CrossMark

EMPIRICAL RESEARCH

Loneliness and Ethnic Composition of the School Class: A Nationally Random Sample of Adolescents

Katrine Rich Madsen[1] · Mogens Trab Damsgaard[1] ·
Mark Rubin[2] · Signe Smith Jervelund[3] · Mathias Lasgaard[4,5] ·
Sophie Walsh[6] · Gonneke G.W.J.M. Stevens[7] · Bjørn E. Holstein[1]

Abstract Loneliness is a public health concern that increases the risk for several health, behavioral and academic problems among adolescents. Some studies have suggested that adolescents with an ethnic minority background have a higher risk for loneliness than adolescents from the majority population. The increasing numbers of migrant youth around the world mean growing numbers of heterogeneous school environments in many countries. Even though adolescents spend a substantial amount of time at school, there is currently very little non-U.S. research that has examined the importance of the ethnic composition of school classes for loneliness in adolescence. The present research aimed to address this gap by exploring the association between loneliness and three dimensions of the ethnic composition in the school class: (1) membership of ethnic majority in the school class, (2) the size of own ethnic group in the school class, and (3) the ethnic diversity of the school class. We used data from the Danish 2014 Health Behaviour in School-aged Children survey: a nationally representative sample of 4383 (51.2 % girls) 11–15-year-olds. Multilevel logistic regression analyses revealed that adolescents who did not belong to the ethnic majority in the school class had increased odds for loneliness compared to adolescents that belonged to the ethnic majority. Furthermore, having more same-ethnic classmates lowered the odds for loneliness. We did not find any statistically significant association between the ethnic diversity of the school classes and loneliness. The study adds novel and important findings to how ethnicity in a school class context, as opposed to ethnicity per se, influences adolescents' loneliness.

Keywords Loneliness · Adolescents · Ethnic composition · Diversity · Multilevel analyses · School class

✉ Katrine Rich Madsen
krma@niph.dk

Mogens Trab Damsgaard
trab@niph.dk

Mark Rubin
mark.rubin@newcastle.edu.au

Signe Smith Jervelund
ssn@sund.ku.dk

Mathias Lasgaard
Mathias.Lasgaard@stab.rm.dk

Sophie Walsh
sophiewalsh@gmail.com

Gonneke G.W.J.M. Stevens
g.w.j.m.stevens@uu.nl

Bjørn E. Holstein
bho@niph.dk

[1] National Institute of Public Health, University of Southern Denmark, Oester Farimagsgade 5A, 2nd Floor, DK-1353 Copenhagen, Denmark

[2] School of Psychology, The University of Newcastle, Newcastle, NSW, Australia

[3] Department of Public Health, Section for Health Services Research, University of Copenhagen, Copenhagen, Denmark

[4] Public Health and Quality Improvement, Central Denmark Region, Århus, Denmark

[5] Department of Psychology, University of Southern Denmark, Odense, Denmark

[6] Department of Criminology, Bar Ilan University, Ramat Gan, Israel

[7] Utrecht Centre for Child and Adolescent Studies, Utrecht University, Utrecht, The Netherlands

Introduction

Loneliness is a public health concern in the Western world (Holt-Lunstad et al. 2015) that increases the risk for several health, behavioral and academic problems among adolescents (van Dulmen and Goossens 2013; Qualter et al. 2013; Goosby et al. 2013). Some studies have suggested that adolescents with an ethnic minority background have a higher risk for loneliness than adolescents from the majority population (e.g. Polo and Lopez 2009; Priest et al. 2014; Madsen et al. 2016). The increasing numbers of migrant youth around the world mean growing numbers of heterogeneous school environments in many countries. Still, there is currently very little non-U.S. research that has examined the importance of the ethnic composition of school classes for loneliness in adolescence. The present research addressed this gap.

Loneliness in Adolescence

Loneliness is a distressing feeling that seems to occur more frequently in adolescents than in any other age group (Qualter et al. 2013; Heinrich and Gullone 2006). It can be defined as the painful feeling of sadness and emptiness that is caused by a cognitive awareness of a discrepancy between the social relationships one wishes to have and those that one perceives one actually has (Peplau and Perlman 1982; Weeks and Asher 2012). Most people will at some point in their life experience a transient feeling of loneliness. However, for some, loneliness is a chronic and painful state (Ernst and Cacioppo 1999). The feeling is not only painful in itself. A substantial body of longitudinal research has found that chronic feelings of loneliness in childhood and adolescence increase the risk of severe problems such as depressive symptoms (Ladd and Ettekal 2013; Qualter et al. 2013), self-harm (Jones et al. 2011), eating disorders (Levine 2012), academic problems (Juvonen et al. 2000; Benner and Crosnoe 2011), and suicide ideation and attempts (Schinka et al. 2012; Jones et al. 2011). It is, therefore, important to prevent and ease loneliness in adolescence not only due to the emotional pain it involves but also because it is a risk factor for a range of adverse outcomes.

Research identifying the antecedents of loneliness in adolescents has primarily highlighted factors that are related to the characteristics of the individual, such as genes (Goossens 2012), introversion, lack of social competences (Mahon et al. 2006; Vanhalst et al. 2014), low social status (Margalit 2010), lack of social support, peer acceptance and exposure to bullying (Vanhalst et al. 2014; Weeks and Asher 2012). Other research has focused on situational factors such as school transfer or parents'

separation (Lasgaard et al. 2015; Kingery et al. 2011). However, less attention has been given to contextual factors that lead to loneliness, even though several studies have pointed to the importance of investigating loneliness across different contexts (e.g., de Jong-Gierveld et al. 2006; Bellmore et al. 2004). Contextual factors are important because they shape the opportunities that individuals have for engaging in social relations and because the normative climate of a given context shapes individuals' relationship standards (de Jong-Gierveld et al. 2006). One of the most important and influential contexts for adolescents is their school environment. Adolescents spend a substantial amount of time in the school setting (Weeks and Asher 2012) and schools are an influential arena for social development (Weare 2000). This makes the school class context an important social arena for understanding loneliness in adolescence. In the present study, we consider one element, the role of ethnic composition in school classrooms, as a key contextual factor that may determine levels of loneliness among adolescents.

Ethnic Composition in the School Classroom

As global migration increases and our societies become more multicultural, there are growing numbers of adolescents living in Europe and the U.S. who have an immigrant background, either because they have migrated themselves, or because they were born into immigrant families (Eurostat 2011). However, the research exploring ethnic and migrant disparities in loneliness is sparse and inconclusive (Madsen et al. 2016). Some studies suggest that immigrant adolescents and adolescents that belong to ethnic minority groups feel lonelier than adolescents from the majority. For example, one U.S. study of 11–15-year-olds found a higher prevalence of loneliness among immigrant Mexican–American youth as compared with U.S.-born Mexican–American youth, suggesting that acculturation stress and a lack of English language proficiency contributed significantly to loneliness (Polo and Lopez 2009). Another Dutch study of 22-year-olds revealed that Turkish immigrants felt lonelier than adolescents of Moroccan immigrant background and the Dutch majority (van Bergen et al. 2008), suggesting that experiences of loneliness may differ among groups from different cultural backgrounds in the same host country. Also, an Australian study of 8–17 year-olds found higher levels of loneliness among students from minority ethnic groups (determined by country of birth) relative to the majority. The authors concluded that experiences of racial discrimination were related to the higher levels of loneliness among the minority groups (Priest et al. 2014). Other studies, however, do not find any significant differences in loneliness across ethnic or immigrant groups (Neto 2002; Neto and Barros 2000; Schinka et al. 2013).

The continuous, dynamic demographic changes also affects the share of adolescents with an ethnic minority background in schools (Boldt 2007; The Danish Union of Teachers 2014) and the ethnic composition in the school class context may therefore play an important role in regard to adolescents' loneliness, but this is an understudied issue.

To reach a more nuanced understanding of how the school class may influence loneliness in adolescence we adopted Benner and Crosnoe's (2011) perspective. These researchers emphasize the importance of studying two dimensions of the school context in relation to socioemotional and academic development in adolescents: the belongingness perspective and the diversity perspective. These dimensions have traditionally been studied separately. However, studying both together provides greater insight into how conceptually distinct dimensions of the school may have different implications for the outcome of interest (Benner and Crosnoe 2011). The belongingness perspective is related to characteristics of the individual within the school context and emphasizes the benefit of familiarity and fitting in with the crowd. It conceptualizes the school context as a setting in which individuals functioning is dependent on one's place within a network of social relations. During adolescence, youth define themselves in relation to others and in relation to characteristics related to their ethnic background (Hamm 2000). For example, as emphasized by Bellmore et al. (2004), it is important to have someone within the school class with whom you feel a mutual understanding and share norms and values with. Consistent with this viewpoint, van Staden and Coetzee (2010) argued that individuals may feel lonely when they experience an absence of mutual empathic understanding: "someone is lonely while being in a foreign culture that leaves one feeling not understood and not able to reciprocate understanding about matters that are culturally meaningful" (van Staden and Coetzee 2010, p. 527). The diversity perspective describes characteristics of the school class context and more specifically the ethnic diversity within a school or school class. According to Benner and Crosnoe (2011), this perspective emphasizes how exposure to different worldviews and life perspectives expand young peoples' curiosity and intellectual capacities. For example, Bagci et al. (2014) found that ethnic diversity of the classroom was positively associated with cross-ethnic friendship selection among year 7 students in 9 multi-ethnic schools in England, suggesting that cross-ethnic friendships relate to more positive intergroup relations and better social competences. Consistent with these findings, a meta-analysis of intergroup contact studies found that people residing or interacting in ethnically-diverse settings were less prejudiced and more likely to like other ethnic groups than people in ethnically homogenous settings (Pettigrew and Tropp 2006).

