



NTNU – Trondheim
Norwegian University of
Science and Technology

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

Silje Steinsbekk

Professor of clinical child,- and adolescent psychology

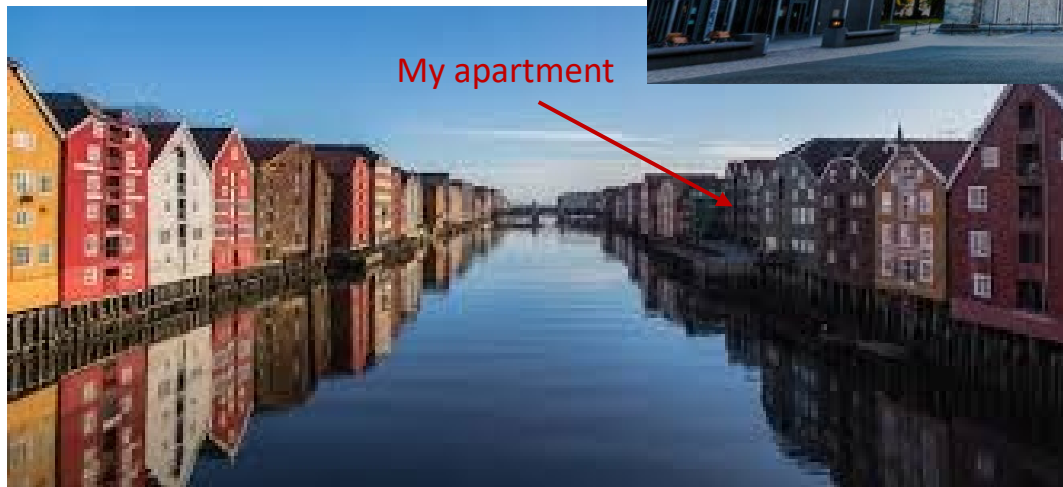
Co-PI, The Trondheim Early Secure Study (TESS)

Dept. of Psychology

Norwegian University of Science and Technology



Nidaros Cathedral



- Trondheim - the old Norse Þrónðheimr: “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

