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ARTICLE

Adolescent loneliness across the world and its relation to school climate, national culture and academic performance

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Abstract

Background: Loneliness during adolescence has adverse consequences for mental health, education and employment outcomes. Yet, we know little about common correlates of loneliness among adolescents, making intervention work difficult.

Aims: In this study, we (1) explore individual-, school- and country-level correlates of loneliness to help identify potential intervention targets, and (2) examine the influence of loneliness on academic performance.

Sample: A total of 518,210 students aged 15 years from 75 countries provided self-reported loneliness data.

Results: Using multilevel modelling, we found individual-, school- and country-level correlates of self-reported school-based loneliness, and showed that loneliness negatively influenced academic performance.

Conclusions: Based on the findings, interventions that focus on enhancing social and emotional skills, increasing trust between teachers and students and changing school climate to be more inclusive are likely to be the most effective for adolescents; they should also be culturally sensitive.

KEYWORDS

academic performance, adolescents, culture, loneliness, PISA, school climate, teacher–student relationship

INTRODUCTION

Loneliness is a negative and unpleasant emotional experience that occurs when a person perceives there to be a discrepancy between the quantity or quality of their actual and desired relationships (Cacioppo et al., 2006). For example, a person who reports loneliness might feel that they have too few relationships or that their relationships lack closeness or intimacy. Irrespective of whether age differences in loneliness follow a U-shaped curve (Hawkley et al., 2020; Lasgaard et al., 2016; Luhmann & Hawkley, 2016; Victor & Yang, 2012) or a downward slope across age (Barreto et al., 2021; ONS, 2018), research consistently shows that loneliness is most prevalent during late adolescence and early adulthood (16–24 years of age). However, little is still known about the most common correlates of loneliness among adolescents, such that key factors for targeted intervention are unknown. In this study, we explore data from the OECD-PISA 2018 study and explore individual-, school- and country-level correlates of loneliness among 15-year-old adolescents across the world.

Risk factors for loneliness

Given the increased prevalence of loneliness among adolescents (Twenge et al., 2021), particularly during the COVID-19 pandemic (for review, see Jefferson et al., 2023), it has become a strategic priority for public health, clinical and educational services and third-sector organizations. Loneliness has been shown to increase the risks for, or amplify the experiences of, serious mental health problems during adolescents (Mann et al., 2017; Park et al., 2020; Solmi et al., 2020). It also has adverse consequences for education and employment outcomes (Matthews et al., 2022). Yet, we know little about common correlates of loneliness among adolescents, making intervention work difficult because we do not know what to target.

In recent work (Qualter, Eccles, & Barreto, 2021), researchers highlighted how risk factors for youth loneliness likely operate at different levels. Using a social ecological perspective (Bronfenbrenner, 2005) to understand loneliness among adults, loneliness has been shown to be the product of individual, social and wider environmental factors (Buecker et al., 2021; Madsen et al., 2021; Marquez et al., 2022). However, such work with youth is missing, such that we do not know how individual-, peer-, school-, neighbourhood- and country-level variables impact experiences of loneliness for school-aged adolescents. The PISA data set allowed us to address this gap in understanding—with the aim of identifying appropriate targets for intervention to alleviate loneliness in youth—by including data on risk factors that span the social ecological spectrum, including the school.

Demographic and individual factors that influence loneliness

With regard to demographic characteristics, there has been inconsistent evidence regarding the association between gender and loneliness. However, meta-analytical evidence (Maes et al., 2019) suggests that males are slightly lonelier than females in youth. Immigration status has also been linked to loneliness in youth, with research finding an increased risk of loneliness for immigrants, but not descendants of immigrants, compared to adolescents without a migration history (Madsen et al., 2016). Moving from friends or family is a common explanation for loneliness making immigrants but not descendants or native-born adolescents particularly vulnerable candidates for loneliness (Tartakovsky, 2009). Further, immigrant youth experience language barriers and may also experience not being properly understood in terms of one's cultural norms and values, which are also potential causes of loneliness (Madsen et al., 2021). Similarly, identification with the majority ethnic group has been shown to be protective from loneliness among immigrant adolescents (Madsen et al., 2016), although other research in the United Kingdom has shown that self-identification with a minority ethnic group can also be protective (Marquez et al., 2022; Yang et al., 2022).

An association between socio-economic status (SES) and loneliness has also been found: youth with lower family SES report higher levels of loneliness than youth with a higher family SES (Batsleer & Duggan, 2020; Madsen et al., 2019; Qualter, Hennessey, et al., 2021). Low SES is also associated with more housing instability (Clark, 2018), which impacts social relationships (Coleman, 1988) and stress (Silver et al., 2002) and contributes, in turn, to poorer mental health, especially among adolescents (Morris et al., 2016). Similarly, moving schools has been linked to increased depression (Herbers et al., 2013), psychotic-like symptoms (e.g., delusions; Singh et al., 2014) and problem behaviour in and out of school (Gasper et al., 2010). However, the effects of school mobility (and the weakened social ties that are likely to come with that) on loneliness have not been explored. We fill that gap in this work, exploring whether high individual school mobility impacts loneliness.

With regard to psychological factors, studies have shown a reciprocal negative relationship between loneliness and personal self-esteem (Lyyra et al., 2021). Having low self-esteem is associated with negative expectations about social interactions, social withdrawal and low confidence during social interactions, as young people worry about what their peers think of them and ultimately about rejection (Watson & Nesdale, 2012; Zhou et al., 2020). Fear of failure also involves an apprehension of social evaluation and devaluing one's self-worth (Conroy et al., 2002) and leads to diminished self-worth, learned helplessness and withdrawal (Elliot & Thrash, 2004; Martin & Marsh, 2003). Fear of failure has not been explored in terms of loneliness, but it seems likely that fear of failure and loneliness are related. In this study, we explored whether a general fear of failure is associated with loneliness for youth across the world.