As argued by de Jong-Gierveld et al. (2006), we need to gain insight into the contextual characteristics that are of importance to adolescents' loneliness in order to obtain a comprehensive understanding of the antecedents of loneliness in adolescence and to better prevent and ease loneliness among adolescents in the future. This is not only important because of the emotional pain loneliness involves. Successful prevention of loneliness in adolescence may also prevent a range of the adverse outcomes. From a health promotion perspective, it is therefore important to understand whether the ethnic composition of the school class can play a role as an intervention component that has the potential to ease and prevent loneliness in adolescents.

Ethnic Background in the School Context and Loneliness

The influence of the ethnic composition of the school and/or school class on adolescent loneliness has received little attention in the international literature even though research on the ethnic composition of different social contexts is a growing field of interest (Budescu and Budescu 2012; Benner and Crosnoe 2011). Indeed, we have only been able to identify two U.S. studies that have addressed this issue. One longitudinal study of 6302 middle- and high-school students from five ethnic groups (White, African American, Latino American, Asian American and Other) explored the mediating role of loneliness in the association between demographic marginalization at the school level and educational success (Benner and Wang 2014). The authors found that 10 % of the student experienced ethnic marginalization at school (defined as having <15 % same racial/ethnic peers at school). However, they did not find an association between being ethnically marginalized at school and loneliness. Another U.S. study of 1421 sixth-grade students in urban middle schools that served communities of low socioeconomic status found a statistically significant association between ethnic diversity within the school and the school class and loneliness (Juvonen et al. 2006). The results of this second study showed increased ethnic diversity in the school and in the school class to lower the risk of loneliness among African Americans and Latinos. However, the researchers emphasized that future research should explore the association in representative samples of adolescents to gain insight into whether the negative association between ethnic diversity in the school and loneliness can be replicated to adolescents in general or other study populations.

The Current Study

The present study examined the association between the ethnic composition in the school class and adolescents' loneliness using a nationally representative sample of 4383

11–15-year adolescents in Danish schools. Large scale immigration is a fairly new phenomenon in Denmark, and until the early 1960's the Danish population was relatively homogeneous. Due to a need for labor, and the impact of conflicts around the world, the share of people living in Denmark with a minority ethnic background has increased. Today, around 11 % of the Danish population is characterized as immigrants (8.5 %) or descendants of immigrants (2.6 %) with the three largest immigrant groups descending from Poland, Turkey and Germany (Statistics Denmark 2014). The influx of immigrants has also influenced the ethnic composition of the Danish school system. During the past 12 years, the proportion of immigrants and descents has increased more than 10 %. Today the proportion of immigrants or descendants are approximately 11 % (The Danish Union of Teachers 2014; Boldt 2007). In Denmark, schoolchildren are organized in classes with an average of 21.5 children of the same age, and most Danish schoolchildren have the same classmates from preschool to the end of compulsory school, making the Danish school class an important social setting (Ministry of Education 2015).

We based our specific predictions on Benner and Crosnoe's (2011) framework. First, we predicted that students who do not belong to the ethnic majority in the school class—irrespective of whether or not they have ethnic compatriots in the class—would be more likely to feel lonely because minority group membership and lack of demographic fit in the school class increase the feeling of social marginalization and being left out (Bellmore et al. 2004; Benner and Crosnoe 2011). Our second prediction related to an individual-based measure of ethnic composition that captures the size of each schoolchild's ethnic group within the school class. Youth define themselves in relation to others, e.g., in relation to characteristics related to their ethnic background (Hamm 2000), and we, therefore, predicted that the more adolescents in the school class that shared self-identified ethnicity with others, the higher the probability of finding peers with whom they feel a mutual understanding and share norms and values with which could lower the risk for loneliness (Bellmore et al. 2004; van Staden and Coetzee 2010). Our third prediction related to a measure based at the school class level that estimated the ethnic diversity of each school class [Simpson's Index of Diversity (Simpson 1949)]. This measure provides an index of the probability that two randomly selected schoolchildren from the same school class will belong to different ethnic groups. Previous studies have found that interacting in ethnically-diverse settings may lower prejudice, increase openness to individuals from other ethnic groups (Pettigrew and Tropp 2006), and/or facilitate cross-ethnic friendships (Damico and Sparks 1986; Bagci

et al. 2014). Based on this evidence, we predicted that adolescents in more heterogeneous school classes would feel less lonely because these settings reduce the risk of adolescents feeling left out or unaccepted because of circumstances related to their ethnicity.

Materials and Methods

Study Population and Procedures

This study is based on Danish data from the international cross-sectional Health Behaviour in School-aged Children (HBSC) survey 2014, which gathered information on the health behaviors, well-being, and social contexts of 11-, 13- and 15 year-old schoolchildren (Roberts et al. 2009). The survey applied an internationally-standardized questionnaire that was completed electronically and anonymously by schoolchildren at school. Participants were sampled from a random selection of schools that was drawn from a complete list of public and private schools in Denmark. The sample was geographically stratified for six regions to accomplish the same relative representativeness in these regions. Within each selected school, data were collected from all schoolchildren in the 5th, 7th, and 9th grades, corresponding to 11-, 13- and 15-year-olds. One hundred and seventy schools were invited to participate in 2014 of which 48 accepted (participation rate for schools: 28.2 %). The most common reasons for non-participation were that (1) the school had recently participated in a similar health survey or (2) lack of time and resources caused by the implementation of a major national school reform.

In total, 5292 schoolchildren were enrolled in the participating classes in the 48 participating schools of which 4534 schoolchildren answered the questionnaire (participation rate for schoolchildren: 85.7 %). The participating schools comprised between 1 and 20 school classes in the selected grades, and the size of each school class varied between 5 and 30 schoolchildren in each school class ($M = 19.3$, $SD = 3.98$). As suggested by Rasmussen et al. 2002, class level analyses in the HBSC study usually restrict analyses to classes of at least ten students. Hence, we deleted ten classes with less than ten students ($n = 65$). Schoolchildren with missing or incomplete information on at least one of the study variables ($n = 86$) were also excluded prior to data analyses ($missing_{loneliness} = 28$, $missing_{ethnic\ self-identification} = 54$, $missing_{migration\ background} = 26$). After exclusion of schoolchildren in classes with less than ten students and schoolchildren with incomplete or missing information for the study variables, the final study population comprised 4383 schoolchildren ($n_{boys} = 2138$, $n_{girls} = 2245$).

Variables

Loneliness

Loneliness was measured by the single item: "Do you feel lonely?" ("yes, very often," "yes, often," "yes, sometimes," "no"). Several researchers have found that single-item measures have similar reliability and validity to equivalent multi-items measures (e.g., Bergkvist and Rossiter 2007; Bowling 2005). This is the case with the current single-item measure of loneliness, which has been found to correlate well with widely used and validated multi-item scales such as the UCLA Loneliness Scale (e.g. Russell 1982) and the De Jong Gierveld Loneliness Scale (e.g. Nicolaisen and Thorsen 2014). The four response categories were dichotomized representing lonely ("yes, very often": 2.4 %/"yes, often": 4.6 %) and not-lonely ("yes, sometimes": 30.4 %/"no": 62.6 %). The literature that explores the possible consequences of loneliness in adolescents emphasizes the importance of differentiating between loneliness as transient feeling and loneliness as a prolonged, chronic feeling, because it seems to be that it is only the prolonged feeling of loneliness that is associated with severe health, behavioral and academic problems (e.g. Jones et al. 2011; Harris et al. 2013). Hence, our dichotomization was based on conceptual considerations: The lonely category captured the most severe, chronic, and potentially debilitating cases of loneliness and the non-lonely category captured less severe and more transient loneliness or a complete absence of loneliness. This same dichotomization approach has been applied in earlier research among adolescents (Stickley et al. 2014; Peltzer and Pengpid 2016) and across ethnic groups (Victor and Burholt 2012; Stickley et al. 2014).

