Setting the Stage for Good Health: The Impact of Sleep, Activity, and Eating Behaviors in Childhood

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Trondheim - the old Norse Þróndheimr: “Home of the strong and fertile ones”
• Approx. 210 000 inhabitants
• Every sixth inhabitant a student
Norwegian University of Science and Technology (NTNU)
Two cohorts (2003/2004)
4-year olds
N = 3456

Health check up
Informed consent
N = 2475

Drawn to participate
N = 1250
Cohort Profile: The Trondheim Early Secure Study (TESS)—a study of mental health, psychosocial development and health behaviour from preschool to adolescence

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The Trondheim Early Secure Study

Mental health

School

Body composition, eating, physical activity

Pain

Marginalization, social exclusion

Social media, gaming

Sleep

Norwegian University of Science and Technology
Sleep, activity and eating behavior

Stability of Sleep Disorders From Preschool to First Grade and Their Bidirectional Relationship with Psychiatric Symptoms
Sijie Steinsbekk, PhD,‡† Lars Wichstrom, PhD‡‡

ABSTRACT: Objectives: To examine the prevalence and stability of DSM-IV-defined sleep disorders from preschool to first grade and to explore the bidirectional relationship between sleep disorders and symptoms of psychiatric disorders. Methods: All children born in 2003 or 2004 in Trondheim, Norway, who attended regular nursery schools, were invited to participate (97.7% attendance). At ages 3, 5, and 6 years, the parents were asked to complete a postal questionnaire of children's sleep habits and psychiatric symptoms. Results: Sleep disorders decreased from preschool to first grade, with a higher rate of outbursts during the night at age 3. The parents' mental health was associated with the children's sleep habits in preschool but not in first grade. Conclusions: Sleep disorders are common among preschool children, and the parents' mental health may be a risk factor for sleep disorders in preschool children. Further research is needed to explore the relationship between sleep disorders and psychiatric symptoms in early childhood.

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Emotional Over- and Undereating in Children: A Longitudinal Analysis of Child and Contextual Predictors
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Predictors of Eating Behavior in Middle Childhood: A Hybrid Fixed Effects Model
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Lars Wichstrom, Norwegian University of Science and Technology

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Parental Feeding and Child Eating: An Investigation of Reciprocal Effects
Measures

Sleep length, physical activity, sedentary behavior

Eating behavior, feeding practices (+ e.g. self-esteem, sports, outdoor activities)

Mental health, sleep disorder symptoms, relationships, social media use, gaming etc.

Body composition, weight/height/BMI

Norwegian University of Science and Technology
Sleep, activity and eating behavior

• What is the prevalence of insufficient sleep and insomnia?
• Does it persist or change? Do we need to intervene?
• Does it affect mental health?
• Can physical activity protect against depressive symptoms and unhealthy weight gain?
• Does internet gaming predict decreased levels of physical activity and increased sedentariness?
• How can parents promote healthy eating behaviors in their offspring?
• How is eating behavior related to changes in BMI?
Prevalence and stability of insufficient sleep and insomnia

• The prevalence and stability of objectively measured insufficient sleep and diagnostically defined insomnia throughout childhood is unknown

• Does it persist or change? Do we need to intervene?

• Insufficient sleep: < 7 h

• Insomnia:
  – Diagnostic and Statistical Manual of Mental Disorders (DSM 5)
  – Clinically significant distress or daytime impairment due to difficulties initiating and/or maintaining sleep and/or early-morning awakenings with an inability to return to sleep
Prevalence and stability of insufficient sleep and insomnia

NSF: 9-11 h, age 6-13, <7 not recommended

Table 2. Averaged sleep duration, prevalence of averaged insufficient sleep and number of nights with insufficient sleep.

<table>
<thead>
<tr>
<th>Sleep duration (minutes), mean (SD)</th>
<th>Age 6 years</th>
<th>Age 8 years</th>
<th>Age 10 years</th>
<th>Age 12 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF: 9-11 h, age 6-13, &lt;7 not recommended</td>
<td>9.7 h</td>
<td>9.2 h</td>
<td>9.0 h</td>
<td>8.7 h</td>
</tr>
</tbody>
</table>

Prevalence and stability of insufficient sleep and insomnia

- Insomnia was found in approx. one in ten children at ages 8, 10, 12 and 14 years of age

- Middle childhood: Male preponderance; Adolescence: Female preponderance

- Insomnia was moderately stable, those having insomnia were more likely to have insomnia two years later (23-40%).

