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Loneliness and ease of communication with parents and friends: cross-sectional study of adolescents in Denmark

Katrine Rich Madsen¹, Mogens Trab Damsgaard¹, Kimberly Petersen², Pamela Qualter³ and Bjørn E. Holstein^{1*}

Abstract

Background Loneliness in adolescence is a serious threat to quality of life. The purpose of this study was to examine the association between loneliness and ease of communication with parents and friends, and whether the association was different for boys and girls.

Methods The study used data from the Danish arm of the international Health Behaviour in School-aged Children (HBSC). The surveys in 2010, 2014 and 2018 included nationally representative samples of students in the age groups, 11-, 13- and 15-year-olds ($n = 10,425$). Loneliness was measured by one item and ease of communication with parents and friends by the HBSC Ease of Communication Measure. Multilevel multivariate logistic regression was applied to study the associations between ease of communication and loneliness. Stratified analysis and interaction analysis tested the modifying effect of sex on the associations.

Results The prevalence of loneliness was 4.3% among boys and 7.6% among girls. There was a strong negative association between loneliness and ease of communication. Compared to participants who found it very easy to communicate with their parents, those who found it very difficult were more likely to feel lonely (OR: 7.64, 95% CI: 5.74–10.15). The association was stronger for girls (OR: 11.89 (8.30–17.02)) than for boys (OR: 3.70 (1.98–6.91)). Similarly, participants who found it very difficult to communicate with friends were more likely to feel lonely than those that found it very easy (OR: 7.71 (5.87–10.12)), again this was stronger among girls (OR: 11.96 (8.19–17.47)) than boys (OR: 4.33 (2.61–7.17)). Analyses of statistical interaction showed that sex was a strong additive effect modifier of these associations.

Conclusion The study found a remarkably strong negative association between loneliness and ease of communication with parents and friends, especially for girls.

Keywords Adolescents, Ease of communication, Friends, Loneliness, Parents, Social support

*Correspondence:

Bjørn E. Holstein
bho@sdu.dk

¹University of Southern Denmark, National Institute of Public Health, Studiestraede 6, Copenhagen DK-1455, Denmark

²School of Education, University of Leeds, Leeds, UK

³University of Manchester, Manchester Institute of Education, Manchester, UK



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Background

Loneliness is not always about being alone. Loneliness is an unpleasant subjective feeling of isolation, a perceived discrepancy between the social relations an individual wishes to have and that one perceives to have. Loneliness is often accompanied by pain, sadness, hopelessness, emptiness, an invisible social stigma, which is common and intense in adolescence [1–8], and often lasts over an extended period [9, 11]. In adolescence, the desire to belong and feel accepted is particularly strong; establishing and maintaining satisfying and dependable relations are important but challenging tasks [1, 4, 10, 11]. Loneliness in adolescence is a serious threat to quality of life [12–15]. It is also a public health problem because it is associated with many physical and mental health problems [1–2, 9, 13, 16, 17, 18, 19, 20, 21], poor sleep [2], lower income in midlife [22], risk behaviours [23], poor academic outcomes, low employability, and downward social mobility [24, 25].

Studies of the association between loneliness and poor social relations present an incoherent picture and are difficult to compare. The studies used a diversity of measurements of social relationships, for instance the Social Support Rating Scale, the Social Support Questionnaire, the Multidimensional Scale of Perceived Social Support, number of friends, positive and negative friendship quality, classmate support, offline and online contacts with friends, childhood emotional neglect, and maternal and paternal expressiveness [26–33]. A meta-analysis and review by Schwartz-Mette et al. [29] examined concurrent and longitudinal associations between youths' friendship experiences (number of friends, positive friendship quality, negative friendship quality) and loneliness. Many of the included studies showed a surprisingly weak or even non-existent correlation between loneliness and poor social relations with friends. The Cohen effect sizes ranged from small to medium [34]. Regarding the social relationships with parents, there is evidence that emotional neglect in childhood predicts loneliness in adolescence [28]. A meta-analysis showed a moderate correlation between loneliness and social support among children living apart from their parents [26]. It is not clear which aspects of social relationships are the most important drivers of loneliness.

Qualitative research provides insight into which aspects of social relationships are important drivers of loneliness among adolescents. The feeling of loneliness is not so much related to the structure or the size of the social network or the quantity of social contacts. The feeling of loneliness is more related to the quality of relationships [5, 12, 35–38]. Important aspects are feeling unhappily disconnected, feeling alone and not psychologically connected with friends, not being accepted by others, lacking closeness and connection with friends

or family, being alone with a major concern or problem, not feeling understood by others, and feeling neglected, rejected, or overlooked by others. In summary, these qualitative studies suggest that difficulties in communicating with parents and friends is a key issue in the lives of lonely adolescents.

