, 41.5-44.6%) of boys reported experiencing multiple health complaints (P<0.001).

Figure 1 here

Table 2 describes the prevalence of reporting health complaints weekly or more frequently by (1) physical activity recommendations, (2) TST recommendations, and (3) compliance to recommendations groupings in girls and boys. Girls and boys who met the physical activity recommendations had a lower prevalence of each health complaint (except for stomach-ache in boys) than those who did not meet the recommendations, with statistically significant differences for five health complaints in girls and for four in boys (see Table 2). In girls and boys, the prevalence of reporting each health complaint was significantly lower in those who met TST recommendations than in those who did not meet TST recommendations (except for stomach-ache in boys). In the compliance to recommendations groupings, the prevalence of each health complaint was significantly higher in girls and boys who did not meet either recommendation when compared to those who met both recommendations**.**

Table 2 here

Table 3 presents the separate associations of meeting physical activity and TST recommendations and the risk of reporting health complaints weekly or more frequently. Univariate models suggest that meeting physical activity recommendations was significantly associated with reporting each health complaint (model 1a). When the models were adjusted for socio-demographic characteristics, significant associations remained for reporting irritability, feeling nervous and multiple health complaints (model 2a). Both univariate models and models adjusted for socio-demographic characteristics suggest that meeting TST recommendations was significantly associated with reporting each health complaint (models 1b and 2b).

Table 3 here

When physical activity and TST were the mutually adjusted whilst accounting for socio-demographic characteristics (models 3a and 3b), the risk of each health complaint was

similar to those reported in models 2a and 2b. For physical activity, significant associations remained for feeling nervous and multiple health complaints (model 3a). For TST, significant associations remained for each health complaint (model 3b) (Table 3).

Table 4 presents the association between the compliance to recommendations groupings and the risk of reporting health complaints weekly or more frequently, adjusted for socio-demographic characteristics. Children who met physical activity recommendations only had a significantly increased risk of reporting each health complaint (except for feeling dizzy) compared to those who met both recommendations. Children who met TST recommendations only did not have a significantly increased risk of health complaints compared to those who met both recommendations. The risk of reporting each health complaint was higher in those who met MVPA recommendations only when compared to those who met TST recommendations only. Children who did not meet either recommendation had a significantly increased risk of each health complaint (except for stomach-ache and feeling dizzy) when compared to those who met both recommendations. Furthermore, there was a graded association between meeting both, TST only, physical activity only and meeting neither recommendation for the psychological health complaints.

Table 4 here

7. Discussion

7.1 Principal findings

This study examined the association between meeting physical activity recommendations, TST recommendations and the risk of eight subjective health complaints in school-aged children. The somatic (headache, stomach-ache, backache, feeling dizzy) and psychological (feeling low, irritability or bad temper, feeling nervous, difficulties in getting to sleep) health complaints in this study are measured as part of the HBSC study in Ireland and internationally. The key findings from the study include that health complaints were prevalent and that a large proportion of children did not meet physical activity or TST recommendations. When independent associations were assessed, meeting TST recommendations was

associated with the risk of health complaints while associations between physical activity and health complaints were less apparent. Finally, as hypothesised, children who did not meet either recommendation had an increased risk of health complaints compared to those who met both recommendations.

Health complaints were prevalent in this study, particularly girls and older children. This is consistent with data from other countries (Inchley et al., 2016). There are a number of possible explanations. Stressors including bullying and level of support from family and peers are associated with health complaints (Hjern et al., 2008; Moreno et al., 2009). Further, pressure from school tends to increase with age and this may result in increased reporting of health complaints (Hjern et al., 2008). Children also go through a number of developmental changes during puberty and this may help explain some of the age and gender differences (Patton and Viner, 2007).