Resilience, defined as the ability to maintain mental health while dealing with challenges and failures (Herrman et al., 2011), has been found to protect young people against the negative impacts of social exclusion and bullying (Arslan, 2019; Hinduja & Patchin, 2017). Adolescence is perceived to be a particularly stressful time with reported daily stressful events involving social conflicts (Seiffge-Krenke & Shulman, 1993), so resilience is important in helping youth cope positively with the everyday stressors of adolescence, and could potentially protect them from loneliness or, at least help them to overcome feelings of loneliness. However, the relationship between resilience and youth loneliness has not been explored, and we addressed that gap in this study.

The contribution of school climate to loneliness

School climate refers to the larger environmental characteristics of a school. It includes (1) values and norms about behaviour, performance and relationships, (2) the emphasis given to learning and teaching and (3) social relationships (Thapa et al., 2013). Recent research suggests that different aspects of school climate are associated with adolescent mental health. In this study, we explored whether aspects of school climate are linked to heightened loneliness among students.

School norms about relationships comprise respect for diversity, social support from adults and students and general school leadership (who is in charge, who contributes to decision-making). A sense of school connectedness to peers and teachers is associated with fewer mental health problems (Long et al., 2020); perceived school inclusivity is also linked to better mental health (László et al., 2019). Experiences with prejudice are linked to heightened loneliness among adults (Barreto et al., 2021, 2022; Qualter, Eccles, & Barreto, 2021, Qualter, Hennessey, et al., 2021), so school climates that emphasize difference in a negative way may prevent people from reaching out for help with their feelings of loneliness. Thus, we anticipated that school climates that emphasize diversity, inclusivity and social support would be associated with lower levels of student loneliness.

School safety is another aspect of school climate and it encompasses general disciplinary practices and the way the school addresses victimization. Negative discipline has been shown to impact mental health in a negative way (Salle et al., 2018); feeling safe in school is linked positively to mental health (Nijs et al., 2014). Evidence shows that bullying predicts loneliness (Matthews et al., 2020), so we anticipated that school climates that emphasized cooperation and were anti-bullying would have students who report less loneliness.

Country-level influences

Research has shown that cultural *individualism* (vs. *collectivism*) affects loneliness prevalence. In individualistic cultures, such as in Northern Europe or America, individuals are encouraged to be self-reliant and independent; in collectivist cultures, such as Latin and Asian countries, interdependence is more valued (Hofstede et al., 2010). This cultural dimension has been shown to help understand differences across countries in the prevalence of loneliness among adults (Barreto et al., 2021; Dykstra, 2009), but how this cultural dissimilarity affects loneliness during adolescence is as yet unknown. It is possible that this dimension is, in fact, less relevant for adolescents, who are still fairly dependent on their families irrespective of where they live.

Previous work has not explored how other dimensions of cultural difference might impact loneliness. As such, in this study, we look beyond the individualistic–collectivist distinction to explore the influence of national culture on loneliness among youth. A second dimension identified by Hofstede is *power distance*, which refers to the extent to which less powerful members of society accept the authority of those who have more power (Hofstede et al., 2010). Greater cultural power distance (such as in China or India, compared to the United Kingdom or the Netherlands) has been associated with more social inequality, which in turn is negatively associated with well-being and aspects of social relationships, such as reciprocity and trust (Daniels & Greguras, 2014; Wilkinson & Pickett, 2009). As such, it is possible that power distance is positively associated with loneliness.

How a particular culture stands along the *masculinity* versus *femininity* dimension might also affect loneliness. More masculine societies (e.g., China and the United Kingdom) are more focused on achievement and material rewards, whereas societies classified as more feminine (e.g., the Netherlands) prioritize cooperation and nurturing (Hofstede et al., 2010). As such, it is expected that loneliness will be more prevalent in more masculine (vs. feminine) societies. Indeed, research with students aged 18–22 years has demonstrated a positive association between masculine ideals, assessed at the individual level and loneliness (Blazina et al., 2007). We explore this link when masculinity versus femininity are assessed at the country level.

Cultures also differ in *uncertainty avoidance*, that is, the extent to which they tolerate uncertainty about the future. Societies high in uncertainty avoidance (e.g., Spain and South Korea) develop rigid norms of behaviour that are strongly enforced to reduce uncertainty, whereas societies low in uncertainty avoidance (e.g., China and Vietnam) have more relaxed norms (Hofstede et al., 2010). These norms extend to social interactions—who one can interact with, how often, and where—restricting opportunities for connection and increasing the potential for loneliness. At the same time, these norms might mean that aspirations for social connection are also more modest, which would instead reduce loneliness. Although the link between uncertainty avoidance and loneliness has not been examined, uncertainty avoidance is reminiscent of a prevention style of self-regulation, which has been shown to increase vigilance to avoid loss and can be distinguished from a promotion regulation style that focuses on gains (Higgins, 2002). Research has shown that priming a promotion (vs. prevention) focus can facilitate social connection (Lucas et al., 2010). However, this has only been examined at the individual level, in societal contexts that are in themselves low on uncertainty avoidance (e.g., the United States). In this article, we examine the role of uncertainty avoidance at the cultural level, reflecting a tendency that is culturally shared.

The dimension of *indulgence* versus *restraint* also refers to stricter (e.g., China) or loser (US) social norms, but the restrictions it refers to are less extreme than those implied by uncertainty avoidance. This dimension might, therefore, have similar but weaker effects to uncertainty avoidance. Finally, *cultural long* versus *short-term orientation* refers to the extent to which a particular society focuses more on maintaining past traditions (e.g., China and South Korea) or on progress and change (e.g., United States). Related to this, research has shown that engaging in nostalgia enhances social connection (Sedikides et al., 2008), so it is possible that societies that focus more on maintaining past traditions are better able to maintain a sense of identity and community, which are protective of loneliness.

