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Psychological Distress, Television Viewing, and Physical Activity in Children Aged 4 to 12 Years

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ABSTRACT

OBJECTIVES. Sedentary behavior and physical activity may be independent risk factors for psychological distress in adolescents, although there is no existing information for children. We examined the cross-sectional association between psychological distress, television and screen entertainment time, and physical activity levels among a representative sample of children aged 4 to 12 years from the 2003 Scottish Health Survey.

METHODS. Participants were 1486 boys and girls (mean age: 8.5 ± 2.3 years). Parents answered on behalf of children who were required to be present. The parents completed the Strengths and Difficulties Questionnaire and information on television and screen entertainment time, physical activity, and dietary intake of their children.

RESULTS. An abnormally high Strengths and Difficulties Questionnaire total difficulties score (20–40) was found in 4.2% of the sample. Approximately 25% of the children were exposed to television and screen entertainment at least 3 hours/day. In general linear models, television and screen entertainment time per week and physical activity levels were independently associated with the Strengths and Difficulties Questionnaire total difficulties score after adjustment for age, gender, area deprivation level, single-parent status, medical conditions, and various dietary intake indicators. There was also an additive interaction effect showing that the combination of high television and screen entertainment time and low physical activity was associated with the highest Strengths and Difficulties Questionnaire score. Higher television and screen entertainment exposure (>2.7 hours/day) alone resulted in a 24% increase in the Strengths and Difficulties Questionnaire score in comparison with lower television and screen entertainment exposure (<1.6 hours/day), although when combined with low physical activity this resulted in a 46% increase.

CONCLUSION. Higher levels of television and screen entertainment time and low physical activity levels interact to increase psychological distress in young children. Pediatrics 2009;123:1263–1268
association of TVSE exposure on psychological function is caused by a lack of physical activity or if sedentary behavior per se is an independent risk factor. A recent study has demonstrated independent associations of self-reported sedentary behavior (indexed as TVSE) and physical activity on measures of psychological distress in 13- to 16-year-olds. In contrast, another study in 12-year-old girls demonstrated that sedentary behavior, assessed by accelerometry, was inversely associated with depressive symptoms although physical activity was unrelated. There is a lack of research in younger children. Therefore, in the present study, we aimed to extend previous work by examining the association between psychological distress, TVSE time, and physical activity in children aged 4 to 12 years. We hypothesized that TVSE time and low physical activity would be independently associated with psychological distress. Because little information exists on how physical activity and TVSE exposure might interact, we also examined the associations between various combinations of physical activity and TVSE levels on psychological distress.

METHODS
Study Design and Participants
The Scottish Health Survey is a periodic survey (typically conducted every 3–5 years) that draws a nationally representative sample of the general population living in households. The sample was drawn using multistage, stratified probability sampling with postcode sectors selected at the first stage and household addresses selected at the second stage. Stratification was based on geographical areas and not on individual characteristics of the population. If 3 or more children were present in the household, 2 of the children were randomly selected for inclusion to limit burden. The present analyses included data from 1486 children (49.0% boys) aged 4 to 12 years (mean age: 8.5 ± 2.3 years) measured in the 2003 Scottish Health Survey. Seventy-seven percent of eligible households with children took part in the survey. The parents of the children gave full informed consent to participate in the study and ethical approval was obtained from the London Research Ethics Council.

Measurements
Trained interviewers visited households, and parents answered on behalf of children who were required to be present. Interviewing was conducted by using computer-assisted personal interviewing. Psychological distress was assessed by using the Strengths and Difficulties questionnaire (SDQ), which has demonstrated good reliability and validity. The outcome was the total difficulties score (ranging from 0 to 40), a combination of scores from the SDQ subscales of hyperactivity, emotional symptoms, conduct problems, and peer problems. Parents reported the total time per week their children viewed TVSE and the weekly frequency of sports and active play (for at least 15 minutes) of their children. Dietary intake of fruit and vegetables (portions per day), confectionary and sweets, and fizzy drinks were also recorded. The Scottish Index of Multiple Deprivation was assessed from 31 indicators in 6 individual domains of parents’ employment, current income, housing, health, education, skills, and training. Information on long-standing medical conditions and if the child was from a single-parent family was also recorded.

In a subsample of 768 children included in the present analysis, resting pulse pressure as an indicator of physical fitness was inversely associated with frequency of sport and active play ($P < .05$), which provided evidence for convergent validity of the physical activity measures. Data on salivary cotinine levels were available in 991 children, which provided an objective measure of recent exposure to tobacco smoke. Less than 1% of the sample demonstrated cotinine levels ($\geq 15$ ng/mL) that were indicative of smoking in the previous 24 hours. Because this indicated a very low prevalence of smoking in this sample, we did not include smoking as a covariate in the present analyses. There were limited available data on BMI, therefore, this variable was not reported in the present analyses. Detailed information on the survey method can be found elsewhere.

