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Risk factors for suicidal thoughts in adolescence-a prospective cohort study: the Young-HUNT study

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ABSTRACT

Objectives: Examining the associations between health and lifestyle factors recorded in the participants' early teens and development of suicidal thoughts recorded 4 years later.

Design: Population-based prospective cohort study.

Settings: All students in the two relevant year classes in Nord-Trøndelag County were invited, 80% attended both waves of data collection.

Participants: 2399 secondary school students who participated in the Young-HUNT1 study in 1995–1997 (13–15 years old) were included in a follow-up study 4 years later (17–19 years old).

Primary outcome measure: Suicidal thoughts reported at age 17–19 years.

Results: 408 (17%, 95% CI 15.5% to 18.5%) of the adolescents reported suicidal thoughts at follow-up, 158 (14.2%, CI 13.6% to 16.4%) boys and 250 (19.5%, CI 18.8% to 22.0%) girls. Baseline anxiety and depressive symptoms (adjusted OR (aOR) 1.9, CI 1.4 to 2.6), conduct problems (aOR 1.8, CI 1.3 to 2.6), overweight (aOR 1.9 CI 1.4 to 2.4), and muscular pain and tension (aOR 1.8, CI 1.4 to 2.4), were all associated with reporting suicidal thoughts at follow-up.

Conclusions: One in six young adults experienced suicidal thoughts, girls predominating. Suicidal thoughts were most strongly associated with symptoms of anxiety/depression, conduct problems, pain/tension and overweight reported when participants were 13–15 years old. Specific preventive efforts in these groups might be indicated. Future research should investigate whether similar associations are seen with suicide/suicidal attempts as endpoints.

Strengths and limitations of this study

- Whole county cohort study with follow-up after 4 years.
- Exposure variables: behaviour/health traits, outcome: suicidal thoughts.
- Suicidal thoughts were prevalent in late adolescence, boys 14.2% and girls 19.5%.
- Suicidal thoughts were associated with anxiety/depression, conduct problems, pain/tension and overweight in early adolescence.

contribute to raised suicide risk,[4–6] yet some prospective studies have also linked anxiety and depression to increased incidence of suicidal thoughts.[3 7–9] In adolescence, externalising disorders such as ADHD and conduct disorders have been associated with suicidal attempts and to a lesser extent suicidal thoughts.[10 11] Further, there is empirical support that childhood adversities, such as low social support, sexual abuse, domestic violence and maternal depression, influence the development of suicidal thoughts during adolescence.[4 7 12] The findings from studies on weight problems, underweight and overweight and suicidal thoughts are contradictory, but overweight is often reported as a risk factor among adults.[13–15] Even though adult alcohol problems contribute to a 10-fold increase in suicide-related mortality,[16] the relationship between alcohol use and suicidal thoughts in adolescence is sparsely studied in the last decade.[17 18] Further, sleep disturbance,[19] pain, especially headache,[20 21] smoking and reduced physical activity[22–24] have all been reported to have a positive association with suicidal ideation in the adolescent general population.

Complex and partly paradoxical findings on gender differences complicate the understanding of adolescent suicidal ideation and behaviour. While girls report suicidal thoughts more often than boys during

INTRODUCTION

Suicidal thoughts and suicidal behaviours develop during adolescence and peak late in adolescence and early adulthood.[1] Recent findings from population-based studies indicate that suicidal thoughts and attempts are parts of a continuum and share a common risk profile.[2 3] It is well known from general population studies that anxiety and depression

adolescence,[25] [26] completed suicide in adolescence and young adulthood is 3–4 times more common in males than females in the Western World.[25] [27] [28] The prevalence of suicidal thoughts among girls peaks at about 16 years of age, while it continues to increase beyond the age of 19 in boys.[29] Intriguingly, in adults overweight may be predictive of suicide among men and a risk factor among women in the general population.[14] [30]

However, few large scale prospective studies have examined a wide range of risk factors and protective factors for suicidal thoughts among adolescent boys and girls.

The aim of this exploratory population study was to investigate the association of different risk factors in early adolescence with the development of suicidal thoughts 4 years later. Based on the existing literature we hypothesised that girls, individuals with high levels of anxiety and depression, inattentiveness, conduct problems, and alcohol-intoxications at baseline would be at increased risk of suicidal thoughts at follow-up.