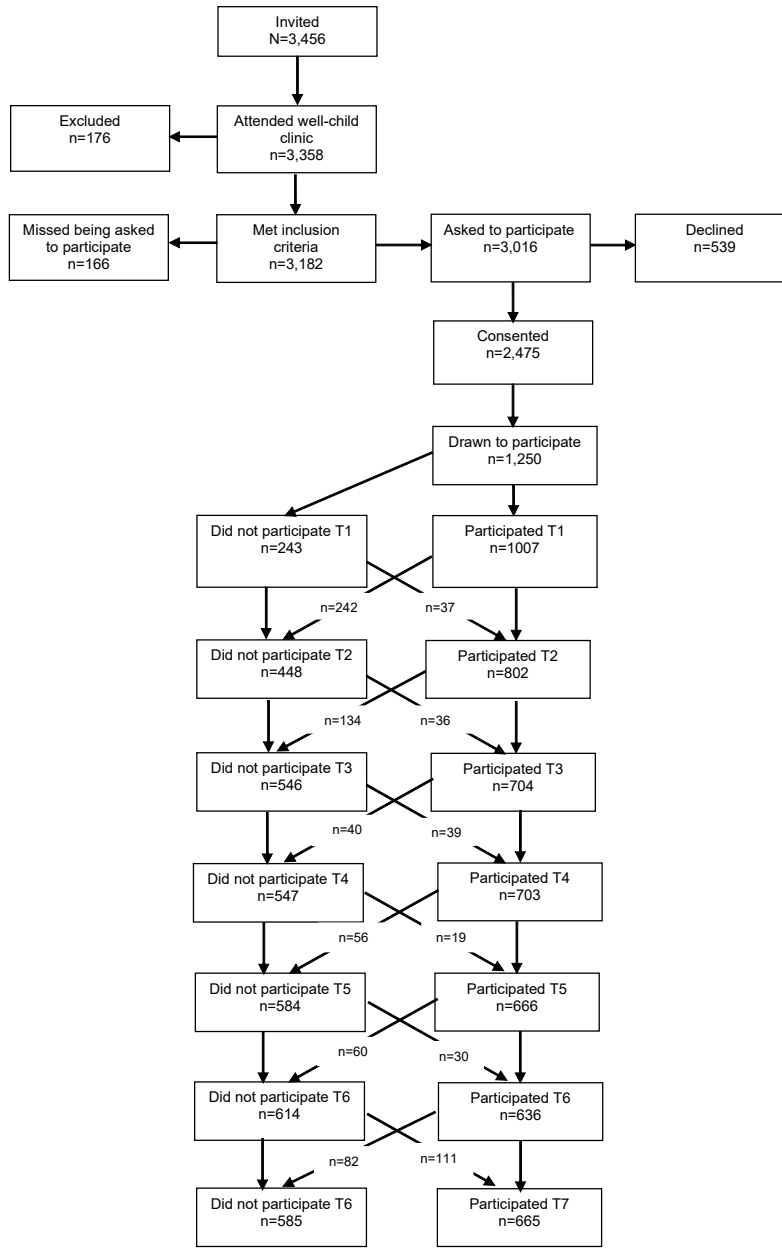
N = 3456

**Health check up
Informed consent
N=2475**

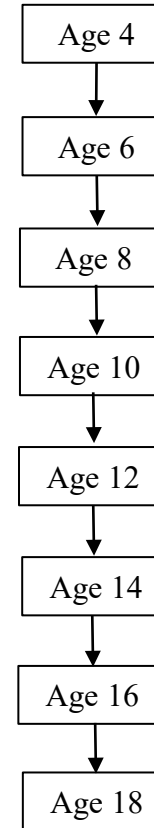
**Drawn to
participate
N=1250**



The Trondheim Early Secure Study (TESS)



The Trondheim Early Secure Study (TESS)




← Ongoing data collection



Cohort Profile

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

Silje Steinsbekk ^{1*} and Lars Wichstrøm^{1,2,3}

¹Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway,

²NTNU Social Science, Trondheim, Norway and ³Department of Child and Adolescent Psychiatry, St Olavs Hospital, Trondheim, Norway

*Corresponding author. Department of Psychology, Norwegian University of Science and Technology, 7491 Trondheim, Norway. E-mail: silje.steinsbekk@ntnu.no

The Trondheim Early Secure Study



Mental health

School



Body composition, eating, physical activity

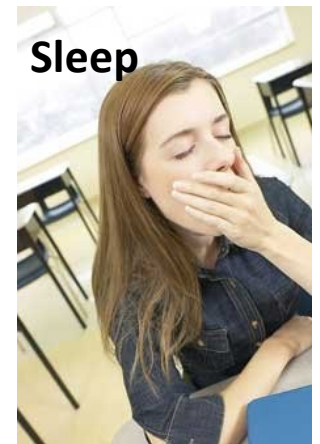
Pain



Marginalization, social exclusion



Social media, gaming



Sleep

Sleep, activity and eating behavior

CHILD DEVELOPMENT

Child Development, xxxx 2018, Volume 00, Number 0, Pages 1–36

Emotional Over- and Under-eating in Children: A Longitudinal Analysis of Child and Contextual Predictors



© 2018 American Psychological Association
0893-3200/18/\$12.00

Developmental Psychology
2018, Vol. 54, No. 6, 1099–1110
http://dx.doi.org/10.1037/dev0000034

Predictors of Eating Behavior in Middle Childhood:
A Hybrid Fixed Effects Model

Oda Bjørklund
Norwegian University of Science and Tech
St. Olavs Hospital, Trondheim,

CHILD DEVELOPMENT

Child Development, xxxx 2016, Volume 00, Number 0, Pages 1–12

Lars Wichstrøm
Norwegian University of Science and Tech
NTNU Social Research, Trondheim

Parental Feeding and Child Eating: An Investigation of Reciprocal Effects

Research

Original Investigation

Polygenic Risk, Appetite Traits,
and Weight Gain in Middle Childhood
A Longitudinal Study

CHILD DEVELOPMENT

Child Development, xxxx 2017, Volume 00, Number 0, Pages 1–13

Silje Steinsbekk, PhD, Daniel Belsky, PhD, Ismael C

Emotional Feeding and Emotional Eating: Reciprocal Processes and the Influence of Negative Affection