There was an association between meeting TST recommendations and the risk of reporting health complaints in this study (Table 3). This is consistent with other literature on sedentary behaviours and indicators of wellbeing (Suchert et al., 2015). Though physical activity recommendations were associated with health complaints, few associations were significant once we accounted for socio-demographic characteristics. This suggests that meeting physical activity recommendations was not a predominant determinant of health complaints in children in this study. However, a recent systematic review has suggested that there is an association between physical activity and measures of mental health and wellbeing in children (Biddle and Asare, 2011).

As lifestyle behaviours tend to co-exist (Laurson et al., 2008; Maher et al., 2012), we explored if meeting both, one or neither recommendation was associated with health complaints. Children who met neither recommendation and those met the MVPA recommendations only were at an increased risk of health complaints when compared to those who met both recommendations. However, children who met TST recommendations only did not have an increased risk of health complaints. Thus TST may be more important than physical activity in terms of health complaints. This has implications for policy and practice suggesting that targeting multiple lifestyle

behaviours with a focus on reducing screen time behaviour may be important. However, it should be noted that longitudinal research in this area would be beneficial.

Furthermore, there was a graded association between meeting both, TST only, physical activity only and neither recommendation for the psychological health complaints, but not for somatic complaints. This suggests that there may be an additive effect for meeting both recommendations rather than meeting one recommendation. However, this additive effect size is small, especially when considering practical implications. Furthermore, as health complaints were associated with age, this suggests that targeting younger children is important.

7.2 Strengths and limitations

This study has a number of strengths. The Irish HBSC study is a large, nationally representative study. The items included in the questionnaire have been previously validated. Children reported on three different types of screen time behaviour and this allowed for a TST variable to be created and reflect current screen time recommendations. Though self-reported activity data may not provide accurate estimates, it is arguably appropriate for ranking individuals. Limitations to this study include that the measures are subjective and self-reported. Furthermore, residual confounding may explain the findings of the current study. As this study is cross sectional, temporal associations are possible and causality cannot be inferred.

8. Conclusion

Subjective somatic and psychological health complaints were common in school-aged children. Poor lifestyle behaviours co-existed in two-thirds of girls and just over half of boys. As physical activity and screen time use are modifiable behaviours, effective population based strategies are urgently needed. To tackle health complaints in children, we suggest that targeting compliance to TST recommendations may be particularly useful for policy and practice. Meeting TST recommendations was associated with the risk of health complaints independent of physical activity level in this study. However, associations between physical activity and health complaints

were less apparent. To tackle health complaints in children, we suggest that targeting compliance to TST recommendations may be particularly useful for policy and practice.

Acknowledgements

The HBSC study is an international study that is carried out in collaboration with WHO Europe. The International Coordinator of the HBSC study is Dr Jo Inchley, with Dorothy Currie the Deputy International Coordinator, based at the Child and Adolescent Health Research Unit in the University of St Andrews. Professor Oddrun Samdal from the University of Bergen is the databank manager. We would like to acknowledge the children and parents who participated, the management authorities, principals and teachers of participating schools, the staff at the Health Promotion Research Centre at the National University of Ireland Galway and the HBSC Ireland Advisory Board.

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Conflicts of interest

None.

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Table 1: Descriptive characteristics of the study population in the 2014 Irish Health Behaviour in School-aged Children (HBSC) study, by gender