METHOD
Study design, setting and participants
Young-HUNT1, the first wave of the adolescent part of the HUNT Study (Nord-Trøndelag Health Study) (http://www.ntnu.no/hunt/english),[31] took place between 1995 and 1997. All teenagers (13–19 years) attending secondary and high schools in the county were invited to participate and 90% attended. In Young-HUNT2, (2000–2001) students in the last 2 years of high school or vocational training (age 17–19) were invited; of these 2399 (80%) attended Young-HUNT1 and 2. The mean follow-up time was 3.9 years.

At baseline and follow-up, the participants completed a self-report questionnaire in class and underwent a physical examination, including height and weight.

All 2399 students who took part in Young-HUNT1 and 2 were included in the present study, but analyses of associations with weight are based on the 2271 participants who took part in the clinical examination.

Ethics
All the potential participants and their parents received a written statement about the study one month prior to the collection of the data, making discussion possible before signing the consent. Voluntary participation was stressed to the adolescents and their parents.

Measures
The Young-HUNT questionnaire includes a broad spectrum of health-related variables relevant for this study (http://www.ntnu.edu/hunt/data/que). Some categorical variables were already dichotomised, other variables (such as anxiety and depressive symptoms, attention and conduct problems, pain and tension symptoms) were based on instruments with multiple subquestions and alternative answers; categorisation of responses to these

questions was based on factor analysis, described in earlier studies.[32] [33]

Outcome measure at follow-up
Suicidal thoughts
At follow-up the students were asked: 'Have you had thoughts about taking your own life?' (yes/no). Positive responses were labelled as suicidal thoughts.

Exposure variables at baseline
Anxiety and depressive symptoms
Derived from the symptom checklist 90 R,[34] an abbreviated and previously validated five-item scale, SCL-5,[35] [36] was integrated in the questionnaire.

According to the previous studies[37] and to our factor analysis, we included all five items in our variable.

Attention and conduct problems
A 14-item school-adjustment questionnaire was included in Young-HUNT, described in previous studies,[32] [38] which was utilised to define attention and conduct variables. A factor analysis identified two separate factors: attention problems and conduct problems. Conduct problems include disagreement with teachers, such as quarrels and scolding, as well as involvement in fights at school; attention problems include inattention and hyperkinetic symptoms. The summarised scores of all items in each category were dichotomised into low or high scores, defining scores above the 70th centile for the study population as high.

Pain and tension symptoms
The following four items constituted the pain/tension variable: headache, neck pain, muscle and joint pain, and palpitations during the past 12 months. The values were dichotomised according to the 70th centile, defining students with score above that as high.[33]

Alcohol use
Baseline alcohol status was defined using number of reported alcohol intoxications. Students answered the question: 'Have you ever been drunk?'. The variables were dichotomised to 'never' or 'ever', and named 'early alcohol intoxication'. For further differentiation early alcohol intoxications were divided into three: none, 1–3, 4 and more (table 3).

Smoking
Smoking at baseline was assessed using the question: 'Do you smoke?' (yes/no). Current smoking was defined as 'yes' to smoking daily or occasionally.

Sleep disturbance
Baseline sleep disturbance was defined as difficulties initiating sleep; 'In the last month, have you had difficulty falling asleep?'. 'Almost every night' and 'often' were classified as insomnia in accordance with former research.[39]

Physical activity

Level of physical activity at baseline was estimated using the question: 'With exception of school activity, how many days a week do you practice sports or exercise to the point where you breathe heavily and/or sweat?'. 'Four days a week or more' was classified as being regularly physically active.[40]

Height and weight

Height and weight were measured by especially trained nurses to the nearest centimetre and nearest 0.5 kg, respectively, with light clothes, without shoes, jacket or outdoor garments. Body mass index (BMI)[41] was calculated as body weight (kg) divided by the square value of height (m). Using the age-specific and gender-specific BMI cut-offs for children and adolescents recommended by the International Obesity Task Force underweight was defined corresponding to BMI 18.5 kg/m^2 or less in adults.[42] Overweight was defined using age-specific and gender-specific BMI-cut-offs corresponding to BMI interval between 25 and 30 in adults and obese was defined with cut-offs corresponding to BMI 30 and beyond in adults.