The consequences of loneliness for academic achievement

Research has identified the detrimental impacts loneliness has on adolescent's educational outcomes. For example, children and adolescents reporting higher loneliness, compared to youth reporting lower loneliness, are more likely to have a negative attitude towards school (Eccles et al., 2021; Guay et al., 1999) and are more likely to intend to leave school at the age of 16 years (Frostad et al., 2015). They are also more likely to have worse academic achievement (Benner, 2011). However, the research linking loneliness and academic achievement is limited and mainly from Western countries: it is unknown whether this relationship is robust across the world. Further, most of the work that explores academic achievement as an outcome of loneliness fails to control for the nested nature of the data. The PISA survey provides data on academic achievement in Science, Mathematics and Reading, enabling an examination of relationships between loneliness and academic performance across the world. Using multilevel modelling to explore the PISA data, we examined the relationship between loneliness and academic performance across the countries involved in the PISA survey, allowing us to investigate the robustness of that relationship. While we acknowledge the limitation of those data being cross-sectional, this analysis allowed an examination of whether the relationship is found across different countries and whether it is robust when other key variables that are related to loneliness and/or academic achievement are controlled.

This study

The overall aim of this study is the identification of important risk factors for loneliness among adolescents, so that appropriate targets for intervention to alleviate loneliness in youth can be developed. We explore correlates of loneliness among youth, such as gender, which have been explored before, but not in such a large cohort of youth; we also explore how resilience, school climate and culture, variables not explored before in relation to loneliness among youth, influence reports of youth loneliness. Using data from the PISA 2018 survey, we conducted multilevel modelling to examine individual, school and country factors that correlate with self-reported school-based loneliness. In addition, given the absence of work exploring the influence of loneliness on academic performance using large data, we investigated whether loneliness is associated with academic performance.

METHOD

Data

Data for this study were obtained from the PISA 2018 survey (https://www.oecd.org/pisa/data/2018database/). PISA is the largest systematic assessment of international educational standards. It assesses the extent to which 15-year-old students can apply the knowledge learned in science, literacy and mathematics to real world problems. Students taking part in PISA are randomly sampled from a representative group of schools, also randomly selected, in each participating country. In 2018, data were collected from 710,000 students from 79 participating countries, representing more than 31 million 15-year-old students across the world. Quality standards were ensured regarding sampling of schools, with PISA 2018 requiring that (1) at least 85% of the schools initially selected in each country took part in the PISA assessment and, (2) at least 80% of the students chosen in each school actually participated (https://www.oecd-ilibrary.org/docserver/1b045c06-en.pdf?expires=1680521660&id=id&accname=guest&checksum=61355CF7F00464732B0A20FAEC550E2D). Data from PISA used in this study are (1) academic performance data, collected during a 2-hr test completed by students, and (2) survey data from the student on loneliness, gender, immigration background, number of school changes, resilience, victimization, disciplinary school climate, teacher support, teacher interest and engagement

with students and subjects, peer competition and cooperation, and discriminatory school climate. Data on country-level variables for each country were calculated for the six cultural dimensions detailed by Hofstede et al. (2010).

A total of 518,210 students aged 15 years ($F = 49.8\%$) from 75 countries and 20,599 schools (an average of 25.16 students in each school) provided data on self-reported loneliness in the PISA 2018 survey.

Measures

Table S1 includes all the items from PISA used in the analyses; where scales are used, we provide each item detail in each and the respective Cronbach's alpha.

Loneliness

School loneliness was assessed using the item 'I feel lonely at school' to which students responded using a 4-point Likert scale from 'Strongly agree' (1) to 'Strongly disagree' (4). Scores on this item were reverse coded so that higher scores on this measure represent higher loneliness. Using a single direct item of loneliness for school-aged children and adolescence has been recommended by the Office for National Statistics in the United Kingdom, and is especially suitable when there are survey space constraints (ONS, 2018); associations between common correlates of youth loneliness are similar when using direct single item or indirect multi-item loneliness scales (Eccles et al., 2020). Single-item loneliness measures appear in many published studies of loneliness (Mund et al., 2023). Loneliness scores, standardized across the full sample, were used in the analyses.

Country-level variables

We coded each country along each of the six cultural dimensions detailed by Hofstede et al. (2010): Individualism/Collectivism, Indulgence/Restraint, Masculinity/Femininity, Uncertainty Avoidance, Long-term Orientation/Short-term Orientation and Power Distance. Scores for each dimension were collected from the online tool: https://www.hofstede-insights.com/product/compare-countries/. All scores collected were checked by a second researcher. For some countries, scores were unavailable for some of the dimensions (see Table S2).

Individual-level variables: School-related (school climate) variables

Students reported on school level variables as follows: Disciplinary climate (five items[1] e.g., 'Students don't listen to what the teacher says'; 4-point scale from 'Every lesson' to 'Never or hardly ever'); Teacher support (four items e.g., 'The teacher shows interest in every student's learning'; 4-point scale from 'Every lesson' to 'Never or hardly ever'); Teacher interest (four items e.g., 'It was clear to me that the teacher liked teaching'; 4-point scale from 'Strongly disagree' to 'Strongly agree'); Peer competition at school (three items e.g., 'Students seem to value competition'; 4-point scale from 'Not at all true' to 'Extremely true'); Peer cooperation at school (three items e.g., 'Students seem to value cooperation'; 4-point scale from 'Not at all true' to 'Extremely true'); Discriminating school climate (four items e.g., 'They [*teachers*] have misconceptions about the history of some cultural groups'; 4-point scale from 'To none or almost none of them' to 'To all or almost all of them').

[1]For disciplinary climate and teacher support, students were asked to answer the questions in relation to their language lessons because reading was the subject of interest for the 2018 PISA cycle.

Individual-level variables

Gender (0 = Female; 1 = Male); Immigration status (0 = native; 1 = second generation 2 = first generation immigrant); Number of schools changes (0 = none or one change of school; 1 = two or more changes of school); General fear of failure (three items, e.g., 'When I am failing, I worry about what others think of me'; 4-point scale from 'Strongly disagree' to 'Strongly agree'); Resilience (three items, e.g., 'I usually manage one way or another'; 4-point scale from 'Strongly disagree' to 'Strongly agree'); Victimization (labelled 'being bullied' in the PISA data set; three items, e.g., 'Other students left me out of things on purpose'; 4-point scale from 'Never' to 'Once a week or more'). The PISA Index of Economic Social and Cultural Status was used as a measure of SES, and was calculated using information provided by students on their parents' education, parents' highest occupational status and household possessions (OECD, 2019).