Statistical Analysis
Analysis of variance was employed to test for differences in variables between thirds of TVSE time. Associations between the total SDQ difficulties score, TVSE time, and physical activity were examined by using general linear models. For these analyses, TVSE time and physical activity were treated as categorical variables representing equal groups for low, medium, and high exposure. We fitted several models that included mutual adjustment for physical activity and TVSE time (model 1), plus psychosocial and demographic factors (model 2), plus dietary factors (model 3). This modeling strategy allowed us to control for potential effect modification from confounding factors. To examine if physical activity and TVSE time interact, we created a variable for the various combination of groups of TVSE time and physical activity. This additive interaction term was fitted in a separate model that included psychosocial, demographic, and dietary factors as covariates. An additive interactive term can be used to establish if the combined risks of 2 variables is greater than the risks associated with the individual variables. All analyses were conducted using SPSS 14 (SPSS Inc, Chicago, IL).

RESULTS
Table 1 represents characteristics of the sample split into thirds of TVSE time. Approximately 25% of the sample engaged in TVSE for at least 3 hours/day, and the mean (± SD) TVSE time was 2.4 ± 1.4 hours/day. Children who engaged in higher TVSE time were more likely to be older, boys, have a higher index of deprivation, lower physical activity, and have poorer dietary intake (lower fruit and vegetable consumption, and more frequent intake of sweets, confectionary, and fizzy drinks). Approximately 20% of children suffered from a chronic medical condition, and in 50% of cases this was asthma or skin-related complaints. Chronic medical conditions were, however, not associated with TVSE time.
An abnormally high SDQ total difficulties score (20–40) was found in 4.2% of the sample and 6.5% were borderline (score of 16–19), using previously recommended bandings.26 A higher total SDQ difficulties score was related to higher TVSE time and lower physical activity levels (see Table 2). In general linear models, both TVSE time and physical activity remained independently associated with the SDQ total difficulties score, after adjustment for age, gender, index of deprivation, single-parent status, chronic medical conditions, and various dietary indicators (see Table 3). Other independent predictors of the SDQ total difficulties score included gender (girls had lower scores than boys; regression coefficient $\beta = -0.78$ [95% confidence interval (CI): $-1.33$ to $-0.22$]), age (12-year-olds had lower scores than 4-year-olds; $\beta = -1.61$ [95% CI: $-2.70$ to $-0.52$]), deprivation (more highly deprived children had higher scores; $\beta = 3.38$ [95% CI: 2.49–4.28]), single-parent status (children of single-parent families had higher scores; $\beta = 2.18$ [95% CI: 1.55–2.82]), medical conditions (children with existing medical conditions had higher scores; $\beta = 2.10$ [95% CI: 1.41–2.74]), and fruit and vegetable intake (children with greater intake had lower scores, highest compared with lowest third; $\beta = -0.83$ [95% CI: $-1.53$ to $-0.12$]). In separate models, adjustment for psychosocial and demographic factors partly attenuated the associations of TVSE time and the SDQ score, although other covariates had negligible impact (see Table 3). In addition, we performed logistic regression analyses to examine if TVSE time and physical activity were associated with abnormal SDQ scores ($\geq$16). In fully adjusted models, the highest TVSE time group was associated with increased odds of abnormally high psychological distress (odds ratio: 1.45 [95% CI: 0.94–2.25]) in comparison with the lowest TVSE group. The lowest physical activity group was also associated with increased odds of abnormally high psychological distress (odds ratio: 1.64 [95% CI: 1.02–2.61]) in comparison with the highest physical activity group.

In additional analyses we examined the interaction of TVSE time and physical activity level on the SDQ score. There was a significant additive interaction between TVSE time and physical activity ($P < .001$). Under a linear model, these results reflect an additive interaction, displayed in a “joint effects” approach. Table 4 presents adjusted regression coefficients for each group in comparison with the reference group (high TVSE/low physical activity). Figure 1 demonstrates that the highest SDQ scores were in the most sedentary children with the highest TVSE times. In fact, higher TVSE exposure (>2.7 hours/day) alone resulted in a 24% increase in the SDQ score in comparison with lower TVSE exposure (<1.6 hours/day), although when combined with low physical activity this resulted in a 46% increased score.

**DISCUSSION**

The main findings from this study demonstrate that TVSE time and physical activity level are independently associated with psychological distress in young children. In addition, higher levels of TVSE time and low physical activity levels interact to increase psychological distress. Although TVSE time and physical activity were inversely associated, the results suggest that these factors operate independently and also synergistically to increase risk. Our findings are consistent with previous research that showed independent effects of sedentary behavior and physical activity on the SDQ total difficulties score in 13- to 16-year-old adolescents.9 Previous studies in children aged 4 to 12 years have shown positive associations of physical activity with male gender, self-efficacy, parental physical activity, and parental support,18 although we are unaware of any studies to date that have examined physical activity and psychological distress in this age group. Therefore, the present study extends existing knowledge in this area.