Ethnic School Class Composition

The ethnic school class composition was conceptualized and measured in three ways that reflected different aspects of ethnic composition in a school class. All three measures were based on aggregated data from an item that measured the schoolchildren's ethnic self-identification: "Do you feel you are…?" ("Danish," "Turkish," "Iraqi," "Lebanese," "Somali," "Pakistani," "other, please specify"). The schoolchildren had the possibility to choose more than one category. In the present sample, 3947 schoolchildren felt they belonged to one ethnic group, 408 belonged to two ethnic groups, 28 belonged to three ethnic groups, and 8 belonged to four ethnic groups or more. These ten were excluded from the analyses. Schoolchildren with two or more self-identified ethnicities were categorized as "mixed ethnicities," which is in accordance with previous literature (Juvonen et al. 2006; Benner and Crosnoe 2011). We counted 98 self-identified ethnicities with the five largest groups being: Danish ($n = 3546$), Mixed ethnicities ($n = 438$, where the majority felt Danish in combination with another self-identified ethnicity), Turkish ($n = 66$), Pakistani ($n = 45$), and Somali ($n = 41$). The three independent variables reflecting different dimensions of the ethnic composition in the school class were calculated as follows:

Member of the Ethnic Majority in Class

The calculation was based on an estimation of the largest ethnic group in each class and whether each individual shared self-identified ethnicity with this specific group. The size of the ethnic majority in the school classes varied between 21.7 % and 100 % ($M = 81.1$ %, $SD = 17.7$). Each schoolchild was categorized as being either a member of the ethnic majority in the school class or not. Out of those schoolchildren who were categorized as belonging to the ethnic majority in their class, 97.3 % felt mostly Danish, 1.83 % were categorized with mixed ethnicities, and 0.9 % were categorized as Pakistani (0.5 %), Turkish (0.3 %) or Iraqi (0.1 %), respectively.

Size of Own Ethnic Group in Class

We estimated two versions of "size of own ethnic group in class" at the individual level: First, we calculated a variable that reflected the *absolute* number of classmates in a school class who shared self-identified ethnicity with the person. The size of each schoolchild's ethnic group varied between 1 and 24 ($M = 13.6$, $SD = 6.4$), and it was subsequently categorized into four groups: (1) schoolchildren who did not share self-identified ethnicity with other classmates, (2) schoolchildren who shared self-identified ethnicity with 1–10 classmates, (3) schoolchildren who shared self-identified ethnicity with 11–15 classmates and (4) schoolchildren who shared self-identified ethnicity with 15 or more classmates. We computed this variable to gain a more nuanced insight into the importance of constituting an ethnic minority in a classroom alone—independent of the school class size—as opposed to a relative size of an ethnic group. The categorization into four categories was based on considerations that ensured enough categories to explore if the association was graded and ensure the categories were large enough to compare. Second, because classroom sizes varied, we also calculated the *relative* size of each schoolchild's ethnic group in class by dividing the absolute size of the ethnic group by the classroom size. The relative size of the schoolchildren's ethnic groups ranged from 3.3 to 100 % ($M = 72.2$ %, $SD = 31.0$). Benner and Crosnoe (2011) recommended that researchers focus on at least 15 % same ethnicity peers as a "critical mass" to promote

the socio-emotional well-being of young children. Following this recommendation, we dichotomized the relative variable as follows: ">15 % same ethnic peers in class" versus "≤15 % same ethnic peers in class". This dichotomization was also applied in the study by Benner and Wang (2014).

Simpson's Index of Diversity

This variable is a measure of ethnic diversity in a school class. The index takes into account both the number of ethnic groups in the school class and the relative representation of each group (Simpson 1949): $D_S = 1 - \sum_{i=1}^{g} p_i^2$ where D_S reflects the ethnic diversity in the school class and p_i represents the psroportion of schoolchildren in the school class that belongs to ethnic group i. The p_i^2 was summed across g ethnic groups in the school class. This version of Simpson's Index of Diversity estimates the probability that two schoolchildren randomly chosen from the same school class will belong to two different ethnic groups. The score ranges from 0 to 1 where 0 reflects completely homogenous school classes and higher values reflect greater ethnic diversity. In the current sample, school class diversity ranged from 0 to 0.89 ($M = 0.29$, $SD = 0.24$).

Covariates

Age group (11-/13-/15-year olds), sex (boy/girl), family occupational class (high/middle/low/unclassifiable and missing), and immigrant background (Danish origin/descendant/immigrant) were included as covariates in the analysis. Grade was used as a proxy for age group. In the Danish school system, hardly any children are promoted or held back and therefore age groups are fairly homogeneous within school classes and age group reflects the participants' social situation better than their exact age. Grade 5, 7 and 9 correspond to 11-, 13- and 15-year-old schoolchildren ($M = 11.8$, $SD = 0.4$; $M = 13.8$, $SD = 0.4$; $M = 15.8$, $SD = 0.4$). Data on family occupational class are derived from the schoolchildren's reports of their parents' occupations. Several studies have demonstrated that schoolchildren are able to report their parents' occupations with a reasonable validity although often with a high proportion of unclassifiable or missing data (Ensminger et al. 2000, Lien et al. 2001). Based on the highest ranking parent, schoolchildren were grouped into family occupational class I (highest) to class V. We added family occupational class VI to include economically inactive parents who receive unemployment benefits, disability pension or other kinds of transfer income and the category "unclassifiable" to describe parents for whom there was no information or

where it was impossible to identify their exact occupation. We categorized family occupational class into high (family occupational class I–II), middle (family occupational class III–IV), low (family occupational class V–VI), and unclassifiable/missing. The unclassifiable/missing category comprised 7.0 % of the participants.

Immigrant background was based on three items that assessed the country of birth of the schoolchild, mother and father. Nordahl et al. (2011) have found high agreement between 11-year-olds and their parents' answers on these questions. This suggests that schoolchildren are able to provide valid responses regarding their own and their parents' country of birth. Based on the definition from Statistics Denmark (2014), each schoolchild was categorized as being either Danish (having at least one parent born in Denmark, regardless of own country of birth), a descendant (born in Denmark to both parents born outside of Denmark), or an immigrant (born abroad to both parents born outside of Denmark).

Statistical Analyses

We used SAS version 9.3 to calculate frequency distributions. We tested for homogeneity using a Chi square test and tested for trends using the Cochran-Armitage test. Multilevel logistic regression analyses (SAS Proc Glimmix) were used to assess the association between the ethnic composition in the school class and loneliness. We applied a three-level model with school and school class as random effects taking the hierarchical data structure into account with schoolchildren (level 1, n = 4383) nested in school classes (level 2, n = 238) within schools (level 3, n = 48), allowing for non-independent observations between individuals within the groups of schools and school classes. We applied a three-step modelling strategy. Model 1 was an empty model without explanatory variables. We calculated the intra-class correlation coefficient (ICC) to estimate the possible contextual variance in adolescents' loneliness that can be ascribed to the school and school class contexts. We were unable to calculate a variance estimate for schools because our data included some schools without lonely schoolchildren and because the school variance was so small, indicating that factors related to the school context had no influence on the participants' level of loneliness. Hence, we only calculated the school class variance. The ICC for schoolchildren within different school classes was estimated as $\mathrm{ICC_{class}} = (\sigma_2^2)/\sigma_2^2 + \sigma_1^2)$, where σ_2^2 is the variance between school classes and σ_1^2 is the variance between schoolchildren, estimated to 3.29 (Merlo et al. 2006). In Model 2, odds ratios (OR) and 95 % confidence intervals (CI) were calculated with loneliness as the dependent variable and the three aspects of the ethnic composition in school class as independent variables. We

also stratified the associations by sex and age group. Differences were identified and we therefore performed statistical analyses with inclusion of interaction terms to study whether sex and age group modified the associations between ethnic composition of the school class and loneliness. None of the interaction terms were significant (see Results section), and we therefore chose to combine the strata and control for sex and age group instead. Finally, in Model 3, the associations were adjusted by sex, age group, family occupational class and immigrant background.

Sensitivity Analyses

We conducted three types of sensitivity analyses. First, we performed sensitivity analyses with alternative cut points of the dependent variable loneliness. The analyses did not change the direction of the associations. The associations were strongest but not statistically significant when the lonely group comprised only schoolchildren who answered "yes, very often" and weakest when the lonely group comprised schoolchildren who answered "yes, very often", "yes, often", "yes, sometimes".

Second, we performed sensitivity analyses with the independent variable "size of own ethnic group in the school class." We applied the initial continuous version of the *absolute* size of own ethnic group in class ($M = 13.9$, $SD = 6.4$) and the initial continuous version of *relative* size of own ethnic group ($M = 72.7$, $SD = 31.0$). Both sensitivity analyses revealed similar and statistically significant associations as with the final versions of the variables. These findings highlight that the size of own ethnic group in class is significantly associated with loneliness.

Third, we carried out two sensitivity analyses with alternative variations of the covariate immigration background to encompass the many ways it is conceptualized and measured. First, each schoolchild was categorized as Danish (born in Denmark with both parents born in Denmark), descendant (born in Denmark with at least one parent born outside of Denmark), or immigrant (born outside of Denmark with at least one parents born outside of Denmark). Second, we distinguished between descendants and immigrants originating from Western and non-Western countries. This distinction was used because individuals descending from non-Western countries are often found to perceive more health and educational problems than Western individuals (Abebe et al. 2014). Neither of the analyses changed the OR-estimates substantially.

Ethics

The study complies with national guidelines regarding ethical standards and data protection and is registered at the Danish Data Protection Agency (J. No. 2013-54-0576).