Academic performance

Proficiency scores for reading, mathematics and science were used to represent academic performance in this study. PISA 2018 students completed performance tests in these subjects, which included a fraction of items from an item bank. Item response theory was used to estimate the ability of the students in each subject, which resulted in the PISA data including 10 plausible values rather than a point estimate of a student's ability in each subject. For this study, only the first plausible value was used because this is recommended by OECD as more reliable than using the average of the plausible values (OECD, 2019).

Scale scoring

The final scores for individual items that reflected individual (socio-demographic and perceived school climate variables) risk factors were grouped into constructs (disciplinary climate, teacher support, teacher interest, peer competition, peer cooperation, discriminating school climate, fear of failure, resilience, victimization and SES) and those were calculated using the Generalized Partial Credit Model, which is an item-response model appropriate for working with ordinal data (Martínez-Abad et al., 2020). The scores of derived variables were transformed by PISA to scales with a mean of 0 and standard deviation of 1 (possible scores are −1 to 1). Transformed scores represent a student's deviation from the mean score of students in OECD countries (for more details see https://www.oecd.org/pisa/data/pisa2018technicalreport/). A score of −1 indicates that a student has scored less than the average student from their country of residence.

Analysis plan

First, we explored the percentage of students in the PISA 2018 survey who reported that they 'strongly agreed' or 'agreed' with the statement 'I feel lonely at school', noting the variation in means across countries. PISA data have a nested structure, since participants are nested within schools within countries. We accounted for that nested structure by using multilevel modelling (MLM) in which school and country of residence are the superordinate (Level 2 and Level 3) factors. Specifically, country of residence and school attended were included as random intercepts. This approach acknowledges the fact that participants from the same school, and within the same country, are more similar in their scores than participants from different schools or countries. To explore whether that was the case for loneliness, our multilevel analysis followed three steps. Step 1 involved the calculation of the ICCs (Model 1) and was a null (empty) multilevel model (Level 1 = individual; Level 2 = school; Level 3 = country) with no fixed predictors included. In Step 2, we added the covariates measured at Level 1 (gender, changing school more frequently, socio-economic status, general fear of failure, self-efficacy, victimization and school climate variables as noted by the pupils; Model 2) to examine their impact on loneliness and to report the ICC after accounting

for those predictor variables. In Step 3, we included student science, maths and reading performance as outcomes of loneliness, exploring whether academic achievement was predicted by school-based loneliness, while controlling for the covariates. In all analyses, significance was accepted at $p < .05$. Effect size measures included the intraclass correlation coefficients (ICC) for random effects and standardized regression coefficients for fixed effects. R^2 was used as the measure of variance explained. Multilevel models were fit using restricted maximum likelihood estimation, with full information maximum likelihood (FIML) used for missing data. Levels of missing data are reported in Table 2; results from MLM Model 2 when listwise deletion is used for missing data are noted in Table S4. Analyses were conducted in MPlus 8.4.

While we acknowledge the ongoing debate regarding multilevel sample size (Sagan, 2019), we followed recommendations from simulation studies that, in MLM, the number of groups is more important than the number of individuals per group (Maas & Hox, 2005; Sagan, 2019; Snijders, 2005). Indeed, those simulation studies showed that, while the sample size at Level 1 (individual) is recommended to be between 30 and 50 respondents in each group, that number is not strictly required, with many studies conducted on groups with only 1–3 people without presenting bias in estimation. Thus, even though the number of children in some of schools in PISA was smaller than 30, we included all children who provided data in our analyses given (1) a large number of schools in each country were sampled, (2) at least 80% of the students chosen in each school participated, and (3) we wanted to ensure that children from across the world were represented.

RESULTS

The percentage of students in the PISA 2018 survey who reported that they 'strongly agreed' or 'agreed' with the statement 'I feel lonely at school' for each country is detailed in Figure 1. On average, 17.9% of the students reported feeling lonely at school (5.6% strongly agreed; 12.3% agreed). The average loneliness score after reverse scoring, so that higher scores represented higher loneliness, for students completing the PISA 2018 survey was 1.82 ($SD = .849$ [range 1–4]). There was variation across countries, with the Dominican Republic reporting the highest prevalence of loneliness (28.2%) and the Netherlands the lowest (7.5%).

Multilevel models

Table 1 details the estimates from the MLM Model 1.[2] The estimates show unique effects of school and country on student self-reported loneliness. The ICC for loneliness at the school level was .022 level and .034 at the country level, suggesting that a small amount of total variance in loneliness was attributable to school effects (2.2%) and to country effects (3.4%). While those are small effects (LeBreton & Senter, 2008), we followed best practice and accounted for the clustering effects of school and country using MLM (Huang, 2016) in the next stage of our analyses, where we explored the correlates of loneliness and the effect of loneliness on academic achievement.

Table 2 shows the descriptive statistics for the covariates of loneliness included in the Model 2. Table S3 shows the correlations between those correlates. Table 3 shows the statistical results for MLM Model 2, which includes all those variables, and FIML for missing data.[3] ICCs drop to .010 and .023 for

[2]Please note that the findings reported here for the multilevel models use information maximum likelihood (FIML) for missing data. Findings when listwise deletion was used can be found in Supporting Information and show the same overall results (similar significant estimates and model fit) as when FIML is used for missing data.

[3]Table S4 shows the results from Model 2 when listwise deletion of missing data is used. Please note that for country dimensions, long-term orientation was not consistent across both sets of findings (when listwise deletion and FIML were used), suggesting this was a less robust finding compared to others.