		Girls N=6132 (58.5%)	Boys N=4342 (41.5%)
		N (%)	N (%)
Age group	**10-11**	928 (15.3)	626 (14.6)
	12-14	2745 (45.2)	2020 (47.2)
	15-17	2394 (39.5)	1630 (38.1)
Social class	**High**	2605 (50.1)	1708 (48.5)
	Medium	1992 (38.3)	1399 (39.7)
	Low	605 (11.6)	415 (11.8)
Family structure	**Two parents**	4806 (82.1)	3338 (83.4)
	One parent	959 (16.4)	601 (15.0)
	Other	87 (1.5)	64 (1.6)
TV viewing (h/d)*	**< 1 hour**	1338 (24.5)	772 (21.2)
	1-3 hours	3415 (62.5)	2333 (63.9)
	≥4 hours	711 (13.0)	544 (14.9)
Computer gaming (h/d)*	**< 1 hour**	2903 (56.4)	1365 (40.3)
	1-3 hours	1616 (31.4)	1570 (46.3)
	≥4 hours	627 (12.2)	455 (13.4)
Computer use (h/d)*	**< 1 hour**	1498 (29.0)	1133 (33.8)
	1-3 hours	2344 (45.4)	1545 (46.1)
	≥4 hours	1318 (25.5)	671 (20.0)
Met TST recommendations	**Yes**	1322 (21.8)	1045 (24.4)
	No	4752 (78.2)	3245 (75.6)
Met MVPA recommendations	**Yes**	961 (16.3)	1259 (30.1)
	No	4935 (83.7)	2921 (69.9)
Compliance to recommendation groupings	**Met both**	295 (5.1)	358 (8.7)
	Met TST only	655 (11.2)	874 (21.2)
	Met MVPA only	961 (16.5)	624 (15.1)
	Met neither	3928 (67.3)	2272 (55.0)

Footnote: *average hours per day over the total week

Table 2. Prevalence of reporting subjective health complaints weekly or more frequently by physical activity and total screen time recommendations in Irish 10-17 year old girls and boys in 2014

		Somatic health complaints				Psychological health complaints				
		Headache N=10317	Stomach-ache N=10229	Backache N=10205	Feeling dizzy N=10252	Feeling low N=10143	Irritability N= 10218	Feeling nervous N=10202	Difficulties in getting to sleep N=10256	Multiple complaints* N=9626
GIRLS										
Met MVPA recomm.	**Yes**	**28.9**	18.1	21.0	23.3	**27.6**	**34.5**	**35.4**	**34.9**	**47.5**
	No	**37.0**	20.6	23.7	24.7	**35.9**	**45.9**	**46.0**	**40.7**	**60.2**
Met TST recomm.	**Yes**	**28.1**	**15.8**	**18.1**	**19.6**	**24.8**	**31.4**	**36.6**	**31.7**	**46.5**
	No	**37.7**	**21.8**	**24.9**	**26.1**	**37.4**	**47.7**	**46.6**	**41.9**	**61.6**
Compliance to recomm. groupings	**Met both**	**23.2**	**15.3**	**14.6**	**21.1**	**20.3**	**25.5**	**31.7**	**29.8**	**37.7**
	Met TST only	**30.0**	**16.1**	**19.1**	**18.9**	**25.8**	**32.8**	**38.1**	**32.4**	**48.8**
	Met MVPA only	**31.6**	**19.3**	**24.1**	**24.5**	**31.1**	**38.8**	**37.1**	**37.2**	**51.8**
	Met neither	**38.8**	**21.9**	**25.0**	**26.2**	**38.6**	**49.3**	**48.1**	**42.8**	**63.3**
BOYS										
Met MVPA recomm.	**Yes**	19.4	11.0	**15.3**	14.4	**17.3**	**32.8**	**28.1**	26.0	**38.3**
	No	21.4	9.8	**18.7**	15.5	**22.0**	**36.4**	**32.7**	28.4	**45.8**
Met TST recomm.	**Yes**	**17.5**	10.0	**13.4**	**12.5**	**16.5**	**27.1**	**23.5**	**22.5**	**32.8**
	No	**21.6**	10.2	**18.9**	**16.1**	**22.5**	**38.2**	**34.1**	**29.1**	**46.4**
Compliance to recomm. groupings	**Met both**	**13.9**	**7.8**	**10.3**	**9.8**	**13.3**	**24.9**	**20.7**	**19.3**	**28.9**
	Met TST only	**19.9**	**11.1**	**14.8**	**13.8**	**17.3**	**28.1**	**24.1**	**24.6**	**35.0**
	Met MVPA only	**21.8**	**12.3**	**17.3**	**16.5**	**19.2**	**36.1**	**31.1**	**28.9**	**42.2**
	Met neither	**21.9**	**9.4**	**19.7**	**16.1**	**23.4**	**38.8**	**35.1**	**29.5**	**48.1**