There is no agency for ethical approval of population-based survey studies in Denmark. We did not obtain written approval from individual parents or schoolchildren. Instead, we received approval from the school principal, the school board representing the parents, and the board of schoolchildren representing the schoolchildren in each of the participating schools. We informed the participants orally and in writing that the data collection was anonymous and voluntary. We did not collect information about name or other personal identification of the schoolchildren.

Results

Descriptive statistics are shown in Table 1. Most participants belonged to the ethnic majority in their class (82.3 %), 7.0 % of the schoolchildren did not share self-identified ethnicity with any classmates, 88.2 % had at least 15 % same ethnicity peers in the classroom, and 18.4 % belonged to completely homogeneous school classes that comprised only schoolchildren with a Danish self-identified ethnicity. Most of the participants were categorized as Danish (84.4 %), 12.0 % were categorized as descendants, and 3.6 % as immigrants. Overall, 7.0 % of the schoolchildren felt lonely. Loneliness was experienced by more girls (8.5 %) than boys (5.4 %; $p < .0001$) and increased with age group ($p = .0022$). No statistically significant differences in loneliness were found at the descriptive level among any of the remaining variables: being a member of ethnic majority in class, the relative size of own ethnic group in class (relative and absolute size), Simpson's index of diversity, family occupational class and immigrant background (Table 1).

Table 2 shows the results from the multivariate multilevel logistic regressions analyses. We found a statistically significant association between being a member of the ethnic majority in the classroom and loneliness when controlling for sex, age group, family occupational class and immigration background. Schoolchildren who did not belong to the ethnic majority in the class had increased odds ratio for loneliness compared to the reference group of schoolchildren who were members of the ethnic majority (OR = 1.57, 95 % CI 1.10–2.25, Table 2). The association was statistically significant and stronger among boys (OR = 2.09, 1.26–3.45) than among girls (OR = 1.24, 0.75–2.04) and statistically significant and stronger among 11-year-olds (OR = 2.57, 1.39–4.77) than among 13-year-olds (OR = 1.66, 0.93–2.96) and 15-year-olds (OR = 0.93, 0.48–1.79). However, interaction analysis revealed no significant interaction on a multiplicative scale of either sex ($p = .1201$) or age group ($p = .5043$) on the association between being a member of the ethnic majority in class and loneliness. Hence, neither age group

Table 1 Descriptive statistics of the 4383 11-, 13- and 15- year-old adolescents, % (N)

	Boys n = 2138	Girls[a] n = 2245	Total n = 4383	Lonely (%)
Dependent variable				
Feeling lonely	5.4 (115)	8.5 (191)	7.0 (306)	
Independent variables				
Individual level				
Member of ethnic majority in class				
Yes	81.1 (1734)	83.5 (1874)	82.3 (3608)	6.8[b]
No	18.9 (404)	16.5 (371)	17.7 (775)	7.9
Absolute size of own ethnic group in class				
Share self-identified ethnicity with more than 15 classmates	48.7 (1041)	49.1 (1103)	48.9 (2144)	6.4[c]
Share self-identified ethnicity with 11–15 classmates	576 (26.9)	623 (27.8)	27.4 (1199)	6.9
Share self-identified ethnicity with 1–10 classmates	345 (16.1)	386 (17.2)	16.7 (731)	8.1
Do not share self-identified ethnicity with classmates	176 (8.2)	133 (5.9)	7.0 (309)	8.4
Relative size of own ethnic group in class				
>15 % same ethnic peers in class	87. (1860)	89.4 (2007)	88.2 (3867)	6.7[b]
≤15 % same ethnic peers in class	13.0 (278)	10.6 (238)	11.8 (516)	8.9
Family occupational class				
High	39.8 (850)	35.0 (785)	37.3 (1635)	6.8[c]
Middle	33.5 (716)	39.2 (879)	36.4 (1595)	6.9
Low	19.6 (420)	18.8 (423)	19.2 (843)	6.9
Unclassifiable/missing	7.1 (152)	7.0 (158)	7.1 (310)	8.7
Immigrant background				
Danish origin	85.6 (1831)	83.3 (1870)	84.4 (3701)	7.2[b]
Descendant	10.2 (219)	13.6 (306)	12.0 (525)	5.3
Immigrant	4.1 (88)	3.1 (69)	3.6 (157)	7.0
School class level				
Simpsons index of diversity (D_S)				
Homogeneous school classes (one ethnic group in class, $D_S = 0$)	18.1 (387)	18.7 (421)	18.4 (808)	7.9[b]
Heterogeneous school classes ($D_S > 0$)	81.9 (1751)	81.3 (1824)	81.6 (3575)	6.8
Age group				
11-year-olds	32.6 (696)	31.4 (705)	32.0 (1401)	5.6[c]
13-year-olds	34.8 (743)	34.9 (784)	34.8 (1527)	7.0
15-year-olds	32.7 (399)	33.7 (756)	33.2 (1455)	8.3

[a] p values from Chi square tests for sex differences in loneliness ($p < .0001$), member of the ethnic majority in class ($p = .0398$), absolute size of own ethnic group in class ($p = .0254$), relative size of own ethnic group in class ($p = .0137$), family occupational class ($p = .0008$), immigrant background ($p = .0007$), Simpson's Index of Diversity ($p = .5781$) and age group ($p = .6771$)

[b] p values from Chi square test for differences in the prevalence of loneliness between member of ethnic majority in class ($p = .2842$), relative size of own ethnic group in class ($p = .0666$), immigrant background ($p = .2858$) and Simpson's index of diversity ($p = .2460$)

[c] p values from Cochran-Armitage test for trend in the prevalence of loneliness between the absolute size of own ethnic group in class ($p = .0758$), family occupational class ($p = .2358$) and age group ($p = .0022$)

nor sex modified the relation between ethnic composition and loneliness.

We also found a statistically significant and graded association between the *absolute* size of the schoolchildren's own ethnic group and loneliness after adjusting for covariates. Compared to the reference group of schoolchildren who shared self-identified ethnicity with more than 20 classmates, the odds ratio for loneliness was significantly higher among adolescents who shared self-identified ethnicity with one to ten classmates (OR = 1.70, 1.17–2.45) and adolescent who did not share self-identified ethnicity with any classmates (OR = 2.05, 1.24–3.40). The direction of the association was similar for boys and girls, but strongest and only statistically significant for boys.

Table 2 OR and 95 % CI for loneliness among 11-, 13- and 15-year old adolescents by member of ethnic majority in class, absolute and relative size of own ethnic group in class and ethnic diversity in the school class, N = 4383

	School class level ICC (%)	Model 2 Unadjusted OR (95 % CI)	Model 3 Adjusted[b] OR (95 % CI)
Model 1: Empty model, random effect	5.0		
Individual variables			
Member of ethnic majority in class (ref = yes)	4.7[a]		
No		1.18 (0.88–1.59)	**1.57 (1.10–2.25)**
Absolute size of own ethnic group in class	4.7[a]		
Share self-identified ethnicity with more than 20 classmates		1 (ref.)	1 (ref.)
Share self-identified ethnicity with 11–19 classmates		1.08 (0.79–1.46)	1.15 (0.84–1.57)
Share self-identified ethnicity with 1–10 classmates		1.31 (0.93–1.83)	**1.70 (1.17–2.45)**
One, do not share self-identified ethnicity with classmates		1.34 (0.86–2.09)	**2.05 (1.24–3.40)**
Relative size of own ethnic group in class	4.7[a]		
>15 % same ethnic peers in class		1 (ref.)	1 (ref.)
≤15 % same ethnic peers in class		1.36 (0.98–1.90)	**1.86 (1.27–2.74)**
School class variable			
Simpson's Index of Diversity (ref = homogeneous school classes)	4.7[a]	1.03 (0.60–1.76)	1.35 (0.74–2.46)

[a] Based on model 2, [b] adjusted for sex, age group, family occupational social class and immigration background, bold findings: OR significant at $p < .05$

When stratified by age group the associations became statistically insignificant but strongest among the 11-year-olds. Again, interaction analysis revealed no statistically significant interaction on a multiplicative scale of either sex ($p = .5043$) or age group ($p = .1842$) on the association.

We also found a statistically significant association between the *relative* size of the schoolchildren's own ethnic group and loneliness after adjusting for covariates: the odds ratio for loneliness was significantly higher among adolescents with 15 % or less same ethnic peers in class compared to the reference group of adolescents with more than 15 % same ethnic peers in class (OR = 1.86, 1.27–2.74). The direction of the association was similar for boys and girls, but strongest and only statistically significant for boys. When stratified by age group the direction of the association was similar but became statistically insignificant among the 15-year-olds and strongest and statistically significant among the 11- and 13-year-olds. There was no significant modifying effect of either sex or gender.

We found no statistically significant association between the ethnic diversity in the classrooms and loneliness (OR = 1.35, 0.74–2.46) and the association did not differ between sex and age groups.