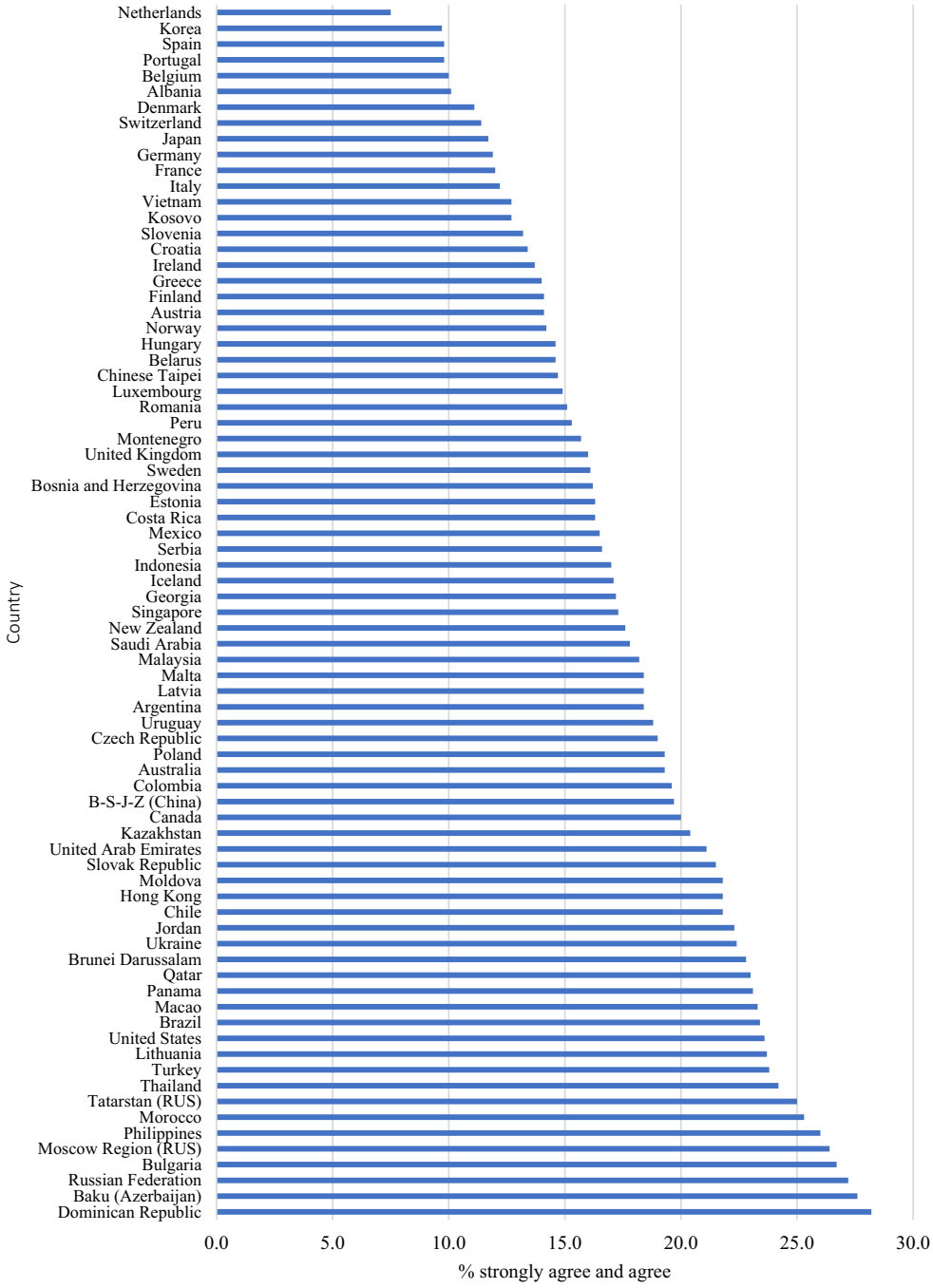

FIGURE 1 Percentage of 15-year-olds who responded 'strongly agree' and 'agree' to 'I feel lonely at school' in PISA 2018 by country.

school and country, respectively (1% and 2.3%), suggesting that the inclusion of correlates of loneliness on Levels 1 and 3 reduced the influence of school and country. At the individual level, significant correlates of loneliness were being female, changing school more frequently, lower socio-economic status, general fear of failure, lower self-efficacy and victimization. These were uniquely correlated with loneliness, adjusted for all other variables in the model. Also at the individual level, school-related variables

TABLE 1 Estimates from the random intercepts-only model (Model 1).

	Coefficient	*SE*	*p*
Loneliness by individual	.067	.013	<.001
Loneliness by school	.016	.002	<.001
Loneliness by country	.024	.003	<.001

TABLE 2 Descriptive information for covariates used in Model 2.

Variables	*n*	*M*	*SD*	% missing data
Student characteristics				
Sex	612,002			0
Immigration status	579,436			5.3
School changes	232,011			62.1
Parental wealth	598,267	−.43	1.24	2.2
General fear of failure	542,105	−.02	.986	11.4
Resilience	537,560	.05	1.02	12.2
Victimization	464,344	.08	1.06	24.1
School characteristics[a]				
Disciplinary climate	579,342	.126	1.09	5.3
Teacher support	551,639	.175	.985	9.9
Teacher interest	551,305	.12	.992	9.9
Perception of competition	479,335	.076	1.00	21.7
Perception of cooperation	464,797	.035	1.02	24.1
Discrimination	348,962	.820	1.06	43.0
Country characteristics				
Individualism/Collectivism	612,002	36.73	38.59	5.3
Masculinism/Femininity	612,002	41.46	36.54	5.3
Indulgence/Restraint	612,002	52.73	52.73	10.7
Power/Distance	612,002	55.04	41.74	5.3
Uncertainty/Avoidance	612,002	61.70	42.50	5.3
Long-term/Short-term orientation	612,002	30.62	55.91	12.0

Note: 612,002 pupils completed the PISA in 2018, of which 518,210 adolescents provided loneliness data. Only data for those who provided loneliness data were included in the MLM Model 2. Sex (0 = female; 1 = male); Immigration status (0 = native; 1 = second generation; 2 = first generation immigrant); School changes (0 = none or one change of school; 1 = two or more changes of school). Scores for the derived variables referring to student and school characteristics have been transformed to scores with a range of −1 to 1, where 0 represents the average score for a student from an OECD country, scores of <0 represents someone who have scored lower than average on a particular variable and scores of >0 higher than average. Four countries did not have Hofstede ratings for all dimensions.