Although it is intuitively plausible that difficulties in communication may result in loneliness, we still need to know how strong that association is, and whether ease of communication with parents and friends are equally important in their associations with loneliness. Furthermore, since loneliness and social relationships vary by sex, it is possible that the association between loneliness and ease of communication is different for boys and girls. This issue has not attracted much attention in the literature. Thus, the aim of the current study was to examine the associations between loneliness and ease of communication with parents and friends in a national sample of adolescents, and whether these associations varied by sex, and whether the association was different for boys and girls.

Methods

Design and study population Data stem from the Danish arm of the international Health Behaviour in School-aged Children (HBSC) study [8]. The study design included nationally representative samples of students in the age groups, 11-, 13- and 15-year-olds. We pooled data from three surveys (2010, 2014 and 2018 available in the Danish national HBSC-trend datafile) to increase the statistical power. The three surveys were comparable because they adhered to similar protocols for sampling, measurement, and data collection. The surveys used cluster sampling, i.e. sampling of schools. We invited random samples of schools, a new sample in each survey, drawn from complete lists of public and private schools in Denmark. In each school we invited all students in the fifth, seventh, and ninth grade (corresponding to the age groups 11, 13 and 15 years) to participate and complete the internationally standardized HBSC questionnaire in the classroom [39]. The participation rate among students across all three surveys was 85.7% ($n = 15,310$), calculated as the percentage of students enrolled in the participating classes who completed the questionnaire. Students in the fifth grade in 2010 ($n = 1,839$) were not asked about loneliness, resulting in an eligible study population of 13,471. We excluded 3,046 students with missing data about loneliness, ease of communication, and socio-demographic co-variables, leaving a final study population of 10,425 students.

Measurements The study measured loneliness with one item, "Do you feel lonely?" (never, sometimes, often, very often), dichotomized into no (never, sometimes) and yes

(often, very often). In adolescent samples, this one-item measure correlated strongly with the four-item version of the University of California Los Angeles (UCLA) Loneliness Scale [2, 40]. Further, the one-item measure and the four-item scale showed remarkably similar patterns of associations with measures of health, sleep, and scholastic self-beliefs [2, 24]. A study by Mund et al. [40] also showed that such a direct single-item measure correlated highly with other measures of loneliness. These findings suggest that the measure is valid for the purpose of our study.

The study used the HBSC Ease of Communication Measure. This measure has been used for analyses of young people's social life [41–45] and asks: “How easy is it for you to talk to the following persons about things that really bother you?... a) father, b) stepfather (or mother's boyfriend), c) mother, d) stepmother (or father's girlfriend), e) best friend, f) friends of the same sex, and g) friends of the other sex” (response categories: very easy, easy, difficult, very difficult, don't have or see this person). We recoded the responses into three measures: first, ease of communication with parents (items a-d above) were categorized into four mutually excluding levels: (1) very easy communication with at least one parent, (2) easy communication with at least one parent, (3) difficult communication with at least one parent, and (4) very difficult communication with at least one parent. Second, ease of communication with friends, based on item e-g, categorized into four levels as above. Third, a combination of the two measures with four categories: having very easy or easy communication with at least one parent and at least one friend; having very easy or easy communication with at least one parent but no friend; having very easy or easy communication with at least one friend, but no parent; and not having very easy or easy communication with any parent or friend. Prior to the data collection, we tested the ease of communication measure by focus group interviews with students just after they had answered the questionnaire. These focus group discussions suggested that the measure has high face validity. Another validation study found a high degree of convergent validity when compared to the Multidimensional Scale of Perceived Social Support [46].