Steinsbekk et al. *International Journal of Behavioral Nutrition and Physical Activity* (2017) 14:87
DOI 10.1186/s12966-017-0542-7

International Journal of Behavioral
Nutrition and Physical Activity

ward D. Barker
g's College, London

RESEARCH

Open Access

Child and parent predictors of picky eating
from preschool to school age

Open Access

Alison Fildes
University of Leeds

Silje Steinsbekk¹, Arielle Bonneville-Roussy², Alison Fildes³, Clare H. Llewellyn⁴, and Lars Wichstrøm^{1,5}

Predictors of Change in BMI From the Age of
4 to 8

Silje Steinsbekk,¹ PhD, and Lars Wichstrøm,^{1,2} PhD

NTNU Social Science

RESEARCH

Open Access

Body composition impacts appetite
regulation in middle childhood. A
five study of Norwegian

Open Access

Appetite



Contents lists available at ScienceDirect
Appetite
journal homepage: www.elsevier.com/locate/appet

Temperament as a predictor of eating behavior in middle childhood – A fixed effects approach

Silje Steinsbekk^{1,2}, Oda Bjørklund^{3,4}, Clare Llewellyn⁵, Lars Wichstrøm^{1,6}

¹Department of Psychology, Norwegian University of Science and Technology (NTNU), Dragvoll, 7015, Trondheim, Norway
²Department of Child and Adolescent Psychiatry, St Olav's University Hospital, 7020, Trondheim, Norway

International Journal of Obesity

www.nature.com/ijo

ARTICLE

Pediatrics

Relations between physical activity, sedentary time, and body fat from childhood to adolescence: Do they differ by sex?

Torje Zahl-Thønen¹, Lars Wichstrøm^{1,2} and Silje Steinsbekk^{1,3}

© The Author(s), under exclusive licence to Springer Nature Limited 2022

BACKGROUND: Efforts to reveal the direction of influence between physical activity (PA), sedentary time (ST) and body fat in youth have produced inconsistent results, possibly due to a lack of adjustment for confounders and other factors. Sex-specific associations have rarely been studied.

Predictors of Physical Activity in Middle Childhood. A Fixed-Effects Regression Approach

Torje Zahl-Thønen^{1,2*}, Silje Steinsbekk^{1,2} and Lars Wichstrøm^{1,2}

¹NTNU Social Research, Trondheim, Norway; ²Department of Psychology, Norwegian University of Science and Technology

the age of 6–14
idence
as found that
8–10 years: B =
0.52, –0.06),
0.9% CI –0.24,
CI 0.02–0.3); 8–10
revealed
ining moderate
adulthood. The
in FMI and PA or

Physical Activity, Sedentary
Behavior, and Symptoms of Major
Depression in Middle Childhood

Torje Zahl, MSc,^{1,2} Silje Steinsbekk, PhD,^{1,2} Lars Wichstrøm, PhD^{1,2}

Prospective relation between physical activity and *Diagnostic and Statistical Manual* (DSM)-defined major depression in middle childhood is unknown, and the stability of depression. We therefore aimed to (1) determine whether there are reciprocal relations between moderate-to-vigorous physical activity (MVPA) and sedentary

Computers in Human Behavior 132 (2022) 107252

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh



Longitudinal relations between gaming, physical activity, and athletic self-esteem*

Beate W. Hygen^{1,2,3}, Jay Belsky⁴, Frode Stenseng^{1,4}, Silje Steinsbekk^{1,2}, Lars Wichstrøm^{1,2,5}, Vera Skalicka⁶

Preventive Medicine Reports 27 (2022) 101795

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/medr



The prospective relation between eating behaviors and BMI from middle childhood to adolescence: A 5-wave community study

Stability of Sleep Disorders From Preschool to First Grade and Their Bidirectional Relationship with Psychiatric Symptoms

Silje Steinsbekk, PhD,¹ Lars Wichstrøm, PhD^{1,2}

ABSTRACT: Objectives: To examine the prevalence and stability of DSM-4–defined sleep disorders from preschool to first grade and to explore the bidirectional relationship between sleep disorders and symptoms of psychiatric disorders. Method: All children born in 2003 or 2004 in Trondheim, Norway, who attended regular community health checkups for 4-year-olds, were invited to participate (97.2% attendance; 82.0% consent rate, n = 7476). This article reports a cross-sectional subsample of 1360 children.