Footnotes: Recomm. = Recommendations, **Bold** data indicates significant differences (within gender p-values). *Multiple complaints=those report two or more health complaints weekly or more

Table 3. The risk of reporting subjective health complaints weekly or more frequently by (1) physical activity recommendations and (2) by total screen time recommendations in Irish 10-17 year olds in 2014

	Somatic health complaints				Psychological health complaints				
	Headache	**Stomach-ache**	**Backache**	**Feeling dizzy**	**Feeling low**	**Irritability**	**Feeling nervous**	**Difficulty in getting to sleep**	**Multiple complaints***
	IRR(95% CI)								
Met MVPA recommendations									
Model 1a	**1.32 (1.20-1.47)**	**1.18 (1.03-1.35)**	**1.23 (1.13-1.35)**	**1.17 (1.06-1.29)**	**1.41 (1.27-1.57)**	**1.27 (1.16-1.38)**	**1.31 (1.24-1.39)**	**1.21 (1.14-1.28)**	**1.29 (1.22-1.37)**
Model 2a	1.05 (0.95-1.18)	0.98 (0.84-1.14)	0.98 (0.90-1.06)	0.93 (0.84-1.04)	1.08 (0.96-1.20)	**1.10 (1.01-1.20)**	**1.12 (1.04-1.20)**	1.06 (0.98-1.15)	**1.11 (1.04-1.17)**
Model 3a	1.04 (0.93-1.15)	0.97 (0.83-1.13)	0.96 (0.88-1.04)	0.91 (0.81-1.00)	1.05 (0.93-1.18)	1.07 (0.99-1.16)	**1.10 (1.02-1.19)**	1.04 (0.96-1.13)	**1.09 (1.03-1.16)**
Met TST recommendations									
Model 1b	**1.32 (1.21-1.45)**	**1.29 (1.15-1.44)**	**1.40 (1.25-1.56)**	**1.34 (1.20-1.49)**	**1.48 (1.35-1.62)**	**1.49 (1.37-1.61)**	**1.34 (1.25-1.44)**	**1.33 (1.23-1.43)**	**1.37 (1.29-1.47)**
Model 2b	**1.23 (1.11-1.36)**	**1.21 (1.05-1.41)**	**1.36 (1.19-1.55)**	**1.26 (1.12-1.43)**	**1.38 (1.24-1.53)**	**1.47 (1.36-1.60)**	**1.24 (1.14-1.35)**	**1.27 (1.16-1.40)**	**1.31 (1.22-1.40)**
Model 3b	**1.23 (1.11-1.36)**	**1.20 (1.03-1.40)**	**1.36 (1.20-1.55)**	**1.27 (1.13-1.44)**	**1.38 (1.24-1.54)**	**1.47 (1.36-1.59)**	**1.23 (1.13-1.35)**	**1.27 (1.15-1.39)**	**1.29 (1.21-1.39)**

Footnotes: Models 1a and 1b are univariate. Models 2a and 2b are adjusted for gender, age group, social class and family structure. Models 3a and 3b are adjusted for gender, age group, social class, family structure, physical activity, and TST recommendations. *Multiple complaints=those report two or more health complaints weekly or more

Table 4. Association between reporting subjective health complaints weekly or more frequently and adherence to meeting both, one or neither recommendation (physical activity and total screen time) in Irish 10-17 year olds in 2014