There is accumulating evidence for an adverse effect of TVSE viewing on the mental health and behavior of young people.27,28 Several interventions designed to reduce children’s exposure to TVSE have demonstrated encouraging effects, such as a reduction in aggressive behavior.4 In another controlled trial, reduced TVSE

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**TABLE 1** Characteristics of the Sample With Reference to TVSE Time

<table>
<thead>
<tr>
<th>Variable (Mean ± SD)</th>
<th>TVSE Thirds (min/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bottom (≥98.5)</td>
</tr>
<tr>
<td></td>
<td>(N = 490)</td>
</tr>
<tr>
<td>Age, y</td>
<td>7.9 ± 2.3</td>
</tr>
<tr>
<td>Gender, male, %</td>
<td>41.2</td>
</tr>
<tr>
<td>Top deprivation quintile, %</td>
<td>15.1</td>
</tr>
<tr>
<td>Single parents, %</td>
<td>29.6</td>
</tr>
<tr>
<td>Sessions per week of sport and active play</td>
<td>8.0 ± 3.6</td>
</tr>
<tr>
<td>With medical condition, %</td>
<td>22.0</td>
</tr>
<tr>
<td>Fruit and vegetable intake (portions/day)</td>
<td>2.9 ± 2.0</td>
</tr>
<tr>
<td>Daily sweet and confectionary intake, %</td>
<td>52.1</td>
</tr>
<tr>
<td>Daily fizzy drinks intake, %</td>
<td>39.5</td>
</tr>
</tbody>
</table>

a The highest and medium TVSE groups were significantly different from the lowest ($P < .05$).
b The highest TVSE exposure group was significantly different from the lowest ($P < .05$).

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**TABLE 2** Mean SDQ Score in Relation to TVSE Time and Physical Activity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean SDQ Score (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVSE time (min/d)</td>
<td>Unadjusted</td>
</tr>
<tr>
<td>Low (&lt;89.5)</td>
<td>7.53 (7.03–8.03)</td>
</tr>
<tr>
<td>Medium (98.6–162.8)</td>
<td>7.65 (7.18–8.13)</td>
</tr>
<tr>
<td>High (&gt;162.8)</td>
<td>9.29 (8.77–9.81)</td>
</tr>
<tr>
<td>Physical activity (sessions per week, ≥15 min)</td>
<td>7.61 (7.08–8.13)</td>
</tr>
<tr>
<td>High (&gt;10/wk)</td>
<td>8.14 (7.03–8.03)</td>
</tr>
<tr>
<td>Medium (7–9/wk)</td>
<td>8.57 (8.06–9.08)</td>
</tr>
</tbody>
</table>

Adjustment was made for psychosocial factors (deprivation index quintiles, single-parent status), age, gender, medical conditions, dietary intake, and mutually for either TVSE time or physical activity.
time and increased physical activity resulted in improved levels of self-efficacy in French adolescents, although it was not clear if an increase in activity or reduction in sedentary time was responsible for these effects. Exposure to TVSE has been shown to cause various physiologic responses in children, such as arousal of the central nervous system, and can also affect sleep patterns. These mechanisms might partly account for the psychological disturbances associated with TVSE exposure. Physical activity is associated with better brain health possibly by altering the metabolism of various neurotransmitters and enhancing growth factors. In a previous study, cardiovascular autonomic responses to playing a computer game differed in physically trained compared with untrained preadolescent boys. Thus, physical activity may alter psychophysiological responses to TVSE exposure and partly reduce the risk of psychological ill effects.

The limitations of the present study should be recognized. Given the cross-sectional nature of this study, we cannot exclude the possibility that the present results are explained by reverse causality or confounding from unmeasured variables, such as overall quality of diet. For example, parents might allow poorly behaved children to spend more time viewing TVSE as a means of regulating their behavior. An increase in television viewing, which is presumably the larger component of TVSE, may result in increased consumption of fast food and calorie-dense snacks. Poor dietary habits have been shown to adversely affect mental wellbeing.

![Figure 1](image_url)

**Figure 1**
Association between psychological distress, TVSE time, and physical activity. Gray bars represent the lowest TVSE time, black bars represent the medium TVSE time, and white bars represent the highest TVSE time.