[a]School characteristics are reported by adolescent participants.

reported by students emerged as important for understanding variance in loneliness; those included poor disciplinary climate, low levels of teacher support, low teacher enthusiasm for learning, low peer cooperativeness and high school discriminatory climate. These all had unique effects on student self-reported loneliness. At the country level, (high) power distance, (low) uncertainty avoidance, (low) indulgence and long-term orientation were important correlates of loneliness.

Table 3 also shows that the Level 2 and 3 residual variances (school = .007 and country = .010) are smaller than the corresponding (unconditional) Level 2 and 3 variance estimated in the intercept-only models (.016 and .024, respectively, for school and country), that did not contain Level 1 predictor variables. Thus, findings show that a substantial amount of the variability in loneliness can be explained by

TABLE 3 Estimates from the MLM Model 2 where covariates of loneliness were included in the model.

	Coefficient	*SE*	*p*
Intercept	2.066	.099	<.001*
Residual variance (Level 1)	.593	.012	<.001*
Residual variance (Level 2)	.007	.001	<.001*
Residual variance (Level 3)	.010	.002	<.001*
Student characteristics			
Sex	−.017	.006	.003*
Immigration status	.007	.005	.219
School changes	.034	.004	<.001*
Parental wealth	−.057	.004	<.001*
General fear of failure	.095	.004	<.001*
Resilience	−.166	.005	<.001*
Victimization	.216	.009	<.001*
School characteristics[a]			
Disciplinary climate	−.045	.003	<.001*
Teacher support	−.015	.003	<.001*
Teacher interaction	−.029	.005	<.001*
Perception of competition	.003	.004	.393
Perception of cooperation	−.107	.005	<.001*
Discrimination	−.027	.004	<.001*
Country characteristics			
Individualism vs. collectivism	−.136	.150	.362
Masculinity vs. femininity	−.028	.082	.732
Indulgence vs. restraint	−.299	.110	.007*
Power distance	.310	.144	.031*
Uncertainty avoidance	−.296	.092	<.001*
Long- vs. short-term orientation	−.298	.110	<.007*

Note: This model does not include loneliness as a predictor of academic performance. *$p < .05$; Scores for the derived variables have been transformed to scores with a range of −1 to 1 where 0 represents the average score for a student from an OECD country, <0 represents someone who has scored lower than average and >0 higher than average. Full information maximum likelihood (FIML) was used to estimate incomplete data.

[a]School characteristics are reported by adolescent participants.

differences in student individual factors, including their perception of school climate, and by differences in culture. The final model (Model 3) explained 48.4% of the variance in loneliness, with the majority explained the country-level variables ($R^2 = .38.1$).

In the final MLM, Model 3, we added academic performance to Model 2, and explored whether loneliness predicted student performance in maths, reading and science. Estimates for the academic outcome variables are detailed in Table 4. Findings show that loneliness explained 2.6% of variance in maths performance ($R^2 = .026$, $p = .003$), 2.7% of variance in reading performance ($R^2 = .027$, $p = .002$) and 2.1% of variance in science performance ($R^2 = .021$, $p < .001$).

DISCUSSION

In this study, we found that the prevalence of loneliness among 15-year-old adolescents varied across the world, ranging from 7.5% feeling lonely at school in the Netherlands to 28.2% in the

TABLE 4 Effects of loneliness on academic performance.

	Coefficient	*SE*	*p*
Maths	−.160	.027	<.001
Reading	−.164	.026	<.001
Science	−.145	.025	<.001

Dominican Republic. Those prevalence rates are comparable to rates found in a recent review (Surkalim et al., 2022) that summarized current loneliness prevalence estimates for adolescent samples (aged 12–17 years) within World Health Organization regions, which ranged from 9.2% (95% confidence interval 6.8%–12.4%) in South-East Asia to 14.4% (12.2%–17.1%) in the Eastern Mediterranean region. Thus, combined findings suggest that a substantial proportion of youth across the world experience problematic levels of loneliness. In our study, we found that loneliness could be explained to some extent by factors relating to the country in which the young person resided, but we also found strong evidence that students' perception of several aspects of the school climate are associated with adolescent loneliness. Exploration of country-level cultural dimensions and school climate (as reported by the students) showed that (1) the cultural dimensions of (high) power distance, (low) uncertainty avoidance, (low) indulgence and long-term orientation were reliable correlates of loneliness, and (2) key school climate variables—disciplinary climate, teacher support, teacher interest, peer cooperation and discrimination—were important in understanding student loneliness. Further, there were individual characteristics of the student that were related to loneliness and those included the number of school changes the student had experienced, fear of failing, resilience, low SES and experiences of victimization. Such findings are consistent with work with adults (Buecker et al., 2021; Marquez et al., 2022) where loneliness has been shown to be the product of individual, social and wider environmental factors. We also found support for the idea that loneliness was negatively associated with academic performance; while this has been explored previously, prior sample sizes are small and restricted to specific countries, and there are no controls in place for school and family SES.

Risk factors for school-based loneliness

Country-level factors

At the country level, prior analyses of the effects of culture are usually restricted to the individualism versus collectivism dimension. In this study, we examined the role of all six cultural dimensions defined by Hofstede et al. (2010) simultaneously in the same analytical model. This revealed no significant role for individualism versus collectivism. Instead, loneliness among the adolescent sample was higher in countries characterized by high power distance (e.g., India) low uncertainty avoidance (e.g., Vietnam), low indulgence and long-term orientation. This is interesting partly because past research on cultural differences has most often compared only a handful of countries, which differ in more than one dimension, obscuring precisely what aspects of culture are associated with such differences. By including a wide range of countries, we were able to differentiate between cultural dimensions, bringing further specificity to our understanding of the role of culture in social connection. For example, while China is relatively collectivist, with high power distance, and low uncertainty avoidance, South Korea is relatively collectivist, with average power distance and high uncertainty avoidance. Our analyses indicate that when other cultural dimensions are considered it is country-level power distance and uncertainty avoidance that predict loneliness.