		Somatic health complaints				Psychological health complaints				
		Headache	**Stomach-ache**	**Back ache**	**Feeling dizzy**	**Feeling low**	**Irritability**	**Feeling nervous**	**Difficulty in getting to sleep**	**Multiple complaints***
		IRR(95% CI)								
Compliance to recomm.	**Met both**	ref	ref	ref	ref	ref	ref	ref	ref	ref
	Met TST only	1.20 (0.97-1.49)	1.19 (0.83-1.71)	1.28 (0.90-1.82)	0.92 (0.70-1.20)	1.16 (0.91-1.49)	1.07 (0.87-1.31)	1.18 (0.99-1.42)	1.07 (0.90-1.27)	**1.17 (1.02-1.35)**
	Met MVPA only	**1.42 (1.12-1.79)**	**1.46 (1.04-2.06)**	**1.78 (1.26-2.53)**	1.29 (0.99-1.67)	**1.53 (1.24-1.88)**	**1.46 (1.22-1.77)**	**1.32 (1.11-1.57)**	**1.30 (1.09-1.55)**	**1.39 (1.21-1.59)**
	Met neither	**1.42 (1.15-1.75)**	1.35 (0.96-1.89)	**1.61 (1.17-2.22)**	1.16 (0.91-1.49)	**1.57 (1.26-1.95)**	**1.57 (1.31-1.88)**	**1.43 (1.21-1.69)**	**1.34 (1.14-1.58)**	**1.49 (1.30-1.70)**
Gender	**Girls**	**1.66 (1.50-1.85)**	**2.12 (1.83-2.44)**	**1.40 (1.28-1.53)**	**1.67 (1.46-1.91)**	**1.63 (1.48-1.80)**	**1.22 (1.14-1.31)**	**1.37 (1.28-1.47)**	**1.45 (1.33-1.57)**	**1.32 (1.24-1.40)**
	Boys	ref	ref	ref	ref	ref	ref	ref	ref	ref
Age group	**10-11**	ref	ref	ref	ref	ref	ref	ref	ref	ref
	12-14	**1.65 (1.37-1.98)**	**1.28 (1.01-1.63)**	**2.28 (1.83-2.84)**	**1.70 (1.40-2.01)**	**1.79 (1.48-2.16)**	**1.40 (1.23-1.60)**	**1.36 (1.20-1.54)**	1.04 (0.92-1.17)	**1.35 (1.19-1.53)**
	15-17	**2.33 (1.94-2.80)**	**1.87 (1.49-2.35)**	**3.74 (3.07-4.56)**	**2.52 (2.11-3.01)**	**2.68 (2.29-3.14)**	**1.99 (1.79-2.22)**	**1.84 (1.66-2.04)**	**1.25 (1.12-1.39)**	**1.84 (1.66-2.04)**
Social class	**High**	ref	ref	ref	ref	ref	ref	ref	ref	ref
	Medium	**1.11 (1.02-1.19)**	**1.23 (1.08-1.39)**	0.96 (0.88-1.04)	1.02 (0.93-1.11)	1.02 (0.94-1.10)	**1.07 (1.01-1.14)**	1.03 (0.96-1.11)	1.03 (0.96-1.09)	1.04 (0.99-1.09)
	Low	1.12 (0.99-1.26)	**1.36 (1.13-1.63)**	**1.14 (1.02-1.29)**	**1.16 (1.01-1.33)**	1.06 (0.96-1.18)	1.09 (1.00-1.19)	1.02 (0.93-1.12)	1.05 (0.94-1.18)	**1.08 (1.00-1.16)**
Family structure[#]	**Two parents**	ref	ref	ref	ref	ref	ref	ref	ref	ref
	One parent	**1.24 (1.15-1.34)**	**1.39 (1.23-1.56)**	**1.18 (1.06-1.31)**	**1.36 (1.23-1.51)**	**1.19 (1.10-1.30)**	**1.17 (1.10-1.26)**	**1.10 (1.02-1.19)**	**1.26 (1.18-1.33)**	**1.17 (1.12-1.24)**

Footnotes: *Multiple complaints=those who report two or more health complaints weekly or more, [#]Data for 'other' family structure not presented due to small N in this grouping

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