The analyses included four socio-demographic co-variables: sex and age group (biological characteristics), survey year (2010, 2014, 2018), and socioeconomic status defined as the parents' occupational social class (OSC). OSC was measured by eight items: “Does your father/mother have a job?”, “If no, why does he/she not have a job?”, “If yes, please say in what place he/she works (for example: hospital, bank, restaurant)” and “Please write down exactly what job he/she does there (for example: teacher, bus driver)”. The research group coded the answers following the Danish Occupational Social Class measure [47]. Each participant was categorised by the

highest-ranking parent into four levels of family OSC: (1) high, e.g. professionals and managerial positions, large-scale business owners and managers, (2) middle, e.g. technical and administrative staff, small-scale business owners and managers, skilled workers, (3) low (unskilled and semi-skilled workers and economically inactive, e. g. parents receiving transfer income) and (4) unclassifiable due to insufficient information. Most participants (88.1%) gave sufficient information for the coding of OSC. Several studies show that most schoolchildren in these age categories can report their parents' occupation with a high agreement with parents' own information [48–51]. Pfortner et al. [52] showed that OSC is a suitable variable for studies of social inequality in adolescents' health.

Statistical procedures The first step was inspection of data by crosstabulations and use of χ^2 -test for homogeneity. The second step was logistic regression analyses to examine the mutually adjusted association between loneliness and the four co-variables. The third step was logistic regression analyses to examine the associations between loneliness and each of the three measures of ease of communication, adjusted for the four co-variables. We present these analyses for the entire study population and separately for boys and girls. The study was based on cluster sampling, i.e. sampling of schools, resulting in a multilevel dataset with students nested in schools. We accounted for the cluster sampling by multilevel modelling of the logistic regression analyses (PROC GLIMMIX and PROC GEE in SAS). The fourth step was examination of potential effect modification by sex. We applied stratified logistic regression analyses and separate analyses of additive and multiplicative interaction as recommended by Knol and VanderWeele 2012 [53].

Results

Comparison of the final study population ($n=10,425$) and the participants excluded because of lack of data ($n=3,046$) showed that the excluded students had a significantly higher proportion of the youngest age group ($p<0.0001$) and a significantly higher proportion of students in the low and unclassifiable OSC-groups ($p<0.0001$). Table 1 shows that most participants ($5303+3846=9149$, 87.8%) answered very easy or easy to the questions about easy communication with parents and ($5393+3854=9247$, 88.7%) answered very easy or easy to the questions about easy communication with at least one friend. Similarly, 80.1% ($n=8350$) of participants reported very easy or easy communication with at least one parent and at least one friend and 16.3% ($n=1696$; $n_{\text{parent}}=799$, $n_{\text{friend}}=897$) reported very easy or easy communication with *either* a parent or a friend. Only a small fraction (3.6%, $n=379$) did not report very easy or easy communication with any parent or any

Table 1 Loneliness by study variables

Variable	Category	Prevalence of loneliness (n) % p-value
Sex	Boys (n = 5049)	(216) 4.3
	Girls (n = 5376)	(408) 7.6 < 0.0001
Age group	11-year-olds (n = 2586)	(123) 4.8
	13-year-olds (n = 4178)	(260) 6.2
	15-year-olds (n = 3661)	(241) 6.6 0.0079
Survey year	2010 (n = 2884)	(138) 4.8
	2014 (n = 4116)	(295) 7.2
	2018 (n = 3425)	(191) 5.6 < 0.0001
Occupational Social Class (OSC)	High (n = 3840)	(195) 5.1
	Medium (n = 3949)	(250) 6.3
	Low (N = 1399)	(90) 6.9
	Unclassifiable (n = 1237)	(83) 6.7 0.0231
Ease of communication with parents	Very easy (n = 5303)	(218) 4.1
	Easy (n = 3846)	(210) 5.5
	Difficult (n = 992)	(121) 12.2
	Very difficult (n = 284)	(74) 26.1 < 0.0001
Ease of communication with friends	Very easy (n = 5393)	(240) 4.5
	Easy (n = 3854)	(91) 5.0
	Difficult (n = 874)	(122) 14.0
	Very difficult (n = 304)	(71) 23.4 < 0.0001
Very easy or easy communication with...	... both parents and friends (n = 8350)	(339) 4.1
	... parents but not friends (n = 799)	(90) 11.3
	... friends but not parents (n = 897)	(92) 10.3
	... neither parents nor friends (n = 379)	(103) 27.2 < 0.0001
Total (n = 10,425)		(624) 6.0

friend. Table 1 also shows that the overall prevalence of loneliness was 6.0%. Loneliness was significantly more prevalent among girls than boys, among 15- and 13-year-olds than 11-year-olds, among students from lower than higher OSC, and among students from the 2014 survey than the 2010 and 2018 surveys. The prevalence of loneliness was significantly elevated among students who did not report very easy or easy communication with parents and friends. Among students who did not report very easy or easy communication with any parent or any friend, 27.2% reported loneliness.