Nature and Science of Sleep

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Persistent Short Sleep from Childhood to Adolescence: Child, Parent and Peer Predictors

This article was published in the following Dove Press journal:
Nature and Science of Sleep

Bror M. Ranum¹

Children: Many children have periods when they sleep too little, with widely recognized

POPULATION STUDY ARTICLE OPEN

Prevalence and stability of insufficient sleep measured by actigraphy: a prospective community study

Bror M. Ranum¹, Lars Wichstrøm^{2,3}, Ståle Pallesen⁴ and Silje Steinsbekk^{1,2}

Original Article

Sleep Disorders in Preschoolers: Prevalence and Comorbidity with Psychiatric Symptoms

Silje Steinsbekk, PhD,¹ Turid S. Berg-Nielsen, PhD,² Lars Wichstrøm, PhD³

JAMA Network | Open

Original Investigation | Pediatrics

Association Between Objectively Measured Sleep Duration and Symptoms of Psychiatric Disorders in Middle Childhood

Bror M. Ranum, MD, PhD; Lars Wichstrøm, PhD; Ståle Pallesen, PhD; Jonas Falch-Madsen, MD, PhD; Marte Halse, MD, PhD; Silje Steinsbekk, PhD

BMJ Paediatrics Open

Prevalence and stability of insomnia from preschool to early adolescence: a prospective cohort study in Norway

Sleep Medicine 87 (2021) 220–226

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep



Original Article

Child and family predictors of insomnia from early childhood to adolescence



Measures

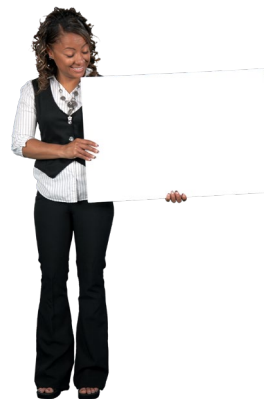


Eating behavior, feeding practices (+ e.g. self-esteem, sports, outdoor activities)



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

Sleep length, physical activity, sedentary behavior



Body composition, weight/height/BMI

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

9,7 h

9,2 h

9,0 h

8,7 h

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

	Age 6 years	Age 8 years	Age 10 years	Age 12 years
Sleep duration (minutes), mean (SD)	579 (35)	550 (36)	539 (35)	519 (38)
Averaged insufficient sleep, % (95% CI)	1.1 (0.2–2.0)	3.9 (2.0–5.9)	4.2 (2.4–6.0)	13.6 (10.2–17.0)
Averaged <i>sufficient sleep</i> with one or more nights of insufficient sleep, % (95% CI)	15.1 (12.0–18.2)	39.1 (34.6–43.7)	45.7 (41.1–50.3)	64.5 (59.6–69.4)
Number of nights with insufficient sleep, no. (SD)	0.25 (0.67)	0.66 (0.98)	0.83 (1.13)	1.56 (1.53)