The empty model of the multilevel logistic regression analysis showed an ICC of 5.0 % on school class level. This finding suggests that 5 % of the variation in adolescents' loneliness can be ascribed to factors that characterize the school class context as opposed to characteristics of the

individuals within the school classes. Therefore, inclusion of determinants, age group, sex, family occupational class and immigration background explained some of the variance and reduced the school class ICCs (Table 2).

Discussion

Loneliness is a public health concern that increases the risk for several health, behavioral, and academic problems among adolescents. Although research on ethnic disparities in loneliness in adolescence is sparse and with inconsistent findings (Madsen et al. 2016), several studies have found that immigrant or ethnic minority adolescents have a higher risk for loneliness than adolescents from the majority population. Migration is an increasing worldwide phenomenon that creates multicultural schools and societies with a growing number of adolescents who have an ethnic background other than that of the majority (Eurostat 2011; Statistics Denmark 2014). Even though adolescents spend a substantial amount of time at school, there is very little research, most of which is restricted to the U.S. context, which has examined the importance of the ethnic composition of school classes for loneliness in adolescence. In the present research, we used a representative multilevel study of 4383 randomly-selected 11–15 year-old adolescents in Denmark to explore the association between loneliness and three dimensions of the ethnic composition in the school class. We found that two dimensions characterizing the

individuals within the school class were significantly associated with loneliness: Adolescents who did not belong to the ethnic majority in the school class had increased odds for loneliness compared to adolescents that belonged to the ethnic majority; and having more same-ethnic classmates lowered the odds for loneliness. We did not find any statistically significant association between the ethnic diversity of the school classes and loneliness. Hence, our findings highlight the value of exploring more than one dimension of the ethnic school class composition (Benner and Crosnoe 2011). Our results also suggest that the school class context plays a role in relation to loneliness in adolescence because it shapes the opportunities that individuals have for engaging in social relations based on characteristics such as ethnicity (de Jong-Gierveld et al. 2006).

Comparison with Previous Research

A key innovation of the present research is that it focused on the relationship between loneliness and self-identified ethnicity in the school class context, as opposed to ethnicity per se. Contrary to our findings, Juvonen et al. (2006) found a significant negative association between loneliness and the ethnic diversity of the school and the school class (measured by Simpson's Index of Diversity) among six grade Latino and Afro American students in U.S. However, there are several methodological issues that separate this study from ours and preclude a straightforward comparison of results. First, the study populations are diverse. The study by Juvonen et al. (2006) was conducted among five ethnic groups in U.S., and ethnic diversity was only investigated among Latinos and African Americans. In contrast, our study population comprised a representative sample of adolescents in Denmark that included 98 self-identified ethnicities and was not estimated among any specific ethnic groups. The different number of ethnic groups that each study population was based on may influence the effect that the ethnic diversity of the classrooms has on loneliness. For example, when the ethnic diversity is high in the study by Juvonen and colleagues, the ethnic groups within the school classes may still be relatively large because the diversity index was estimated on only five groups. This influences the opportunity to have someone within the classroom with whom you share ethnicity. In our study, the 98 self-identified ethnicities entail that the ethnic groups within the school classes are often quite small. Second, the participating schools in the U.S. study were urban middle schools from communities of low socioeconomic status. In contrast, our sampling strategy ensured a representative study population from all communities and socioeconomic groups in Denmark. Third, loneliness was measured in different ways across the two

studies. In our study, loneliness was measured with one item that captured adolescents' self-perceived loneliness. In the study by Juvonen et al. (2006), loneliness was measured using a 16-item scale that assessed loneliness in the school context (Qualter 2003). The single loneliness measure that we used does not provide us with specific knowledge about the specific social domains in which adolescents feel lonely, and it is likely that the item captures loneliness in social domains other than the school class (e.g., loneliness in the family or community).

Our results were also inconsistent with those of Benner and Wang (2014), who did not find a significant association between being loneliness and ethnically marginalized at school (having < 15 % same racial/ethnic peers). An important difference here is the context in which ethnic marginalization was assessed. Benner and Wang (2014) studied the effect of being ethnically marginalized at school, whereas we studied the effect of being ethnically marginalized in the school class. It is likely that the potential protective effect of having same ethnic peers is stronger when it is assessed in the class context as opposed to the whole school. Furthermore, Benner and Wang's study was conducted in the U.S. and among an older study population than our study population.

Our initial predictions regarding the relationship between loneliness and the three different aspects of the ethnic school class composition were only partly supported by our findings: Consistent with our predictions, students who did not belong to the ethnic majority in the school class and adolescents who did not share self-identified ethnicity with any or only few classmates had increased odds for loneliness. However, contrary to our predictions, the ethnic diversity of school classes was not significantly associated with loneliness. During adolescence, youth define themselves in relation to others, and friendships and social evaluation are based on shared interests, attitudes and behavior of fundamental importance to the individuals (e.g., in relation to others who are similar in terms of their ethnic background; Hamm 2000). It is likely that the significant associations found in our study can be partly explained by this process of self-identification, because having classmates that share self-identified ethnicity increases the probability of finding peers with mutual understandings, norms and values, increasing a feeling of connection and belonging that lowers the risk for loneliness (Bellmore et al. 2004). This interpretation is supported by van Staden and Coetzee (2010), who suggested that *loneliness has a cultural dimension that emerges when individuals experience an undesired absence of mutual empathic understanding.* Furthermore, ethnic minority group membership in the school class may be associated with feelings of social marginalization (Benner and Crosnoe 2011) and loneliness (Eisenberg et al. 2009). Our

findings, therefore, suggest that belonging to the ethnic majority group and a sense of belonging, fitting in, or connection to classmates of the same self-identified ethnicity seems to be protective factors against loneliness, but that ethnic diversity within the classroom is not.

Strengths and Limitations

Migration is a growing worldwide phenomenon, and the issue of how the ethnic composition of schools may affect adolescents is a relevant and important issue that needs to be considered not only in the U.S but also in other countries. To our knowledge, the present study is the first non-U.S. study that has explored the association between the ethnic composition in the school class and loneliness.

Our study design is observational and cross-sectional, and these aspects preclude firm conclusions regarding causality. However, the problem with cross-sectional data is not substantial in this study because the exposure variable—ethnic composition in the school class—is unlikely to be caused by loneliness. Another possible limitation is that this random sample of adolescents only includes fairly small groups of the same self-identified ethnicity, making the study unsuitable for stratified analysis of selected ethnic groups. However, this aspect of the research can also be considered a strength because it allows us to draw conclusions about the effects of ethnic composition in general, relatively independent of the specific nature of the ethnic groups involved.

A further limitation is that our study involved a risk of selection bias because of the large proportion of schools that declined participation in the study. The vast majority of non-participating schools explained their non-participation with lack of time or that they had recently participated in a similar survey. We substituted non-participating schools with other schools chosen at random from the same complete list of all schools in Denmark. With this random selection of all schools in Denmark one merit of this study is the large and representative study population reflecting the ethnic composition of adolescents in Denmark. In the case that schoolchildren who were not present on the day of data collection have higher rates of loneliness, our analyses are likely to underestimate the actual level of loneliness. Because of the anonymous data collection it was not possible to carry out individual based non-participation analyses.

An additional limitation of our study is that we obtained information about the adolescents' loneliness using a single, self-report item: "Do you feel lonely?" Research suggests that children and adolescents have a fundamental understanding of what loneliness is, and that loneliness can be reliably measured in this age group (Asher and Paquette 2003). Loneliness is considered a multifactorial experience

that can be difficult to capture with one item (Russell et al. 1978). However, previous studies have shown that the single loneliness item correlates highly with multi-item loneliness scales such as the widely-used and well-validated UCLA Loneliness Scale (Russell 1982) and the De Jong Gierveld Loneliness Scale (Nicolaisen and Thorsen 2014). Furthermore, several researchers have found that single-item measures have similar reliability and validity to equivalent multi-items measures (e.g., Bowling 2005; Bergkvist and Rossiter 2007). For example, single-item measures of social support (Blake and Mckay 1986) and social identification (Postmes et al. 2013) have been shown to be useful research tools. Loneliness also carries a social stigma, and it has been suggested that studies that ask respondents directly about loneliness may underestimate the actual level of the respondents' loneliness (de Jong-Gierveld et al. 2006). We have no information on whether the potential underreporting is unequally distributed between the groups under study leading to differential misclassification. It is possible that the degree to which loneliness is stigmatizing may be different between cultures as cultural background plays an important role in the experience and understanding of loneliness (de Jong-Gierveld et al. 2006; Rokach et al. 2001).

Ethnicity can be defined as a multifaceted phenomenon that refers to the social group to which a person identifies with and belongs to or is assigned to by others. It is influenced by factors such as ancestry, cultural practices and values, language, and traditions (Bhopal 2004). It is a strength of our study, that we applied a measure of self-identified ethnicity as the basis for the measure of ethnic composition in the school classes. A person's self-defined ethnicity may be dynamic and change over time and context. Hence, this way of categorizing individuals, with the opportunity to choose which ethnic group one feels most affiliated with, provides a more valid approach to identifying groups that share cultural values and practices than alternative approaches such as categorizing individuals by their country of birth (Bhopal 2014; Phinney 1990). Following previous literature (Juvonen et al. 2006; Benner and Crosnoe 2011), schoolchildren with "mixed ethnicities" (i.e., those that reported two or more self-identified ethnicities) were considered as one ethnic group in the data material. However, considering "mixed ethnicities" as one group can be considered to be a limitation of the study because schoolchildren from the same mixed ethnic group do not always share the same self-identified ethnicity.