Statistics

PASW Statistics 18 was used for data analysis. Frequencies are given as percentages and 95% CIs for proportions were included for comparison. Logistic regression was the main statistical analysis in the study, presenting results as ORs with 95% CI.

In the main analysis, univariable logistic regression analyses were first used to examine the crude associations between health and behavioural exposures with suicidal ideation at follow-up. Results were stratified on gender with adjustment only carried out for age. Then all the variables were entered in the same models stratified by gender (table 2), thus adjusting for each other in addition to age. The fully adjusted models in this study include only participants that completed all the variables used from the questionnaire and had participated in the clinical examination, giving a total number of completers as 1911 in these models.

According to the results from former studies using the Young-HUNT data set,[33] [43] several clinically relevant statistical interactions were tested for. In the present study, interactions were shown between gender and overweight (p=0.01), possible interactions also between gender and anxiety/depressive symptoms (p=0.09), pain and tension (p=0.10) and early alcohol intoxication (p=0.09). Accordingly, all analyses were stratified by gender (table 2). Further, there were possible interactions shown between early alcohol intoxication and anxiety/depressive symptoms (p=0.07) or physical activity (p=0.05), analysing for suicidal thoughts. To control for these potential interactions, analysis stratified on the presence of early alcohol intoxication were conducted, but only gave modest effect on the ORs and are not shown here.

RESULTS

Altogether 2399 students (80% of the eligible) completed the questionnaire in both waves of the study, 1115 boys (46.5%) and 1284 girls. 2271 students answered the question on suicidal thoughts at follow-up; 408 students (17%) reported having had suicidal thoughts and the prevalence was 14.2% (CI 13.6% to 16.4%) in boys and 19.5% (CI 18.8% to 22.0%) in girls.

At baseline, symptoms of anxiety and depression were more frequent among girls (21%, CI 18.8% to 23.2%), than boys (11.5%, CI 9.6% to 13.4%) (table 1), as was daily or occasionally smoking: girls (12.1%, CI 10.3% to 13.9%), boys (7.8%, CI 6.2% to 9.4%). Conduct problems were more frequent among boys (16.2%, CI 14.4% to 18.4%), than girls (5.3%, CI 4.1% to 6.5%)

Table 1	Baseline prevalence of health and behavioural problems and lifestyle					
	Total		Boys		Girls	
	N	Per cent	N	Per cent	N	Per cent
Mental health variables						
Anxiety/depressive symptoms	397	16.5	128	11.5	269	21.0
Attention problems	448	18.7	188	16.9	260	20.2
Conduct problems	249	10.4	181	16.2	68	5.3
Insomnia (DIS)	185	7.7	67	6.0	118	9.2
Physical health variables						
Pain and tension problems	453	18.9	148	13.3	305	23.8
Underweight* (total N=2210)	149	6.2	60	5.4	89	6.9
Overweight* (total N=2210)	303	12.6	138	12.4	165	12.9
Obesity (total N=2210)	64	2.7	35	3.1	29	2.3
Lifestyle factors						
Early alcohol intoxication(s)	624	26.0	267	23.9	357	27.8
Physical activity (4 days/week or more)	697	29.1	397	35.6	300	23.4
Daily or occasional smoking	248	10.3	87	7.8	161	12.1

DIS, difficulties initiating sleep.
Total N=2399, N completers suicidal thoughts=2271, N physical examination=2210.
*Overweight and underweight are defined by international (IOTF) criteria based on BMI cut-off in each year and gender cohort.

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and more boys were physically active (35.6%, CI 32.8% to 38.4%), compared to girls (23.4%, CI 21.1% to 25.7%).

In the univariable age-adjusted models (table 2), anxiety and depressive symptoms, attention and conduct problems, insomnia, pain/tension problems and smoking at baseline more than doubled the odds for suicidal thoughts at follow-up in both genders. Alcohol intoxication and overweight at baseline had moderate effects on suicidal thoughts (50–70% increase) in both genders (table 2), whereas underweight did not show an influence on suicidal ideation in this study. Physical activity 4–7 days a week had a protective effect (OR 0.7, CI 0.5 to 0.9), whereas smoking at baseline increased odds for suicidal thoughts 4 years later (OR 2.1, CI 1.5 to 2.8).