What predicts unhealthy sleep?

**Table 5** Predictors of Probability of Belonging to a Class of Short Sleepers. Linear Regression Model Testing Association Between Covariates and Probability of Being a Short Sleeper

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Standardized Regression Coefficient $\beta$</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative affectivity of child</td>
<td>0.08</td>
<td>0.01, 0.15</td>
<td>0.03</td>
</tr>
<tr>
<td>Emotional availability of parent</td>
<td>-0.09</td>
<td>-0.18, -0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Victimization from bullying</td>
<td>0.01</td>
<td>-0.10, 0.11</td>
<td>0.88</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>-0.01</td>
<td>-0.09, 0.07</td>
<td>0.90</td>
</tr>
<tr>
<td>Boy</td>
<td>0.09</td>
<td>0.02, 0.17</td>
<td>0.01</td>
</tr>
<tr>
<td>Emotional problems</td>
<td>-0.03</td>
<td>-0.27, 0.20</td>
<td>0.77</td>
</tr>
<tr>
<td>Behavioral problems</td>
<td>-0.09</td>
<td>-0.18, 0.35</td>
<td>0.52</td>
</tr>
</tbody>
</table>

- Within-person effects, 4-14 years: Previous insomnia, emotional reactivity, and emotion regulation, but not family factors (family functioning and marital conflicts) significantly predicted future insomnia.

Sleep and mental health

• Long-term relations between obj.m sleep-time, diagnostically defined sleep disorders and psychiatric symptoms in childhood is unknown

• Findings:
  – 4-6 years: Insomnia psychiatric symptoms
  – Within-person effects, 6-12 years: Short sleep ass. with
    • increased risk of future symptoms of emotional disorders
    • increased risk of future symptoms of behavioral disorders – boys

Physical activity and mental health

• Does moderate-to-vigorous physical activity (MVPA) protect against future symptoms of depression and does depression predict less MVPA over time?

• Is sedentariness forecasted by depressive symptoms or vice versa?

• Data waves: age 6, 8, and 10 years

Physical activity and mental health

![Diagram showing the relationship between sedentary behavior, moderate-to-vigorous physical activity (MVPA), and symptoms of major depressive disorder (MDD) over 6, 8, and 10 years.]

Note: Only significant paths are displayed. MVPA: moderate-to-vigorous physical activity; MDD: major depressive disorder

Can PA protect against unhealthy weight gain?

- To inform health policies, health promotion, and obesity prevention programs, the relationships among PA, sedentary time (ST) and obesity need to be established
- PA/ST predict body fat or the other way around?
- Gender differences?

- Data waves: age 6, 8, 10, 12, 14 years
- Within-person effects

Can PA protect against unhealthy weight development?

Boys

• Higher levels of body fat predicted lower levels of PA and increasing ST over time

• Age 12 to 14 years, not earlier:
  ↑ PA predicted ↓ Body fat

Girls

• No relations between PA; ST and body fat
Predictors of physical activity

• PA and especially moderate to vigorous physical activity (MVPA) has a range of health benefits and track from childhood to adulthood

• To promote MVPA in childhood, multilevel factors affecting MVPA need to be identified