In Table 2, the first column shows analyses for the entire sample and the next two columns present separate analyses for boys and girls. The analyses in the first four sections of Table 2 on socio-demographic covariates were mutually adjusted. The last three sections of Table 2 show separate analyses of how loneliness was associated with each indicator of ease of communication, with each analysis adjusted for socio-demographic covariates.

Both before and after adjustments for all socio-demographic variables, there was a strong negative association between loneliness and ease of communication. Compared to participants who found it very easy to communicate with parents, the adjusted OR (95% CI) for loneliness among those who found it very difficult to communicate with parents was 7.64 (5.74–10.15). The association was stronger for girls, 11.89 (8.30–17.02) than boys, 3.70 (1.98–6.91). The adjusted OR (95% CI)

for loneliness among participants who found it very difficult to communicate with friends was 7.71 (5.87–10.12), again stronger among girls 11.96 (8.19–17.47) than boys 4.33 (2.61–7.17). The adjusted OR (95% CI) for loneliness among participants who did not find it very easy or easy to communicate with either parents or friends was 8.79 (6.87–11.26), again stronger among girls 10.76 (7.59–15.25) than boys 6.15 (4.13–9.14).

The interaction analysis in Table 3 reveals that sex was a strong additive effect modifier of the association between loneliness and ease of communication with parents. The interaction analysis in Table 4 shows that sex was a strong additive and a modest multiplicative effect modifier of the association between loneliness and ease of communication with friends.

Discussion

In this study population, where we examined the association between loneliness and ease of communication with parents and friends, the prevalence of loneliness was 6% and a large majority of students found it easy to communicate with parents and friends. These findings are consistent with other studies [8, 43].

There were two main findings. First, the prevalence of loneliness increased in a graded manner with decreasing ease of communication with parents and friends. Although this finding is intuitively plausible, a main contribution of the study is documenting the remarkably

Table 2 Adjusted OR (95% CI) for loneliness by study variables. Full study population and separate analyses for boys and girls

Independent variable (<i>n</i> in total study population)	Total (boys and girls combined)	Boys	Girls
Sex ^a			
Boys (<i>n</i> = 5049)	1 (ref.)		
Girls (<i>n</i> = 5376)	1.83 (1.54–2.18)		
Age group ^a			
11-year-olds (<i>n</i> = 2586)	1 (ref.)	1 (ref.)	1 (ref.)
13-year-olds (<i>n</i> = 4178)	1.55 (1.24–1.93)	1.49 (1.00–2.22)	1.59 (1.20–2.11)
15-year-olds (<i>n</i> = 3661)	1.65 (1.31–2.07)	1.69 (1.132–53)	1.64 (1.23–2.18)
Survey year ^a			
2010 (<i>n</i> = 2884)	1 (ref.)	1 (ref.)	1 (ref.)
2014 (<i>n</i> = 4116)	1.75 (1.44–2.13)	1.55 (1.10–2.19)	1.91 (1.44–2.52)
2018 (<i>n</i> = 3425)	1.40 (1.10–1.77)	0.87 (0.58–1.29)	1.82 (1.35–2.44)
Occupational Social Class ^a			
High (<i>n</i> = 3840)	1 (ref.)	1 (ref.)	1 (ref.)
Medium (<i>n</i> = 3949)	1.26 (1.03–1.53)	1.47 (1.06–2.06)	1.16 (0.91–1.47)
Low (<i>n</i> = 1399)	1.39 (1.03–1.86)	1.48 (0.95–2.31)	1.34 (0.99–1.83)
Unclassifiable (<i>n</i> = 1237)	1.48 (1.11–1.96)	2.11 (1.40–3.20)	1.67 (0.82–1.67)
Communication with parents ^b			
Very easy (<i>n</i> = 5303)	1 (ref.)	1 (ref.)	1 (ref.)
Easy (<i>n</i> = 3846)	1.31 (1.04–1.65)	0.79 (0.57–1.09)	1.77 (1.35–2.34)
Difficult (<i>n</i> = 992)	3.08 (2.31–4.10)	2.18 (1.47–3.21)	3.86 (2.70–5.50)
Very difficult (<i>n</i> = 284)	7.64 (5.74–10.15)	3.70 (1.98–6.91)	11.89 (8.30–17.02)
Communication with friends ^b			
Very easy (<i>n</i> = 5393)	1 (ref.)	1 (ref.)	1 (ref.)
Easy (<i>n</i> = 3854)	1.20 (1.02–1.43)	0.95 (0.71–1.29)	1.34 (1.10–1.64)
Difficult (<i>n</i> = 874)	3.84 (3.12–4.73)	2.74 (1.97–3.82)	4.53 (3.43–5.97)
Very difficult (<i>n</i> = 304)	7.71 (5.87–10.12)	4.33 (2.61–7.17)	11.96 (8.19–17.47)
Very easy or easy communication with ^b			
... both parents and friends (<i>n</i> = 8350)	1 (ref.)	1 (ref.)	1 (ref.)
... parents but not friends (<i>n</i> = 799)	3.28 (2.62–4.11)	2.38 (1.67–3.39)	4.03 (2.90–5.59)
... friends but not parents (<i>n</i> = 897)	2.51 (1.93–3.25)	1.71 (0.97–3.03)	2.98 (2.23–3.98)
... neither parents nor friends (<i>n</i> = 379)	8.79 (6.87–11.26)	6.15 (4.13–9.14)	10.76 (7.59–15.25)