While these data do not clarify why this is the case, one might point to the association between power distance and social inequalities, which in turn make people unhappy, untrusting and restrict

opportunities for social interaction (Wilkinson & Pickett, 2009). Regarding uncertainty avoidance, our results clash with what has been found at the individual level about the role of self-regulation styles. That previous work pointed to the importance of a promotion mindframe (like low uncertainty avoidance) in social engagement (Lucas et al., 2010), whereas we find low uncertainty avoidance to be linked to more loneliness. This further demonstrates how little we understand about this cultural dimension as yet, and highlights the importance of not extrapolating from the individual to the cultural level of analysis. In addition, the association between low indulgence and loneliness could be explained by a lack of value for human desires such as socialization. Indeed, previous work finds that those in low indulgent cultures reported lower subjective well-being than those in high indulgent cultures (Li et al., 2022). Similarly, long-term orientation indicated that characteristics that are orientated towards long-term economic prosperity are valued; those include the ability to delay personal gratification to reach long-term collective goals (Galor & Özak, 2016). In theory, long-term orientated people should anticipate the impacts of an uneven work–life balance (Graafland, 2020). However, it could be that in practice focusing on long-term economic prosperity means that social relationships are neglected, and loneliness arises particularly in those cultures that also value low indulgence. Importantly, cultural factors refer to collectively shared and valued mindframes, whereas the same characteristic at the individual level might in fact signal or express difference. Future research should continue to examine multiple dimensions of culture simultaneously and extend this work to adult populations, to further our understanding of how culture affects loneliness and social connection.

The contribution of school climate to loneliness

Our findings provide strong evidence of the importance of school climate in influencing adolescents' loneliness, supporting the ecological and health-promotion perspectives that are highlighted by prior research (Harding et al., 2019). School-level variables that were important for understanding loneliness included students' perceived actions from teachers: lower levels of teacher support, them being less enthusiastic about their teaching (and their students' learning), and less in control of their students' behaviour in the classroom were associated with higher levels of loneliness. Other school-level variables referred to the wider school climate: the less students viewed their peers to cooperate with each other, and the more perceived discrimination from teachers were perceived to be, the lonelier the student. More experiences of school-based victimization were also related to loneliness. These findings highlight the importance of positive relationships with teachers and peers, and how that includes respect, connectedness, support, positive attitudes towards diversity and an absence of victimization. Those variables have been found to link directly to increases in adolescents' mental health (Harding et al., 2019) and we extend that work by evidencing how those school characteristics are also associated with loneliness, which itself has been shown to be an important predictor of later mental ill-health (Loades et al., 2020).

It looks, then, that good teacher relationships with students are protective factors against youth loneliness. Relationships between teachers and students, and between students, which include the recognition, understanding and acceptance of differences are particularly important. These findings are important because they indicate specific aspects of school climate that could be targeted by future interventions to support social connection and reduce the likelihood of loneliness. Most loneliness interventions for youth are focused at the individual level (Eccles & Qualter, 2021), and while those are important, our findings suggest that targeting school-level factors should also reduce reports of loneliness: creating supportive teacher–student relationships, encouraging inclusivity and using an authoritative disciplinary style should lead to increased social connection, and fewer reports of youth loneliness.

Demographic and individual factors that influence loneliness

Supporting previous literature, we found individual-level correlates that were associated with loneliness. Consistent with previous evidence (Batsleer & Duggan, 2020; Madsen et al., 2019; Qualter, Hennessey, et al., 2021), we found that having lower socio-economic status predicted loneliness. In contrast to meta-analytic findings (Maes et al., 2019), we found that being female predicted loneliness. However, Maes et al. (2019) findings were based on a large age range of 12–21 years, during which youth will experience

numerous developmental changes. It is plausible that loneliness may occur to a greater or lesser extent for males and females at different points in this developmental period. This contradictory finding could also have been influenced by the availability, in the PISA survey, of a direct item to measure loneliness, as previous research found females to report more loneliness than males when a direct measure is used, compared to an indirect measure of loneliness (Borys & Perlman, 1985). We did not find immigration background to be associated with loneliness in contrast to findings some research, where immigrant adolescents are at higher risk of feeling lonely compared to native-born adolescents or adolescents who are descendants of immigrants (Madsen et al., 2016). This could be due to country variance in how immigration background is conceptualized and measured. Further, the impact of being an immigrant might differ between countries as language barriers, connections to relatives in the country of origin and potential feelings of feeling different in relation to norms and values may be very context specific. In this study, we also explored three variables (school-mobility, fear of failure and resilience) that had not been previously explored as risk factors for loneliness. As expected, we found that changing school more frequently, being more fearful of failure and having lower resilience were associated with higher loneliness. Fear of failure is perhaps unsurprisingly related to loneliness given that it, like lower self-esteem, might contribute to a belief that loneliness is unchangeable and cannot be remedied (Qualter et al., 2015). Having low resilience means someone has difficulty recovering from setbacks. Changing schools more frequently also appears to be a risk factor for loneliness, likely because of disruption to social relationships and the (social) stress that comes from that. Future work should explore how these individual risk factors work together and interact with school-level variables.

Loneliness and its association with academic performance

We are not the first to explore the relationship between loneliness and academic performance, although we do examine this relationship across cultures and in a much larger sample of adolescents than in previous work. Loneliness might lead to worse academic achievement through negative cognitions related to loneliness (Hawkley & Cacioppo, 2010) that reduce one's perceived competence (Guay et al., 1999). Put simply, loneliness reduces self-worth, which means feelings of competence in many domains are affected, ultimately impacting academic performance. Given our findings that provide further evidence that low resilience and fear of failure are strongly associated with loneliness among this age group, global self-worth is a strong candidate as a mediator linking loneliness and academic outcome. Future work will want to test that idea explicitly using prospective data.