In the fully adjusted model stratified by gender, anxiety and depressive symptoms (aOR 1.9, CI 1.4 to 2.6), together with pain and tension problems (aOR 1.8, CI 1.4 to 2.4) still seemed strongly associated with later suicidal ideation, especially among boys. Conduct problems also remained robustly associated to suicidal thoughts (aOR 1.8, CI 1.3 to 2.6) after adjustment. The association with overweight was strengthened (aOR 1.9, CI 1.4 to 2.7), with a robust relationship demonstrated also even among boys (aOR 2.0, CI 1.1 to 3.4). In contrast; obesity was strongly associated with suicidal thoughts only among girls (aOR 3.1, CI 1.2 to 7.7). Further, smoking was associated with suicidal thoughts, specifically among girls (aOR 1.9, CI 1.2 to 3.1).

The effect of early alcohol intoxications on crude OR for suicidal thoughts weakened in models controlling for other variables; controlling for smoking in particular attenuated the strength of the associations. Such effects were also seen when the association with alcohol was investigated across 3 levels of increasing exposure (table 3). Attention problems, insomnia and early alcohol intoxications did not show statistically significant associations with suicidal thoughts in the fully integrated model.

The protective effect of physical activity was evident among boys (aOR 0.6 CI 0.4 to 0.9) but not significantly among girls (aOR 0.7 CI 0.5 to 1.1). Further stratified analyses showed that the protective association was evident in the group not reporting early alcohol intoxication(s) (OR 0.6, CI 0.4 to 0.8), compared to the group with early intoxication (OR 1.0, CI 0.6 to 1.6).

DISCUSSION

Anxiety and depressive symptoms, together with pain and muscular tension, were associated with nearly doubled increased risk for the development of suicidal thoughts during adolescence; and more so in boys than girls. Attention problems also had a similar unadjusted effect that, we suspect, might be mediated through other health problems such as depression, visualised by reduced OR after adjustment in our analysis.

Table 2 Logistic regression models; single input* age adjusted associations and fully adjusted model† of health and behavioural problems, and lifestyle at baseline 1995–1997 with suicidal ideation at follow-up in 2000–2001

	Total				Boys				Girls			
	OR*	CI	aOR†	CI	OR*	CI	aOR†	CI	OR*	CI	aOR†	CI
Mental health issues												
Anxiety/depressive symptoms	2.7	2.1 to 3.4	1.9	1.4 to 2.6	3.5	2.3 to 5.4	2.8	1.7 to 4.8	2.3	1.7 to 3.1	1.5	1.0 to 2.2
Attention problems	2.1	1.7 to 2.7	1.3	1.0 to 1.7	2.2	1.5 to 3.3	1.3	0.8 to 2.1	2.0	1.5 to 2.7	1.2	0.8 to 1.8
Conduct problems	2.3	1.7 to 3.1	1.8	1.3 to 2.6	2.5	1.7 to 3.7	1.9	1.2 to 3.1	3.0	1.8 to 5.1	1.8	1.0 to 3.4
Insomnia (DIS)	2.3	1.7 to 3.2	1.4	0.9 to 2.1	2.1	1.2 to 3.8	1.1	0.5 to 2.3	2.3	1.6 to 3.5	1.5	1.0 to 2.6
Physical health issues												
Pain and tension problems	2.7	2.1 to 3.4	1.8	1.4 to 2.4	3.1	2.1 to 4.8	2.0	1.2 to 3.3	2.3	1.7 to 3.2	1.7	1.2 to 2.5
Underweight (total N=2210)	1.3	0.8 to 2.0	1.5	0.9 to 2.5	1.4	0.7 to 2.8	1.8	0.8 to 4.1	1.2	0.7 to 2.2	1.4	0.7 to 2.5
Overweight (total N=2210)	1.7	1.3 to 2.3	1.9	1.4 to 2.7	1.6	1.0 to 2.6	2.0	1.1 to 3.4	1.7	1.2 to 2.6	1.8	1.2 to 2.8
Obesity (total N=2210)	1.9	1.0 to 3.4	1.5	0.8 to 3.1	0.7	0.2 to 2.3	0.6	0.1 to 2.5	3.7	1.7 to 8.0	3.1	1.2 to 7.7
Lifestyle factors												
Early alcohol intoxication(s)	1.7	1.3 to 2.2	1.2	0.8 to 1.6	2.1	1.4 to 3.2	1.5	0.9 to 2.4	1.5	1.1 to 2.1	1.0	0.6 to 1.5
Physical activity	0.7	0.5 to 0.9	0.7	0.5 to 0.9	0.7	0.5 to 0.9	0.6	0.4 to 0.9	0.8	0.6 to 1.1	0.7	0.5 to 1.1
Daily or occasional smoking	2.1	1.5 to 2.8	1.5	1.0 to 2.3	2.1	1.2 to 3.5	1.0	0.5 to 2.0	2.0	1.3 to 2.9	1.9	1.2 to 3.1