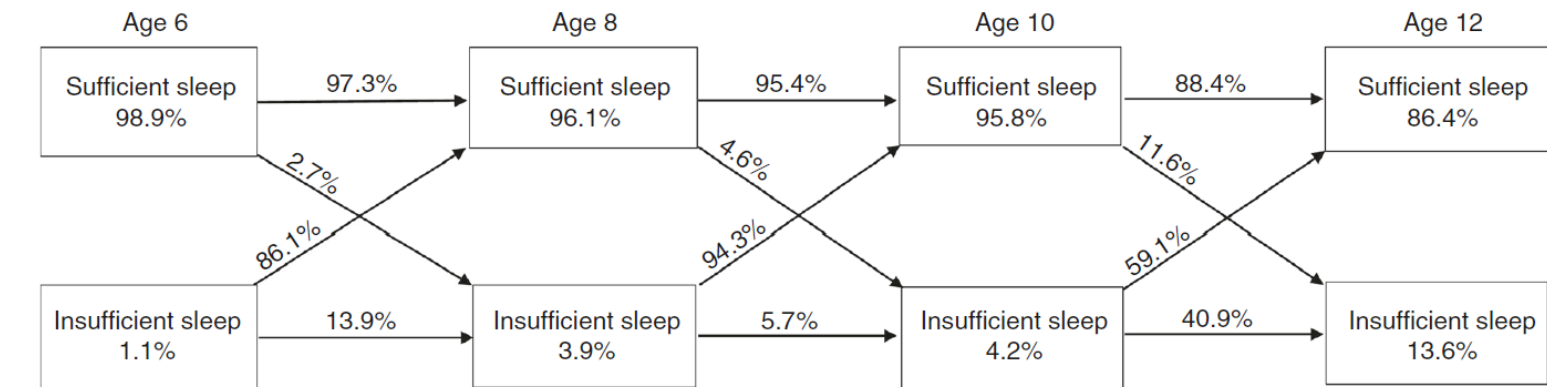


Fig. 2 Flowchart of children moving between averaged sufficient and insufficient sleep.

Ranum, B. M., Wichstrøm, L., Pallesen, S., Steinsbekk, S. (2020). Prevalence and stability of insufficient sleep measured by actigraphy: a prospective community study. *Pediatric Research*, <https://doi.org/10.1038/s41390-020-0768-y>

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%).

Falch-Madsen, J., Wichstrøm, L., Pallesen, S., Halse, B., Steinsbekk, S. (2020). Prevalence and stability of insomnia from preschool to early adolescence - a prospective cohort study in Norway. *BMJ Paediatrics Open*, 4: e000660. doi: 10.1136/bmjpo-2020-000660

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

	Standardized Regression Coefficient β	95% CI	P-value
Negative affectivity of child	0.08	0.01, 0.15	0.03
Emotional availability of parent	-0.09	-0.18, -0.01	0.04
Victimization from bullying	0.01	-0.10, 0.11	0.88
Socioeconomic status	-0.01	-0.09, 0.07	0.90
Boy	0.09	0.02, 0.17	0.01
Emotional problems	-0.03	-0.27, 0.20	0.77
Behavioral problems	-0.09	-0.18, 0.35	0.52

- 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.

Falch-Madsen, J., Wichstrøm, L., Pallesen, S., Ranum, B., Steinsbekk, S. (2021). Child and Family Predictors of Insomnia from Early Childhood to Adolescence. *Sleep Medicine*, doi.org/10.1016/j.sleep.2021.08.023; Ranum B.M., Wichstrøm L., Pallesen S., Falch-Madsen J., Steinsbekk S. (2021) Persistent Short Sleep from Childhood to Adolescence: Child, Parent and Peer Predictors. *Nat Sci Sleep*, 13:163-175. <https://doi.org/10.2147/NSS.S290586>; Falch-Madsen J., Wichstrøm L., Pallesen S., Jensen M.R., Bertheussen L., Solhaug S., Steinsbekk S. (2021). Predictors of diagnostically defined insomnia in child and adolescent community samples: A literature review, *Sleep Medicine*, <https://doi.org/10.1016/j.sleep.2021.09.003>;

Sleep and mental health

- Long-term relations between objectively measured sleep-time, diagnostically defined sleep disorders and psychiatric symptoms in childhood is unknown
- Findings:
 - 4-6 years: Insomnia \longleftrightarrow psychiatric symptoms
 - Within-person effects, 6-12 years: Short sleep associated with
 - increased risk of future symptoms of emotional disorders
 - increased risk of future symptoms of behavioral disorders – boys