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**Table 3**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate, $\beta$ (95% CI)</th>
<th>Model 1, $\beta$ (95% CI)</th>
<th>Model 2, $\beta$ (95% CI)</th>
<th>Model 3, $\beta$ (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVSE time (min/d)</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low ($\leq98.5$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium ($98.6–162.8$)</td>
<td>0.13 ($-0.56$ to $0.81$)</td>
<td>0.13 ($-0.55$ to $0.82$)</td>
<td>0.29 ($-0.36$ to $0.94$)</td>
<td>0.21 ($-0.44$ to $0.87$)</td>
</tr>
<tr>
<td>High ($&gt;162.8$)</td>
<td>1.76 (1.05 to 2.48)*</td>
<td>1.71 (0.99 to 2.42)*</td>
<td>1.32 (0.63 to 2.02)*</td>
<td>1.17 (0.47 to 1.87)*</td>
</tr>
<tr>
<td>Physical activity (sessions per week, $\geq15$ min)</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High ($\geq10$/wk)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium ($7–9$/wk)</td>
<td>0.53 ($0.17$ to $1.23$)</td>
<td>0.49 ($0.21$ to $1.18$)</td>
<td>0.44 ($0.21$ to $1.10$)</td>
<td>0.39 ($0.27$ to $1.04$)</td>
</tr>
<tr>
<td>Low ($\leq6$/wk)</td>
<td>0.97 (0.23 to 1.70)*</td>
<td>0.79 (0.06 to 1.52)*</td>
<td>1.12 (0.42 to 1.81)*</td>
<td>1.06 (0.35 to 1.76)*</td>
</tr>
</tbody>
</table>

Model 1 was mutually adjusted for TVSE time and physical activity. Model 2 was further adjusted for psychosocial factors (deprivation index quintiles, single-parent status), age, gender, and medical conditions. Model 3 was further adjusted for dietary intake.

* $P < .05$. The values represent differences in SDQ scores compared with the reference group.

**Table 4**

<table>
<thead>
<tr>
<th>TVSE Group</th>
<th>Physical Activity Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>Reference</td>
</tr>
<tr>
<td>Medium</td>
<td>-1.81 ($-2.94$ to $-0.67$)*</td>
</tr>
<tr>
<td>Low</td>
<td>-2.63 ($-3.82$ to $-1.45$)*</td>
</tr>
</tbody>
</table>

The values represent differences in SDQ scores ($\beta$ regression coefficients) compared with the reference group.

* All regression coefficients were adjusted for deprivation index, single-parent status, age, gender, medical conditions, and dietary intake markers.

* $P < .05$ compared with referent.
teenager’s activity,9 and we have also reported evidence for convergent validity of the physical activity measures used in the present study. Therefore, our findings should be replicated and extended by using objective measures of physical activity. We did not specifically examine if the content or context of TVSE might have influenced SDQ scores independently of viewing time, which might be an important factor.7–10

CONCLUSIONS
Given that high TVSE time and low physical activity both independently predicted abnormally high SDQ scores, our results might be clinically meaningful and have relevance for practitioners. This is the first study, to our knowledge, to demonstrate that higher levels of TVSE and low physical activity interact to increase psychological distress in younger children (aged 4–12 years). Measured physical activity seems to decrease significantly between the ages of 9 and 15.14 Because physical activity levels in adolescence also predict mental health in adulthood,15 public health policy should focus on reducing sedentary time and maintaining sufficient physical activity levels in younger children.

ACKNOWLEDGMENTS
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REFERENCES
THE VALIDITY OF TEENS’ AND YOUNG ADULTS’ SELF-REPORTED CONDOM USE

“Objective: To examine the concordance between teens’ and young adults’ self-reported condom use, assessed by audio-computer-assisted self-interviewing, and Y-chromosome polymerase chain reaction (Yc-PCR) assay, a nondisease marker for detecting the presence of sperm in vaginal fluid for 14 days after unprotected vaginal sex.

Design: Randomized trial of a human immunodeficiency virus prevention program. Only data from baseline (before randomization) were used for this analysis.

Setting: A clinic-based sample in Atlanta, Georgia.

Participants: Eligible teens and young adults were African-American female teens and young adults 15–21 years old who had reported sexual activity in the previous 60 days. Of 1558 teens and young adults screened from March 1, 2002, through August 31, 2004, 847 were eligible and 715 (84.4%) participated at baseline.

Main Outcome Measures: Self-reported consistent condom use in the 14 days before baseline and Yc-PCR results.

Results: Of participants who reported vaginal sex in the past 14 days, 186 reported consistent condom use, defined as 100% condom use. Of these, 63 had a positive Yc-PCR result, indicating detection of the Y chromosome in the vaginal fluid. Participants who reported consistent condom use with a self-reported history of sexually transmitted diseases were 2.4 times more likely to have a positive Yc-PCR result (adjusted odds ratio, 2.4; 95% confidence interval, 1.2–4.8; P=.01.)”


Noted by JFL, MD