DIS, difficulties initiating sleep.
N=2271 (completers of suicidal thoughts question).
*OR adjusted for age.
†aOR, OR adjusted for age, anxiety/depressive symptoms, attention problems, conduct problems, insomnia, pain/tension problems, physical activity, alcohol intoxications and smoking.

Table 3 Logistic regression, associations of frequencies of alcohol intoxications at baseline 1995–1997 with suicidal ideation at follow-up in 2000–2001

	Total					Boys					Girls				
	OR*	95% CI		aOR†	95% CI		OR*	95% CI		aOR†	95% CI		OR*	95% CI	aOR†	95% CI
No early alcohol intox	1			1			1			1			1		1	
1–3 alcohol intox	1.5	1.1 to 2.0		1.1	0.8 to 1.6		1.7	1.1 to 2.8		1.3	0.8 to 2.3		1.3	0.9 to 1.9	0.9	0.6 to 1.5
>4 alcohol intox	1.9	1.3 to 2.7		1.3	0.8 to 2.1		2.5	1.4 to 4.4		1.8	0.9 to 2.6		1.5	1.0 to 2.5	1.1	0.6 to 2.0

OR from single input age adjusted models, and adjusted OR (aOR) from fully adjusted models.
*OR adjusted for age.
†aOR, OR adjusted for age, anxiety/depressive symptoms, attention problems, conduct problems, insomnia, pain/tension problems, physical activity and smoking.

In accordance with previous suicide research,[44 45] we found that conduct problems robustly increased the odds for suicidal thoughts in both genders. Conduct problems as well as conduct disorder emerge early in child development, and include some degree of impulsivity, frustration, poor academic achievement, social marginalisation and, often, low self-esteem,[46] all previously linked to suicidal behaviours and suicide.[47] Using diagnostic categories, comorbidity in conduct disorder is common, especially with attention and hyperactivity disorders.[48 49] Features that are specific (eg, social reaction on rule breaking behaviour) and features that commonly occur within attention and conduct problems (such as impulsivity), can be the basis for development of suicidality. The link might also be mediated through development of depressive symptoms around puberty. However, our broad category of conduct problems seems robustly associated with suicidal thoughts even after controlling for depression and other possible confounders.

The observation that boys seemed more vulnerable to anxiety and depressive symptoms, is in accordance with a previous study on adolescents with major depressive disorder.[26] The gender differences in findings may be related to the fact that depressive states are less frequent among boys, or might be reported by boys with more serious problems, thus representing a more extreme sample. The dissimilarity may also be due to different underlying causes and the stigma of anxiety and depression may be more socially excluding among boys than girls.[26] Muscular pain and tension were formerly[20] thought to be mediated through mental health problems. Our findings were, however, robust to adjustment, including anxiety and depression, and merit further study.

In relation to weight/BMI, the literature indicates that the epidemiology and mechanisms of suicide ideation and suicide attempts differ from those leading to a completed suicide.[13] Consistently, population-based studies of adults have demonstrated a negative association of BMI with risk of completed suicide. In contrast, and in line with our findings among girls, several studies have demonstrated an increased risk of suicidal ideation and suicide attempts in the obese.[14 50] Overweight might be less socially accepted in girls compared to boys and body image perspective more dominant. Owing to an earlier onset of puberty, girls were physically more mature than boys at baseline, and this difference might have influenced our results.