^a Mutually adjusted for other sociodemographic variables^b Adjusted for sociodemographic variables**Table 3** Modification by sex of the relation between communication with parents and loneliness^a

Sex	Communication with parents		Very difficult or difficult versus very easy or easy within strata of sex OR (95% CI)
	Very easy or easy OR (95% CI)	Very difficult or difficult OR (95% CI)	
Boys	1.00	2.90 (2.02–4.14)	2.90 (2.02–4.14)
Girls	1.64 (1.35–2.01)	6.32 (4.87–8.20)	3.85 (3.01–4.91)

Measures of effect modification:

On additive scale, relative excess risk due to interaction: RERI (95% CI) = 2.78 (1.10–4.45).

On multiplicative scale: ratio of odds ratios (95% CI) = 1.33 (0.85–2.06).

^a Adjusted for age group, survey year and occupational social class**Table 4** Modification by sex of the relation between communication with friends and loneliness^a

Sex	Communication with friends		Very difficult or difficult versus very easy or easy within strata of sex OR (95% CI)
	Very easy or easy OR (95% CI)	Very difficult or difficult OR (95% CI)	
Boys	1.00	3.30 (2.56–4.26)	3.30 (2.56–4.26)
Girls	1.76 (1.43–2.16)	9.13 (7.17–11.63)	5.19 (4.14–6.53)

Measures of effect modification:

On additive scale, relative excess risk due to interaction: RERI (95% CI) = 5.07 (3.00–7.15).

On multiplicative scale: ratio of odds ratios (95% CI) = 1.57 (1.10–2.25).

^a Adjusted for age group, survey year and occupational social class

strong associations, with odds ratios around 8.0. It is important to highlight the significance of ease of communication during adolescence for mitigating loneliness. Most prior studies have shown that the association between loneliness and social relations was moderate to weak, in some studies even non-existent [26, 27, 29, 30, 33]. Comparing these studies is challenging due to the diverse measurements of social relationships with parents and friends that they employ. It is also difficult to pinpoint why our study shows stronger associations than others. One explanation could be that our study is the only one which focused specifically on ease of communicating with parents and friends as a driver of adolescent loneliness.

Second, another main contribution is the finding about differences between boys and girls. The association between ease of communication and loneliness was much stronger among girls than boys, suggesting that girls are more vulnerable to the lack of close social relations with whom they can communicate with ease. Schwartz-Mette et al. [29] suggest that positive qualities of friendships (e.g. support and intimacy) are more common in girls' than boys' friendships and that close social relationships are especially important to girls.

The few available qualitative studies provide insights that help to interpret the findings. Loneliness in adolescence appears to reflect insufficient quality of social relations [5, 35–38]. Triggers for loneliness include lacking closeness and connection with friends or family, not being accepted, and feeling neglected, rejected, or overlooked by others [37, 38]. Quality social relations may buffer the harmful effects of stressors and thereby reduce the risk of loneliness [32]. Together, our findings and those from qualitative work emphasize that, during adolescence, having social relationships where one feels one can easily communicate may prevent loneliness. The finding of different associations for boys and girls suggests that future studies on adolescent loneliness may benefit from a conscious gender perspective [54]. The use of biological categories like boys and girls does not provide sufficient understanding of the different associations. The term gender emphasizes the social context. It is a relational concept; boys and girls live gendered lives in specific social contexts, which may provide a deeper insight into loneliness.