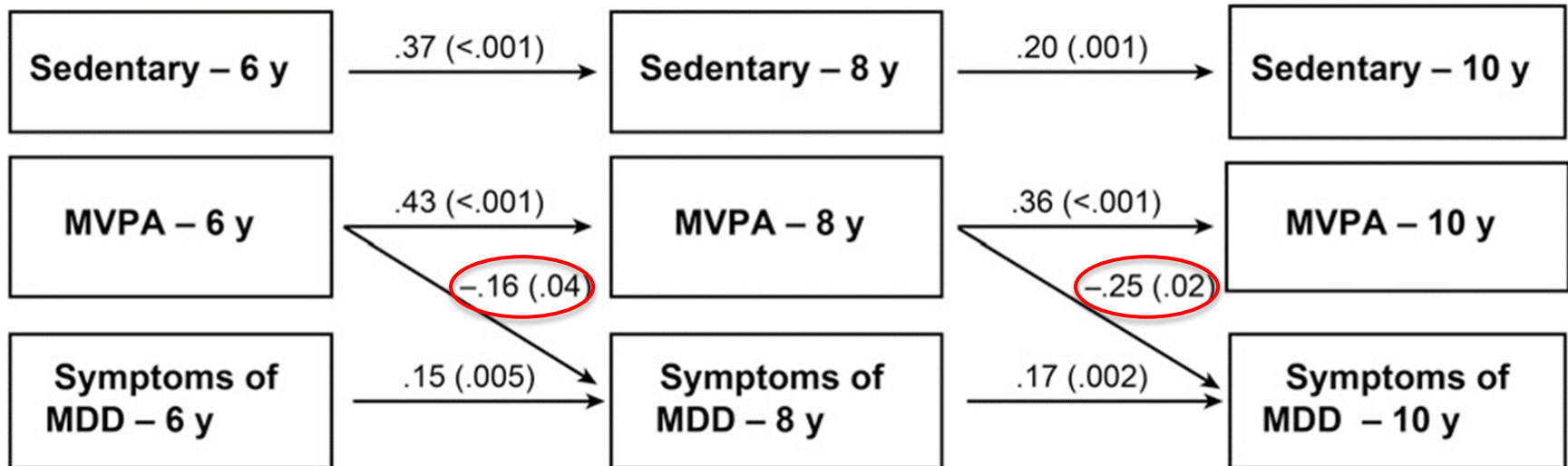
Ranum, B. M., Wichstrøm, L., Pallesen, S., Falch-Madsen, J., Halse, M., Steinsbekk, S. (2019). Association Between Objectively Measured Sleep Duration and Symptoms of Psychiatric Disorders in Middle Childhood. *JAMA Network Open*, 2(12), e1918281-e1918281; Steinsbekk, S. & Wichstrøm, L. (2015). Stability of sleep disorders from preschool to first grade and their bi-directional relationship with psychiatric symptoms. *Journal of Developmental and Behavioral Pediatrics*, 36(4):243-51; Steinsbekk, S. Berg-Nielsen, T. S., Wichstrøm, L. (2013). Sleep disorders in preschoolers: Prevalence and comorbidity with psychiatric symptoms. *Journal of Developmental and Behavioral Pediatrics*, 34 (9): 633-41, doi: 10.1097/01.DBP.0000437636.33306.49.

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

Zahl, T, Steinsbekk, S, & Wichstrøm, L. (2015). Physical activity, sedentary behavior, and symptoms of major depression in middle childhood. *Pediatrics*, 139, 2, e20161711, doi:0.1542/peds.2016-1711

Physical activity and mental health



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

Zahl, T, Steinsbekk, S, & Wichstrøm, L. (2015). Physical activity, sedentary behavior, and symptoms of major depression in middle childhood. *Pediatrics*, 139, 2, e20161711, doi:0.1542/peds.2016-1711

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

Zahl-Thanem T, Wichstrøm L, Steinsbekk S. Relations between physical activity, sedentary time, and body fat from childhood to adolescence: Do they differ by sex? *Int J Obes (Lond)*. 2022 Sep;46(9):1615-1623. doi: 10.1038/s41366-022-01156-6. Epub 2022 Jun 3. PMID: 35662270.