Alcohol use disorders are frequently recorded in studies of completed suicide,[51] yet our findings show a marginal association of early alcohol intoxications and development of suicidal thoughts. Alcohol intoxications at baseline might not represent an ideal measure to link early alcohol use to later suicidal ideation. Binge drinking is a common social activity among Norwegian teenagers, and might involve protective and risk inducing factors. For instance, adolescents not drinking at all

might be more lonely and isolated. Alcohol intoxication might initialise an impulsive attempt rather than generating suicidal thoughts. In addition, early alcohol involvement can act as a modifier on other risk factors. Additional analysis in our study confirmed that early alcohol intoxication nearly doubled the effect anxiety/depressive symptoms had on suicidal ideation.

Smoking increased odds for suicidal thoughts in our study, but was heavily correlated with early alcohol intoxication. Of the 244 adolescents reporting smoking at baseline, 199 (82%) also reported early alcohol intoxications. Alcohol use and smoking can be perceived as experimental and deviant behaviour among persons under 16. They tend to identify with the same group of adolescents, sharing many risk factors, including conduct problems.

Among Norwegian adolescents, physical activity seemed moderately protective against suicidal ideation, but the effect was most evident among boys and among students without alcohol experience in secondary school. Moderating effects of gender and alcohol use on health behaviour are also reported in some newer studies.[52–54]

Strengths and limitations

The Young-HUNT Study is a total population study with a high response rate and few drop-outs even at follow-up. The study thus was representative for the population in Nord-Trøndelag and Norway, at that time, but more importantly, it represents a baseline for general studies of later health effects for many years to come. The study was designed for prospective investigations, with approximately 4 years' follow-up time. Even if 4 years seems little in prospective studies, these years represent a great leap in adolescent development. The questionnaire included a broad collection of health and lifestyle background variables, some prevalidated, and some tested in former research from the Young-HUNT Study.[55] None of the variables used have diagnostic precision, but represent broader problem groups in a majority of otherwise healthy adolescents.

However, some limitations have to be pointed out. The Regional Committee for Medial and Research Ethics was concerned that even asking a question about suicidal thoughts might initiate suicidal thinking and did not allow the question in secondary school at the time. Exclusion of adolescents with suicidal thoughts at baseline was thus not possible, so the study is based on lifetime suicidal thoughts reported at follow-up. Other studies have confirmed that suicidal thoughts develop between the age of 13 and 18,[56] supporting our assumption of suicidal thoughts mostly emerging during follow-up time. Questions about self-harm were also excluded.

In the third year of high school, some students were attending vocational training and were not at school when the study was conducted. They were invited by post, but the response rates were low (34%). This represents a possible social bias, but former studies have

compared the baseline responses of the missing at follow-up, without finding any disturbing skewness.[31]

The fully adjusted models require answers in all variables, and there is no way to be totally sure that the 1911 informants in the adjusted analysis are representative for the whole cohort, but the similarity in results in crude ORs and adjusted ORs are reassuring.

According to existing literature and our factor analysis, it is not possible to separate anxiety from depression in SCL-5. The measure used in this study, therefore, represents the symptom load of mixed anxiety and depression. Evidence from the adult population supports the premise that mixed anxiety and depression, rather than any single condition, is strongly associated with suicide.[57 58]

Conclusion and implications

Suicidal thoughts are frequent among high school students in Norway. In this study, anxiety/depression, conduct problems, overweight, together with pain and tension at the age of 13–15 years, were strongly associated with developing suicidal thoughts during late adolescence. The importance of externalising behaviour seems under-communicated in the actual debate about risk factors and prevention of suicidal behaviours.[59]

The role of early alcohol intoxication remained inconclusive, while physical activity might protect from suicidal thoughts among boys.

To study the pathway from suicidal thoughts to completed suicide, large-scale population-based studies with specified baseline measures on suicidal behaviours should be linked with hospital and mortality registries.

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