## Predictors of physical activity

<table>
<thead>
<tr>
<th>Predictors</th>
<th>$B$ (95% C.I.)</th>
<th>$\beta$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHILD FACTORS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (%, boys)</td>
<td>13.11 (15.61, 10.61)</td>
<td>0.27</td>
<td>0.001</td>
</tr>
<tr>
<td>Child’s outdoor time, hours per day</td>
<td>1.21 (0.61, 1.81)</td>
<td>0.08</td>
<td>0.001</td>
</tr>
<tr>
<td>Number of sports activities</td>
<td>0.98 (-0.15, 2.10)</td>
<td>0.02</td>
<td>0.09</td>
</tr>
<tr>
<td>Screen time, hours per day</td>
<td>-1.00 (-2.44, 0.44)</td>
<td>-0.04</td>
<td>0.17</td>
</tr>
<tr>
<td>Athletic self-concept (1–5)</td>
<td>0.23 (-0.03, 0.48)</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>0.10 (-0.08, 0.28)</td>
<td>0.04</td>
<td>0.29</td>
</tr>
<tr>
<td>Fat (kg)</td>
<td>-0.22 (-0.68, 0.24)</td>
<td>-0.04</td>
<td>0.35</td>
</tr>
<tr>
<td>Sedentary time, hours per day</td>
<td>-0.15 (-0.18, -0.13)</td>
<td>-0.43</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>FAMILY FACTORS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother’s MVPA, min per day</td>
<td>0.00 (-0.03, 0.03)</td>
<td>0.00</td>
<td>0.93</td>
</tr>
<tr>
<td>Father’s MVPA, min per day</td>
<td>0.00 (-0.02, 0.02)</td>
<td>0.01</td>
<td>0.77</td>
</tr>
<tr>
<td>Parents outdoors with child, hours per day$^a$</td>
<td>0.98 (-0.54, 2.49)</td>
<td>0.04</td>
<td>0.21</td>
</tr>
<tr>
<td>Active transportation to school, days per week</td>
<td>0.24 (-0.34, 0.81)</td>
<td>0.02</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>CONTEXTUAL FACTORS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic status (1–6)</td>
<td>1.00 (-0.07, 2.08)</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Time to ballpark (1–8)</td>
<td>0.88 (-0.06, 1.83)</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Time to other recreational area (1–8)</td>
<td>0.11 (-1.19, 1.41)</td>
<td>0.00</td>
<td>0.87</td>
</tr>
<tr>
<td>Traffic safety (1–4)</td>
<td>2.46 (0.88, 4.05)</td>
<td>0.07</td>
<td>0.002</td>
</tr>
<tr>
<td>Garden (0 = No, 1 = Yes)</td>
<td>6.76 (2.59, 10.97)</td>
<td>0.08</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Hybrid fixed and random effects model. MVPA, Moderate and Vigorous Physical Activity.  
$^a$Parents outside with child was only measured when children were 6 and 8 years of age, as parents spend less time outside with their offspring with increased age.
Internet gaming and physical activity

Does gaming predict less PA? Gender differences?

Fig. 4. Within-Person Unstandardized Estimates from the Random Intercept Model of Boys. Nonsignificant Paths and Cross-Sectional Correlations are Omitted.

Note. *p < .05, **p < .01.

Eating behavior

- Are you picky or do you truly enjoy food?
- Do you eat fast or slowly?
- Do you empty your plate even though you’re full?
- Do you use food to soothe negative emotions?
Can parents promote healthy eating?

• The most powerful socialization agents affecting young children’s eating behavior

• Findings
  – Using food as reward → Food responsiveness, Emotional overeating
  – Restrained eating → Food responsiveness
  – Emotional feeding ← Emotional overeating
  – Less parental structuring ← Emotional overeating, picky eating

Eating behavior and BMI

• Some eating behaviors are associated with increased risk of childhood obesity and are thus potential targets for obesity prevention. However, longitudinal research, especially on older children and adolescents, is needed to substantiate such a claim.

• Bidirectionally related?

• Data waves: Age 6, 8, 10, 12 and 14 years

• Within-person vs between-person effects (ALT-SR)

Eating behavior and BMI

• Change in eating behavior did not predict change in BMI at any time point

• Increases in BMI:
  – more food responsiveness, emotional overeating (all time points)
  – more enjoyment of food (age 8-10, 10-12)
  – decreased satiety responsiveness (age 8-10, 10-12, 12-14)
  – decreased emotional undereating (age 12-14)

Increased BMI ➔ More ‘obesogenic’ eating behavior
The Impact of Sleep, Activity, and Eating Behaviors in Childhood - TESS findings

• Short sleep negatively impacts mental health

• Physical activity can protect against depressive symptoms, but not against increased body-fat

• Eating behavior does not predict increased body fat from age 6 to 14, but increased body fat predicts more ‘unhealthy’ eating behavior
Future studies

• YouthHealth – Physical Activity and Eating in the Transition from Childhood to Emerging Adulthood
• Funded by the Norwegian Research Council (NOK12 mill /$1,2 mill)

• TESS + ALSPAC (UK) + Generation R (The Netherlands)
Future studies

What is not known and will be tested are:

(i) how these individual pieces (of the model) interact to form the bigger picture (i.e., an ecological perspective acknowledging different layers of influence) impacting PA and eating, and how PA may influence eating; in the (ii) crucial transition from childhood to emerging adulthood, (iii) whether initially identified pathways hold once all unmeasured time-invariant and measured time-varying confounders are adjusted for, and (vi) whether they differ across nations.
Acknowledgement
Our brilliant research assistants. Our Gold.
Thank you for your attention!