A further issue is that immigration background is conceptualized and measured differently in the literature (Madsen et al. 2016). However, careful sensitivity analyses with two alternative variations of this covariate were completed, and we found no substantial change in the OR-estimates. We also carried out careful sensitivity analyses

with the outcome variable "loneliness" and with the determinant "size of ethnic group in class". All of the sensitivity analyses confirmed the robustness of our results.

The fact that the participation rate for schoolchildren was only 85.7 % can also be considered a limitation. In the study by Juvonen et al. (2006), only classrooms with greater than 50 % participation where examined. Unfortunately, we did not have sufficiently detailed data to calculate response rates at the class level. Hence, we are unable to select classes in which all children participated. Instead, we complied with recommendations by (Rasmussen et al. 2002), who recommended that HBSC class level analyses be restricted to classes of at least ten students.

Finally, it is likely that our study suffered from unmeasured confounding. In particular, we did not have any information about whether schools or municipalities had policies that addressed the integration of special groups. This information is relevant because these policies could affect the composition of the schools and school classes (Spenner Kjeldberg 2014) and the level of loneliness (Qualter 2003).

Directions for Future Research

In the present study, we explored the association between ethnic composition in the school class and loneliness. Following Juvonen et al. (2006), it would have been interesting to explore whether the associations that we found would differed between ethnic groups in Denmark. Unfortunately, our study did not comprise ethnic groups that were large enough to carry out these analyses.

Our measure of loneliness is a measure defining loneliness as a uniform construct that primarily varies in intensity (Weeks and Asher 2012). Some loneliness scales apply a different approach to loneliness and introduce loneliness as a construct of several dimensions—e.g. the Loneliness and Aloneness Scale for Children and Adolescents (Marcoen et al. 1987) that distinguish between peer-related and parent-related loneliness. Applying a multidimensional measure of loneliness in future research could provide a more nuanced picture of the possible mechanisms through which ethnic composition relates to loneliness.

It is possible that the association that we identified between the individual characteristics of the schoolchildren in the school classes and loneliness could be modified by the ethnic diversity of the school class. For example, being a numerical ethnic minority in a homogenous school class as opposed to a heterogonous school could strengthen the association with loneliness because the status of being a minority would be more visible. This potential modifying effect should be tested in future research in this area.

Future research should also test potential mediators in order to obtain a fuller understanding of the association that we found between ethnic composition and loneliness. It is possible that minority stress could play an important role in this regards because ethnic minority youth may be confronted with stigma and prejudice related to their ethnic background (Abebe et al. 2014).

Although age group and sex were not significant modifiers of our key association, we did observe some interesting age group and sex differences in the strength of the associations between loneliness and membership of the majority ethnic group in class and size of ethnic group in the school class. In particular, the associations were stronger among boys than among girls and among 11-year-olds than among 13- or 15-year-olds. It is possible that these sex differences reflect differential treatment by male classmates compared to female classmates. In particular, male classmates may interact with ethnic minorities in terms of their social group more than females and, shown greater prejudice and discrimination as a result (Gabriel and Gardner 1999; Baumeister and Sommer 1997). Similarly, the age difference may reflect classmates' greater adherence to social norms of equality as they grow older (Raabe and Beelmann 2011). Again, however, the current results show that these age and sex differences are nonsignificant. Hence, future research is required in order to either corroborate or challenge these null findings.

Lastly, the ICC of the null model suggested that approximately 5 % of adolescents' loneliness can be explained by factors that are related to the school class context. This finding highlights the importance of acknowledging the school class context as another important element of adolescents' loneliness, and it prompts more research that explores these school class factors.

Implications for Practice

The Danish public school system comprises the vast majority of children in Denmark, making it a unique and important arena for interventions that aim to reduce and prevent loneliness in adolescents. Our results point to policies or interventions that focus on ethnically-marginalized schoolchildren and suggest approaches for ensuring that these adolescents are included in the social environment in the school class. In particular, our results suggest that belonging to the ethnic majority group and having a large ethnic group are inversely related to adolescents' loneliness in Denmark, but that ethnic diversity within the classroom is unrelated to loneliness. Hence, diversity per se does not seem to be as important as membership in a relatively large ethnic in-group, and making a classroom more diverse will not necessarily

reduce loneliness. Instead, a more promising approach to reducing loneliness is to increase the size of the ethnic groups to which minority group members belong. So, for example, although a Polish immigrant might not necessarily feel less lonely when a Turkish immigrant joins their class, thereby making it more ethnically diverse, they may feel less lonely when a Polish immigrant joins their class thereby increasing the size of their ethnic in-group.

A focus on promoting social connections between adolescents by emphasizing shared interests and behaviors other than those related to their ethnicity could also induce feelings of belonging and fitting in and eventually reduce levels of loneliness (Hamm 2000). An effective reduction of lonely adolescents would also have positive implications for schoolchildren's future academic performance (Juvonen et al. 2000; Benner and Crosnoe 2011) and mental health (e.g., Jones et al. 2011; Qualter et al. 2013; Schinka et al. 2013).

Conclusion

The influence of the ethnic composition of the school or the school class on adolescent loneliness has received little attention in the international literature. Despite that migration is a growing worldwide phenomenon and the issue of how the ethnic composition of schools may affect adolescents is a relevant and important issue in many parts of the world, we have only been able to identify two U.S. studies that have addressed this issue. The study, therefore, adds novel and important findings to how ethnicity in a school class context, as opposed to ethnicity per se, influences adolescents' loneliness in a representative sample of Danish adolescents. We found that two dimensions characterizing individuals within the school class may induce feelings of loneliness in adolescence: Adolescents who did not belong to the ethnic majority in the school class had increased odds for loneliness compared to adolescents that belonged to the ethnic majority; and having more same-ethnic classmates lowered the odds for loneliness. We did not find any statistically significant association between the ethnic diversity of the school classes and loneliness. Sensitivity analyses confirmed the robustness of these results. Hence, diversity per se does not seem to be as important as membership in a relatively large ethnic in-group, and interventions should focus on increase the size of the ethnic groups to which minority group members belong rather than simply making classrooms more diverse. Our results also suggest that the school class context plays an important role in relation to loneliness in adolescence because it shapes the opportunities that individuals have for engaging in social relations based on characteristics such as ethnicity.

Conflicts of interest The authors report no conflict of interests.

Ethical Approval The study complies with national guidelines regarding ethical standards and data protection and is registered at the Danish Data Protection Agency (J. No. 2013-54-0576). There is no agency for ethical approval of population-based survey studies in Denmark.

Informed Consent There is no official request for formal consent from parents in anonymous surveys. Therefore, we did not obtain written informed consent from parents or schoolchildren. Instead, we asked the school principal, the school board representing the parents, and the board of schoolchildren representing the schoolchildren in each of the participating schools for approval of the study. We informed the participants orally and in writing that the data collection was anonymous and voluntary. We did not collect information about name or other personal identification of the schoolchildren.

References

Abebe, D. S., Lien, L., & Hjelde, K. H. (2014). What we know and don't know about mental health problems among immigrants in Norway. *Journal of Immigrant and Minority Health, 16*(1), 60–67. doi:10.1007/s10903-012-9745-9.

Asher, S. R., & Paquette, J. A. (2003). Loneliness and peer relations in childhood. *Current Directions in Psychological Science, 12*(3), 75–78. doi:10.1111/1467-8721.01233.

Bagci, S. C., Kumashiro, M., Smith, P. K., Blumberg, H., & Rutland, A. (2014). Cross-ethnic friendships: Are they really rare? Evidence fromsecondary schools around London. *International Journal of Intercultural Relations, 41*, 125–137. doi:10.1016/j.ijintrel.2014.04.001.

Baumeister, R. F., & Sommer, K. L. (1997). What do men want? Gender differences and two spheres of belongingness: Comment on Cross and Madson (1997). *Psychological Bulletin, 122*(1), 38–44. doi:10.1037/0033-2909.122.1.38.

Bellmore, A. D., Witkow, M. R., Graham, S., & Juvonen, J. (2004). Beyond the individual: The impact of ethnic context and classroom behavioral norms on victims' adjustment. *Developmental Psychology, 40*(6), 1159–1172. doi:10.1037/0012-1649.40.6.1159.

Benner, A. D., & Crosnoe, R. (2011). The racial/ethnic composition of elementary schools and young children's academic and socioemotional functioning. *American Educational Research Journal, 48*(3), 621–646. doi:10.3102/0002831210384838.

Benner, A. D., & Wang, Y. (2014). Demographic marginalization, social integration, and adolescents' educational success. *Journal of Youth and Adolescence*. doi:10.1007/s10964-014-0151-6.