Loneliness has also been linked to poor sleep quality during adolescence (Eccles et al., 2020; Harris et al., 2013; Matthews et al., 2017) and that is another potential mediator linking loneliness and academic performance. Given the importance of sleep for cognitive development (Tarokh et al., 2016) and mental health (Firth et al., 2020), it is likely sleep mediates the relationship between loneliness and academic achievement. Again, future work should explore this potential mechanism linking loneliness and academic outcome.

Implications for research on loneliness

This study emphasizes the importance of taking a socio-ecological perspective when exploring loneliness. It demonstrates the impact that an individual's social environment, alongside individual characteristics has on loneliness prevalence. Missing from the current exploration is how neighbourhood and family characteristics influence experiences of loneliness. Research in the United Kingdom finds that young adults experiencing loneliness have more negative perceptions of their neighbourhoods than their less lonely siblings (Matthews et al., 2019). Qualitative research demonstrates the importance of taking those factors into consideration, particularly for adolescents whose countries are experiencing

social adversity (Jenkins et al., 2020). For those with less social mobility, familial and neighbourhood characteristics are likely to have a greater impact on loneliness than those who are more socially mobile. In addition, it is likely that loneliness operates differently across the lifespan. The level of importance that an individual places upon certain relationships may be dependent upon changes in needs according to developmental stages. For example, relationships with parents may be important in childhood, while relationships with peers are important in adolescence (Laursen & Hartl, 2013). Future research should consider the social contexts in which loneliness occurs at different points across the lifespan.

Implications for interventions

Many Governments around the world have put loneliness onto their agendas, with the aim to reduce loneliness, including among adolescents. So far, their intervention focus has been at the individual-level, and is out of school time, but the current findings suggest that universal school-based approaches to reducing youth loneliness may be appropriate and effective. Such work need not be cumbersome: our findings suggest that attending to the psychosocial school climate is a manageable way in which schools can promote social connection; making changes to the school environment would be effective for decreasing reports of loneliness, and is within the reach of most schools and teachers. While some school-based socio-emotional learning packages have been shown to reduce loneliness among students (Hennessey et al., 2021), those are expensive and require intensive training of teachers. Our findings suggest that such approaches may not be needed and simple changes to the school climate are likely to have important positive impacts on adolescents' reports of loneliness. This is particularly significant given that past research has shown that, although teachers acknowledged that schools should seek to enhance students' well-being, they often feel ill-equipped to do so (Reinke et al., 2011). We acknowledge that teachers may not necessarily have the specialist knowledge and skills needed for the types of individual-level interventions that target students who report loneliness, but it is well within the reach of schools and teachers to work, proactively and intentionally, to enhance aspects of the school climate (Aldridge & McChesney, 2018).

Limitations and future directions

One important limitation of this study is the cross-sectional nature of the data, which means we cannot provide clarity on the causal direction of the associations identified. In addition, except for the cultural data, responses were all obtained by asking students about their views. Although these are valuable, future research might complement students' ratings with data collected from teachers, and even with objective data about the schools, hopefully producing converging insights from different perspectives. With regard to the cultural dimensions examined, although these go well beyond prior research that either merely compared a handful of countries, or measured some of these dimensions at the individual level, they are not without critique. The research on the basis of which the six Hofstede dimensions were developed is now somewhat dated and it is crucial to continue to develop our ability to compare across cultures. At the same time, no single taxonomy is likely to encompass all ways in which cultural contexts differ, so it is important to stress that cultural comparisons are merely a tool to improve our understanding of how these processes operate across countries and should not be taken to fully represent any specific culture. Other considerations include the fact that academic data were represented by a 2-hr test completed by students—while those tests used in PISA are standardized and allow comparison of skills across students, one could argue that they do not speak of academic functioning in school. Further, in our analyses, because we used secondary data, we were unable to control for mental health problems to determine the unique impact of the proposed correlates on loneliness when mental health was controlled; future work will want to explore those effects where secondary data are available on loneliness and mental health.

CONCLUSION

This study used data from the PISA 2018 survey to explore the country, school and individual variables that were associated with loneliness, and to examine whether loneliness could predict academic performance on the PISA tests. We found that students' perceptions of the school climate are associated with adolescent reports of loneliness, confirming the role of school climate in influencing students' loneliness, and suggesting that improving teacher–student and student–student relationships in school will have positive impacts on reports of loneliness among adolescents. Given those findings, we recommend teachers be more attuned to the social education of students and construct school environments that facilitate social connection.

We also found that aspects of national culture are important for understanding the experience of loneliness among adolescents, specifically pointing to the importance of examining multiple aspects of culture simultaneously and to do so across a wide variety of countries. While we confirm the role of school and culture in influencing students' reports of loneliness, and support previous evidence that loneliness influences academic performance, future research will want to explore the mechanism linking the variables.

AUTHOR CONTRIBUTIONS

Rebecca Jefferson: Data curation; investigation; methodology; project administration; supervision; writing – review and editing. **Manuela Barreto:** Conceptualization; investigation; methodology; writing – original draft; writing – review and editing. **Frederick Jones:** Data curation; investigation; validation; writing – review and editing. **Jasmine Conway:** Data curation; methodology; software; writing – review and editing. **Aishwarya Chohan:** Data curation; methodology; software; validation; writing – review and editing. **Katrine Rich Madsen:** Conceptualization; writing – original draft; writing – review and editing. **Lily Verity:** Conceptualization; formal analysis; investigation; methodology; writing – review and editing. **Kimberly J. Petersen:** Formal analysis; investigation; validation; writing – review and editing. **Pamela Qualter:** Conceptualization; formal analysis; investigation; methodology; project administration; supervision; validation; writing – original draft; writing – review and editing.

CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

Publicly available data sets were analysed in this study. This data can be found here: https://www.oecd.org/pisa/data/2018database/.

ETHICAL APPROVAL

This study is a secondary data analysis.

INFORMED CONSENT

Ethical review and approval was not required for this study because it included only secondary data analysis. This study is based on the public databases of the PISA 2018 assessment (OECD). Data collection for OECD-PISA studies is under the responsibility of the governments from the participating countries, and written informed consent to participate in the PISA 2018 study was provided by the participants' legal guardian/next of kin.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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