Methodological issues The strength of the study is the large and nationally representative study population and the use of appropriate measures. An important limitation is the cross-sectional design, which hinders a causal interpretation of the statistical associations. Prospective studies have shown that poor social relationships predict loneliness [26]. We acknowledge the possibility of a bi-directional relationship or a reverse causation, i.e.

that intense and prolonged feelings of loneliness during adolescence may have dire consequences for the establishment and maintenance of easy communication with parents and friends. Another potential limitation is the one-item measurement of loneliness which focuses on frequency of loneliness. The findings do not address the intensity or duration of loneliness, factors that may shape the link between social relations and loneliness. Future work should explore how various aspects of loneliness are influenced by, and influence, social relationships. The study may suffer from selection bias due to exclusion of the students without data on loneliness and ease of communication; it is our assessment that this does not invalidate the main finding of a strong and graded negative association between loneliness and ease of communication. The study may suffer from unmeasured confounding. For instance, psychological characteristics of the participants may influence both their ease of communication and their loneliness [32]. Other examples are exposure to bullying [12, 44] or prior mental health problems [9, 13, 18] which may influence both ease of communication and loneliness.

Implications From a research point of view, it is important to investigate the causal direction of the association between loneliness and ease of communication with parents and friends. It is also important to study whether various aspects of loneliness (frequency, intensity, direction, emotional vs. social) are differently associated with social relationships. Distinguishing between parent-related and peer-related loneliness may provide further insight [55]. We recommend further studies to determine whether the findings about ease of communication with parents differ for adolescents with one, two or more adults in a parent-role, and how specific aspects of social relationships may be associated with loneliness. These aspects are parental stress [56], maternal and paternal expressiveness [27], perceiving the parents as caring [22], quality of maternal consulting [57], and offline and online contact with friends [30]. Finally, studies which embrace gender theory may provide a better understanding for the boy-girl differences in the associations between loneliness and ease of communication.

From an intervention point of view, the findings suggest that relationships where adolescents can talk openly and confide with each other may help to prevent loneliness [58]. School-based interventions may be a feasible way to combat loneliness by developing close relationships between students, facilitating social skills training in schools, and / or preventing bullying [59, 60]. Teachers may have a key role in preventing loneliness. A longitudinal study in Norway showed that among girls who had a trusted class advisor, a teacher they could turn to in difficult or hurtful situations, loneliness did not affect school

wellbeing two years later [61]. It may be more challenging to intervene in family life and stimulate close relationships between adolescents and their parents.

Conclusion

There was a remarkably strong association between loneliness and difficulties in communication with parents and friends in this national sample of adolescents. Girls were more vulnerable to difficulties in communication with parents and friends.

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Author contributions

All authors (MTD, BEH, KRM, KP, PQ) contributed to the planning of the study. MTD and BEH acquired the data. MTD prepared the data file. BEH and MTD performed the statistical analyses. BEH and KRM wrote the first draft of the manuscript. All authors contributed to the revision and intellectual content of the manuscript and approved the final version of the manuscript.

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Data availability

The dataset used in the current study is available from the Primary Investigator of the Danish HBSC Study, Dr. Katrine Rich Madsen, krma@sdu.dk.

Declarations

Consent for publication

There was no request for parental consent in 2010 and 2014. The survey in 2018 complied with the new Data Protection Act, under which data is collected (<https://www.datatilsynet.dk/media/7753/danish-data-protection-act.pdf>). It is legal to collect and process data from students at school where the processing takes place for the sole purpose of conducting statistical or scientific studies of significant importance to society. There was no request for obtaining written approval from individual parents or schoolchildren. Prior to the survey in 2018 we provided written information to the parents about the study, as requested in the new legislation.

Ethics approval and consent to participate

According to Sect. 14 in the Danish Scientific Ethical Committees Act, there is no request for ethics approval of population-based questionnaire surveys and there was no agency to provide approval in 2010, 2014 and 2018 (<https://www.retsinformation.dk/eli/ta/2017/1083>). In all surveys, we received approval from the school principal, the school board representing the parents, and the board of schoolchildren representing the schoolchildren in every participating school. We informed the participants orally and in writing about the purpose of the study, that data collection was anonymous and voluntary.

Data protection

The surveys in 2010 and 2014 were as requested registered at the Danish Data Protection Authority (J. No. 2013-54-0567) and the survey in 2018 as requested registered within the institution (Case 10 622, University of Southern Denmark). The research group had no access to information that can identify participants.

Competing interests

The authors declare that they have no competing interests.

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