Bergkvist, L., & Rossiter, J. R. (2007). The predictive validity of multiple-item versus single-item measures of the same constructs. *Journal of Marketing Research, 44*(2), 175–184. doi:10.1509/jmkr.44.2.175.

Bhopal, R. (2004). Glossary of terms relating to ethnicity and race: for reflection and debate. *Journal of Epidemiology and Community Health, 58*(6), 441–445.

Bhopal, R. (2014). *Migration, ethnicity, race, and health in multicultural societies*. New York: Oxford University Press.

Blake, R. L., & Mckay, D. A. (1986). A Single-Item Measure of Social Supports as a Predictor of Morbidity. *Journal of Family Practice, 22*(1), 82–84.

Boldt, L. E. (2007). Tosprogede elever i grundskolen 2006/07 [Bilingual schoolchildren in the primary school 2006/2007]. In U. C. S. Analyse. Copenhagen: Styrelsen for It og Læring.

Bowling, A. (2005). Just one question: If one question works, why ask several? *Journal of Epidemiology and Community Health, 59*(5), 342–345. doi:10.1136/jech.2004.021204.

Budescu, D. V., & Budescu, M. (2012). How to measure diversity when you must. *Psychological Methods, 17*(2), 215–227. doi:10.1037/a0027129.

Damico, S. B., & Sparks, C. (1986). Cross-group contact opportunities—Impact on interpersonal relationships in desegregated middle schools. *Sociology of Education, 59*(2), 113–123. doi:10.2307/2112436.

de Jong-Gierveld, J., van Tilburg, T., & Dykstra, P. A. (2006). Loneliness and social isolation. In A. Vangelisti & D. Perlman (Eds.), *Cambridge handbook of personal relationships* (pp. 485–500). Cambridge: Cambridge University Press.

Eisenberg, N., Sallquist, J., French, D. C., Purwono, U., Suryanti, T. A., & Pidada, S. (2009). The relations of majority-minority group status and having an other-religion friend to indonesian youths' socioemotional functioning. *Developmental Psychology, 45*(1), 248–259. doi:10.1037/a0014028.

Ensminger, M. E., Forrest, C. B., Riley, A. W., Kang, M. S., Green, B. F., Starfield, B., et al. (2000). The validity of measures of socioeconomic status of adolescents. *Journal of Adolescent Research, 15*(3), 392–419. doi:10.1177/0743558400153005.

Ernst, J. M., & Cacioppo, J. T. (1999). Lonely hearts: Psychological perspectives on loneliness. *Applied and Preventive Psychology, 8*(1), 1–22. doi:10.1016/S0962-1849(99)80008-0.

Eurostat group. (2011). *Migrants in Europe A statistical portrait of the first and second generation* (2011th ed.). The European Union: Belgium.

Gabriel, S., & Gardner, W. L. (1999). Are there "his" and "hers" types of interdependence? The implications of gender differences in collective versus relational interdependence for affect, behavior, and cognition. *Journal of Personal and Social Psycholoty, 77*(3), 642–655.

Goosby, B. J., Bellatorre, A., Walsemann, K. M., & Cheadle, J. E. (2013). Adolescent loneliness and health in early adulthood. *Sociological Inquiry, 83*(4), 505–536. doi:10.1111/soin.12018.

Goossens, L. (2012). Genes, environments, and interactions as a new challenge for European developmental psychology: The sample case of adolescent loneliness. *European Journal of Developmental Psychology, 9*(4), 432–445. doi:10.1080/17405629.2012.673747.

Hamm, J. V. (2000). Do birds of a feather flock together? The variable bases for African American, Asian American, and European American adolescents' selection of similar friends. *Developmental Psychology, 36*(2), 209–219. doi:10.1037//0012-1649.36.2.209.

Harris, R. A., Qualter, P., & Robinson, S. J. (2013). Loneliness trajectories from middle childhood to pre-adolescence: Impact on perceived health and sleep disturbance. *Journal of Adolescence*. doi:10.1016/j.adolescence.2012.12.009.

Heinrich, L. M., & Gullone, E. (2006). The clinical significance of loneliness: A literature review. *Clinical Psychology Review, 26*(6), 695–718.

Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science, 10*(2), 227–237. doi:10.1177/1745691614568352.

Jones, A. C., Schinka, K. C., van Dulmen, M. H., Bossarte, R. M., & Swahn, M. H. (2011). Changes in loneliness during middle childhood predict risk for adolescent suicidality indirectly through mental health problems. *Journal of Clinical Child and Adolescent Psychology, 40*(6), 818–824.

Juvonen, J., Nishina, A., & Graham, S. (2000). Peer harassment, psychological adjustment, and school functioning in early adolescence. *Journal of Educational Psychology, 92*(2), 349–359.

Juvonen, J., Nishina, A., & Graham, S. (2006). Ethnic diversity and perceptions of safety in urban middle schools. *Psychological Science, 17*(5), 393–400. doi:10.1111/j.1467-9280.2006.01718.x.

Kingery, J. N., Erdley, C. A., & Marshall, K. C. (2011). Peer acceptance and friendship as predictors of early adolescents' adjustment across the middle school transition. *Merrill-Palmer Quarterly-Journal of Developmental Psychology, 57*(3), 215–243.

Ladd, G. W., & Ettekal, I. (2013). Peer-related loneliness across early to late adolescence: Normative trends, intra-individual trajectories, and links with depressive symptoms. *Journal of Adolescence*. doi:10.1016/j.adolescence.2013.05.004.

Lasgaard, M., Armour, C., Bramsen, R. H., & Goossens, L. (2015). Major life events as predictors of loneliness in adolescence. *Journal of Child and Family Studies*. doi:10.1007/s10826-015-0243-2.

Levine, M. P. (2012). Loneliness and eating disorders. *Journal of Psychology, 146*(1–2), 243–257. doi:10.1080/00223980.2011.606435.

Lien, N., Friestad, C., & Klepp, K. I. (2001). Adolescents' proxy reports of parents' socioeconomic status: How valid are they? *Journal of Epidemiology and Community Health, 55*(10), 731–737.

Madsen, K. R., Damsgaard, M. T., Jervelund, S. S., Christensen, U., Stevens, G. W. J. M., Walsh, S., et al. (2016). Loneliness, immigration background and self-identified ethnicity: A nationally representative study of adolescents in Denmark. *Journal of Ethnic and Migration Studies*, accepted for publication, doi:10.1080/1369183X.2015.1137754.

Mahon, N. E., Yarcheski, A., Yarcheski, T. J., Cannella, B. L., & Hanks, M. M. (2006). A meta-analytic study of predictors for loneliness during adolescence. *Nursing Research, 55*(5), 308–315.

Marcoen, A., Groossens, L., & Caes, P. (1987). Loneliness in pre-through late adolescence: Exploring the contributions of a multidimensional approach. *Journal of Youth and Adolescence, 16*, 561–577.

Margalit, M. (2010). Peer relations and loneliness within different cultures. In *Lonely Children and Adolescents. Self-Perceptions, Social Exclusion, and Hope* (pp. 133–170). Tel Aviv: Springer.

Merlo, J., Chaix, B., Ohlsson, H., Beckman, A., Johnell, K., Hjerpe, P., et al. (2006). A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena.

Journal of Epidemiology and Community Health, 60(4), 290–297. doi:10.1136/jech.2004.029454.

Ministry of Education (2015). *Folkeskolen i tal* [*The Danish Public School in Numbers*]. Retrived October 11, 2015, from http://www.uvm.dk/Uddannelser/Folkeskolen/Folkeskolens-maal-love-og-regler/Om-folkeskolen-og-folkeskolen-formaal/Folkeskolen-i-tal.

Neto, F. (2002). Loneliness and acculturation among adolescents from immigrant families in Portugal. *Journal of Applied Social Psychology, 32*(3), 630–647. doi:10.1111/j.1559-1816.2002.tb00234.x.

Neto, F., & Barros, J. (2000). Predictors of loneliness among adolescents from Portuguese immigrant families in Switzerland. *Social Behavior and Personality, 28*(2), 193–205. doi:10.2224/sbp.2000.28.2.193.

Nicolaisen, M., & Thorsen, K. (2014). Who are lonely? Loneliness in different age groups (18–81 years old), using two measures of loneliness. *International Journal of Aging and Human Development, 78*(3), 229–257. doi:10.2190/AG.78.3.b.

Nordahl, H., Krølner, R., Pall, G., Currie, C., & Andersen, A. (2011). Measurement of ethnic background in cross-national school surveys: Agreement between students' and parents' responses. *Journal of Adolescent Health, 49*(3), 272–277. doi:10.1016/j.jadohealth.2010.12.013.

Peltzer, K., & Pengpid, S. (2016). Health risk behaviour among in-school adolescents in the Philippines: Trends between 2003, 2007 and 2011, A Cross-Sectional Study. *International Journal of Environmental Research and Public Health, 13*(1), 73. doi:10.3390/ijerph13010073.

Peplau, L., & Perlman, D. (1982). *Loneliness: A source book of current theory, research, and therapy*. New York: John Wiley.