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

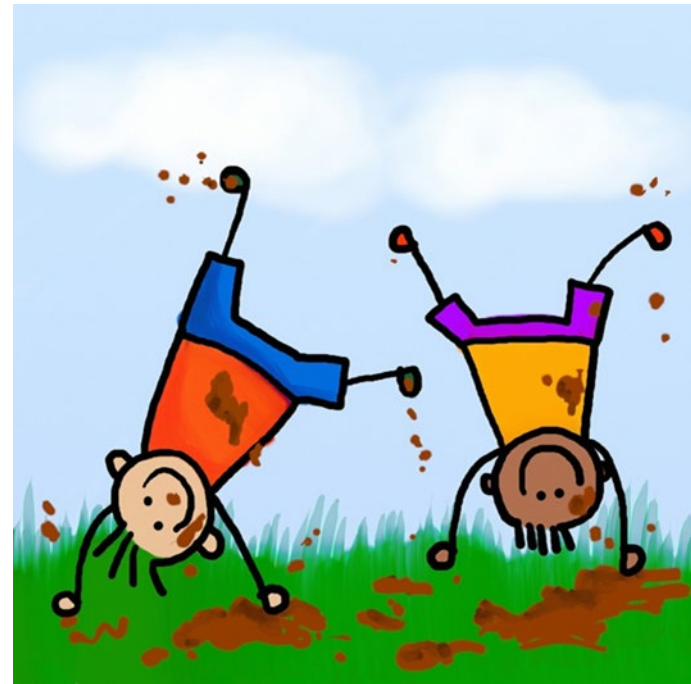
Zahl, T., Steinsbekk, S., Wichstrøm, L. (2018). Predictors of Physical Activity in Middle Childhood. *Frontiers in Public Health*. 24:6; 305. doi: 10.3389/fpubh.2018.00305

Predictors of physical activity

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

Hybrid fixed and random effects model. MVPA, Moderate and Vigorous Physical Activity.

^aParents 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?

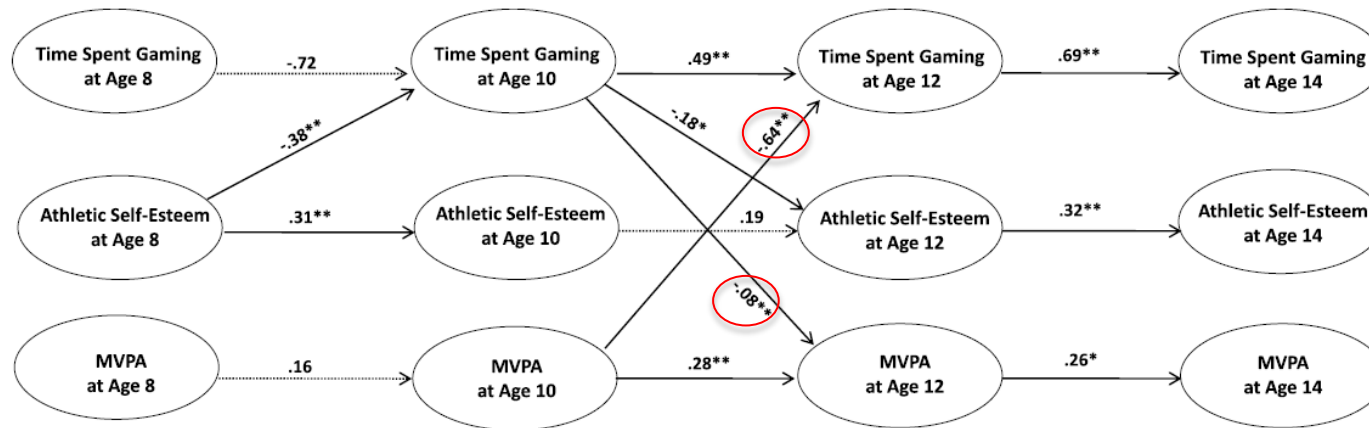


Fig. 4. Within-Person Unstandardized Estimates from the Random Intercept Model of Boys. Nonsignificant Paths and Cross-Sectional Correlations are Omitted. Note. $^*p < .05$, $^{**}p < .01$.

Hygen, B., W., Belsky, J., Stenseng, F., Steinsbekk, S., Wichstrøm, L., Skalicka, V. (2022). Longitudinal relations between gaming, physical activity, and athletic self-esteem, *Computers in Human Behavior*, 132, <https://doi.org/10.1016/j.chb.2022.107252>

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 sooth 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

Steinsbekk, Barker, E., Llewellyn, C., Fildes, A., Wichstrøm, L. (2018). Emotional Feeding and Emotional Eating: Reciprocal Processes and the Influence of Negative Affectivity. *Child Development*, 89, 4, 1234-1246. DOI: 10.1111/cdev.12756; **Steinsbekk S, Bjørklund O, Llewellyn C, Wichstrøm L. (2020).** Temperament as a predictor of eating behavior in middle childhood - A fixed effects approach. *Appetite*. Feb 22. doi:10.1016/j.appet.2020.104640; **Bjorklund, O., Belsky, J., Wichstrom, L, Steinsbekk, S. (2018).** Predictors of eating behavior in middle childhood: A hybrid fixed effects model. *Developmental Psychology*, 54, 6, 1099-1110. doi: 10.1037/dev0000504; **Bjørklund, O., Wichstrøm, L. Llewellyn, C., & Steinsbekk, S. (2018).** Emotional Over- and Undereating in Children: A Longitudinal Analysis of Child and Contextual Predictors. *Child Development*, 29. doi:10.1111/cdev.13110; **Steinsbekk, S., Bonneville, A., Fildes, A, Llewellyn, C., Wichstrøm, L. (2017).** Child and parent predictors of picky eating from preschool to school age. *International Journal of Behavioral Nutrition and Physical Activity (IJBNPA)*, 14, 87, doi: 10.1186/s12966-017-0542-7; **Steinsbekk, S., Belsky, D., J, Wichstrøm, L. (2016).** Parental Feeding and Child Eating: An Investigation of Reciprocal Effects. *Child Development*, 87(5):1538-49, doi: 10.1111/cdev.12546

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)

Bjørklund, O., Wichstrøm, L, Steinsbekk, S. (2022). The prospective relation between eating behaviors and BMI from middle childhood to adolescence: a 5-wave community study. Preventive Medicine Reports. <https://doi.org/10.1016/j.pmedr.2022.101795>

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)

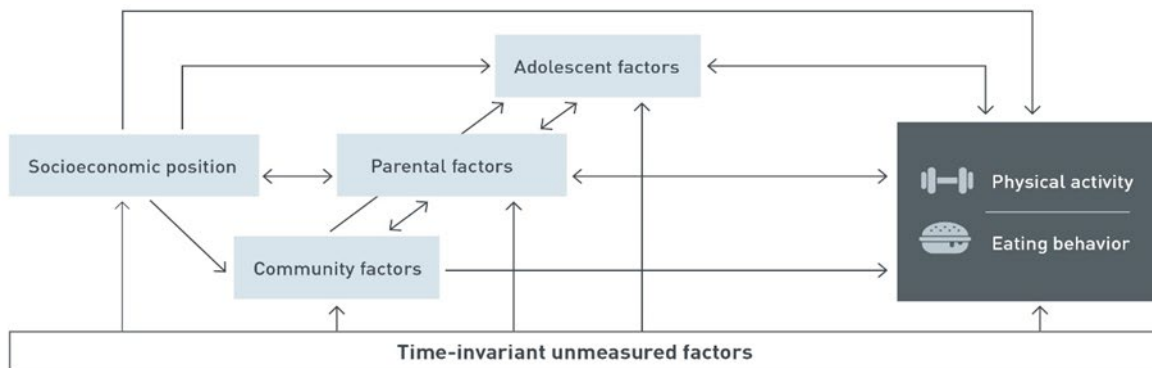
Increased BMI → More 'obesogenic' eating behavior

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:

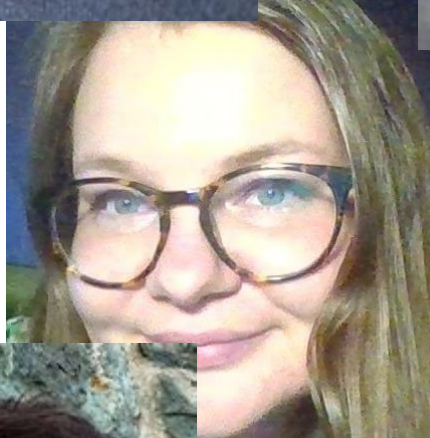
(i) how these individual pieces (of the model) interact to form the bigger picture (i.e., an ecological perspective acknowledging different layers of influence) impacting PA and eating, and how PA may influence eating; in the (ii) crucial transition from childhood to emerging adulthood, (iii) whether 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!



 NTNU | The Trondheim Early Secure Study