Pettigrew, T. F., & Tropp, L. R. (2006). A meta-analytic test of intergroup contact theory. *Journal of Personality and Social Psychology, 90*(5), 751–783. doi:10.1037/0022-3514.90.5.751.

Phinney, J. S. (1990). Ethnic identity in adolescents and adults: Review of research. *Psychological Bulletin, 108*(3), 499–514.

Polo, A. J., & Lopez, S. R. (2009). Culture, context, and the internalizing distress of Mexican American Youth. *Journal of Clinical Child and Adolescent Psychology, 38*(2), 273–285. doi:10.1080/15374410802698370.

Postmes, T., Haslam, S. A., & Jans, L. (2013). A single-item measure of social identification: Reliability, validity, and utility. *British Journal of Social Psychology, 52*(4), 597–617. doi:10.1111/bjso.12006.

Priest, N., Perry, R., Ferdinand, A., Paradies, Y., & Kelaher, M. (2014). Experiences of racism, racial/ethnic attitudes, motivated fairness and mental health outcomes among primary and secondary school students. *Journal of Youth Adolescence, 43*(10), 1672–1687. doi:10.1007/s10964-014-0140-9.

Qualter, P. (2003). Loneliness in children and adolescents: What do schools and teachers need to know and how can they Help? *Pastoral Care in Education, 12*(2), 10–18. doi:10.1111/1468-0122.00257.

Qualter, P., Brown, S. L., Rotenberg, K. J., Vanhalst, J., Harris, R. A., Goossens, L., et al. (2013). Trajectories of loneliness during childhood and adolescence: Predictors and health outcomes. *Journal of Adolescence*. doi:10.1016/j.adolescence.2013.01.005.

Raabe, T., & Beelmann, A. (2011). Development of ethnic, racial, and national prejudice in childhood and adolescence: A multinational meta-analysis of age differences. *Child Development, 82*(6), 1715–1737. doi:10.1111/j.1467-8624.2011.01668.x.

Rasmussen, M., Damsgaard, M. T., Due, P., & Holstein, B. E. (2002). Boys and girls smoking within the Danish elementary school classes: A group-level analysis. *Scandinavian Journal of Public Health, 30*(1), 62–69.

Roberts, C., Freeman, J., Samdal, O., Schnohr, C. W., de Looze, M. E., Gabhainn, S. N., et al. (2009). The health behaviour in school-aged children (HBSC) study: Methodological developments and current tensions. *International Journal of Public Health, 54*, 140–150. doi:10.1007/s00038-009-5405-9.

Rokach, A., Orzeck, T., Cripps, J., Lackovic-Grgin, K., & Penezic, Z. (2001). The effects of culture on the meaning of loneliness. *Social Indicators Research, 53*(1), 17–31. doi:10.1023/A:1007183101458.

Russell, D. (1982). The Measurement of Loneliness. In L. Peplau & D. Perlman (Eds.), *Loneliness: A sourcebook of current theory, research and therapy* (pp. 81–104). New York: John Wiley.

Russell, D., Peplau, L. A., & Ferguson, M. L. (1978). Developing a measure of loneliness. *Journal of Personality Assessment, 42*(3), 290–294. doi:10.1207/s15327752jpa4203_11.

Schinka, K. C., Van Dulmen, M. H. M., Bossarte, R., & Swahn, M. (2012). Association between loneliness and suicidality during middle childhood and adolescence: Longitudinal effects and the role of demographic characteristics. *Journal of Psychology, 146*(1–2), 105–118. doi:10.1080/00223980.2011.584084.

Schinka, K. C., van Dulmen, M. H., Mata, A. D., Bossarte, R., & Swahn, M. (2013). Psychosocial predictors and outcomes of loneliness trajectories from childhood to early adolescence. *Journal of Adolescence*. doi:10.1016/j.adolescence.2013.08.002.

Simpson, E. H. (1949). Measurement of diversity. *Nature, 163*(4148), 688. doi:10.1038/163688a0.

Spenner Kjeldberg, K. (2014). *Allerslev vil bruge ny test til at blande børn i Københavns skoler* [*Allerselv will apply a new test to mix up schoolchildren i Copenhagen schools*]. Retrived January 11, 2015, from http://www.b.dk/nationalt/allerslev-vil-bruge-ny-test-til-at-blande-boern-i-koebenhavns-skoler.

Statistics Denmark. (2014). *Indvandrere i Danmark [Immigrants in Denmark]*. Copenhagen: Statistics Denmark.

Stickley, A., Koyanagi, A., Koposov, R., Schwab-Stone, M., & Ruchkin, V. (2014). Loneliness and health risk behaviours among Russian and US adolescents: A cross-sectional study. *BMC Public Health*. doi:10.1186/1471-2458-14-366.

The Danish Union of Teachers. (2014). *Antal tosprogede elever i folkeskolen [Number of bi-lingual schoolchildren in the primary school]*. Retrived October 11, from http://www.dlf.org/media/2072158/antal-tosprogede-elever-i-folkeskolen.pdf.

van Bergen, D. D., Smit, J. H., van Balkom, A. J. L. M., van Ameijden, E., & Saharso, S. (2008). Suicidal ideation in ethnic minority and majority adolescents in Utrecht, The Netherlands. *Crisis—The Journal of Crisis Intervention and Suicide Prevention, 29*(4), 202–208. doi:10.1027/0227-5910.29.4.202.

van Dulmen, M. H., & Goossens, L. (2013). Loneliness trajectories. *Journal of Adolescence*. doi:10.1016/j.adolescence.2013.08.001.

van Staden, W. C., & Coetzee, K. (2010). Conceptual relations between loneliness and culture. *Current Opinion in Psychiatry, 23*(6), 524–529.

Vanhalst, J., Luyckx, K., & Goossens, L. (2014). Experiencing loneliness in adolescence: A matter of individual characteristics, negative peer experiences, or both? *Social Development, 23*(1), 100–118. doi:10.1111/Sode.12019.

Victor, C., & Burholt, V. (2012). Loneliness amongst ethnic minority elders: Preliminary results of a survey in England and Wales. *Gerontologist, 52*, 269.

Weare, K. (2000). *Promoting Mental: A whole school approach*. New York: Routledge.

Weeks, M. S., & Asher, S. R. (2012). Loneliness in childhood: Toward the next generation of assessment and research. *Advances in Child Development and Behavior, 42*, 1–39.

Katrine Rich Madsen cand.scient.san.publ is a Ph.D. fellow at the National Institute of Public Health, University of Southern Denmark. Her research focuses on the social factors, such as ethnicity and socioeconomic position, which contributes to loneliness and mental health in adolescence.

Mogens Trab Damsgaard sociologist, is an associate professor in social epidemiology at the National Institute of Public Health, University of Southern Denmark. He has worked for many years with methodological development and linkage between theory and methods in the field of child and adolescent health. His recent focus has mainly been within overweight and mental health and well-being.

Dr. Mark Rubin is a senior lecturer in social psychology at the University of Newcastle, Australia. He is best known for his work on social identity and intergroup relations, including research on counterstereotypicality, ingroup identification, intergroup contact, and perceived group variability. His other research interests include individualism and collectivism, interdependent problem-solving, migration processes, the need for closure, social class, and social integration.

Signe Smith Jervelund, M.Sc., Ph.D. is Associate Professor and Research Director at Danish Centre for Migration, Ethnicity and Health at the Section for Health Services Research, Department of Public Health at the University of Copenhagen. Her research focuses on the functions, effects and outcomes of healthcare for different population groups with a special focus on vulnerable groups in both a national and international comparative perspective. Current projects include intervention projects on healthcare-seeking behavior among newly-arrived immigrants as well as investigation of trajectories from childhood to young adulthood in refugees, including identifying welfare policies that promote health and socio-economic equity.

Mathias Lasgaard is an associate professor at the Department of Psychology, University of Southern Denmark and at Public Health and Quality Improvement, Central Denmark Region, Aarhus, Denmark. His research focuses on mental health in adolescence with a particular interest in loneliness/isolation, sexual assault and violence, and applied research.

Sophie D. Walsh, Ph.D. is a Clinical Psychologist and a Senior Lecturer in the Criminology Department at Bar Ilan University, Israel. Sophie's research currently focuses on well-being, substance use, violence and delinquency among adolescents in general and immigrant adolescents in particular. She is especially interested in understanding the mechanisms (risk and resiliency factors) for the involvement of immigrant adolescents in risk behavior.

Dr. Gonneke W. J. M. Stevens is an assistant professor at the Utrecht Centre for Child and Adolescent Studies, Utrecht University, The Netherlands. In her research, she attempts to unravel the (alleged) risks of immigration to child development, by focusing among others on socioeconomic status, (perceptions of) discrimination, acculturation orientations, parent–child relationships, ethnic density and receiving country comparisons.

Bjørn Holstein mag. scient. soc., is professor in social epidemiology at the University of Southern Denmark, National Institute of Public Health. He has been involved in research about health and health behaviors among children and adolescents for many years. His research focuses mostly on the contribution of social factors for child and adolescent health.