

Do Municipal Contexts Matter for Adolescent Mental Health? A Within-Municipality Analysis of Nationwide Norwegian Survey Data Across Six Years

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Abstract

Background

Despite growing concerns about substantial socio-economic differences between districts in many developed nations, limited attention has been paid to how adolescent mental health may be shaped by district characteristics. A few studies have shown that adolescent mental health is related to contextual factors such as district socio-economic status, neighborhood disorder, and quality of infrastructure. However, prior estimates may be an artifact of unmeasured differences between districts.

Methods

We used data from the nationwide Norwegian Ungdata surveys ($N = 278,764$), conducted across the years 2014 to 2019. We applied three-level hierarchical linear models to examine within-municipality associations between municipal factors and adolescent mental health in the domains of internalizing problems (i.e., depressive symptoms), externalizing problems (i.e., behavioral problems), and well-being (i.e., self-esteem), thereby accounting for all time-invariant municipality-level confounders.

Results

Our results showed that municipal-level safety, infrastructure, and youth culture, beyond individual characteristics, are associated with adolescent mental health problems. Further, cross-level interaction models indicated gender-specific associations, with stronger associations of municipality infrastructure and community belongingness with increased self-esteem and reduced problematic behaviors among girls than boys.

Conclusion

Our findings highlight that municipality-level interventions may be a feasible strategy for adolescent mental health, even in a society characterized by low inequality and high redistribution.

Background

Adolescence constitutes the primary period of risk for the emergence of mental health problems (Hoare et al., 2019), with the onset of more than half of all lifetime cases of mental disorders occurring at this stage (Solmi et al., 2021). Mental health problems cause extensive personal suffering and predict a number of important outcomes, including academic and social problems (Deighton et al., 2018), unemployment, morbidity, and mortality (Cuevas et al., 2013; Richmond-Rakerd et al., 2021). Patton et al. (2016) further argue that investment in adolescent health and well-being may bring a triple dividend of benefits right away, into future adulthood, and for the next generation of children. As such, particular

attention has been paid to better understand the determinants of adolescent mental health and the nuanced mechanisms to improve prevention and intervention strategies (Deighton et al., 2018).

Developmental researchers have long recognized the importance of considering development in *context*—that is, as a dynamic process that occurs via transactional relationships between individuals and the various settings in which they are immersed (Leventhal & Brooks-Gunn, 2000; Sameroff, 2009). Yet, limited attention has been paid to contextual (e.g., municipal and district) or structural factors for adolescent mental health beyond individual-level predictors. To date, the majority of studies on determinants of adolescent mental health have primarily focused on individual-level characteristics (e.g., Meier et al., 2015; Moore et al., 2014; Trotta et al., 2020), including personality and genetic influences (e.g., Baselmans et al., 2018) and adolescents' primary contexts such as family (e.g., Smokowski et al., 2015), peer group (e.g., Narr et al., 2019), and school (e.g., Aldridge & McChesney, 2018). Given the broad acknowledgement of contextual influences and increasing socio-economic disparities between districts, regions, and states in many developed nations (e.g., Reardon et al., 2019), the relative paucity of research on contextual-level factors is striking.

Importantly, prior research on the relationship between residential contexts and adolescent mental health has primarily relied on cross-sectional analyses that are susceptible to unmeasured confounders. Such confounding could occur if correlations between adolescents' mental health and district characteristics are reflective of unmeasured district contexts instead (e.g., cultural and political conditions or selection effects into districts). Indeed, recent reviews highlight an urgent need for robust evidence on how changes over time in communities and residential contexts matter for adolescent mental health (Nordbø et al., 2020; Visser et al., 2021). The present study addresses this research gap by examining the link between municipal characteristics and adolescent mental health in a multilevel fixed-effects framework that accounts for all stable unobserved confounding at the municipality level.

In doing so, we leverage rich Norwegian surveys of more than 200,000 adolescents linked to register data on municipality characteristics across six years (2014–2019). As such, this study is the first that provides within-municipality associations between municipal factors and adolescent mental health using large-scale data. We include two main dimensions of common mental health problems, namely internalizing (i.e., depressive symptoms) and externalizing (i.e., behavioral problems) problems (Krueger, 1999). Additionally, we include positive mental health (i.e., self-esteem) to cover mental well-being. The three dimensions (i.e., externalizing, internalizing, and well-being) have overlapping and distinct genetic and environmental sources, but with the latter being more domain-specific (Bartels et al., 2013; Kendler et al., 2011).

Linking Municipal Contexts And Mental Health

How might the municipal or district contexts affect adolescent mental health problems? Building on early theories of eco-epidemiology and socio-ecology, previous studies have examined several structural

factors in explaining the multi-layered processes that determine mental health (for an overview of related theories and mechanisms, see Galster, 2012 or Goldfeld et al., 2015).

First, municipality socio-economic status (SES) has been examined as a potential risk for adverse adolescent mental health (e.g., Fong et al., 2019; Haugan et al., 2021; Xiao et al., 2017). For example, adolescents residing in communities with a higher proportion of unemployed or poor families may be more exposed to delinquent peer behaviour or lower levels of parental monitoring, which in turn may affect their psychological well-being and mental health (Ingoldsby et al., 2006). In particular, Wight et al. (2005) showed that even after accounting for family SES and structure, district income level is significantly associated with adolescent depressive symptoms. Urbanity may also be linked with resident mental health, since urban living provides both opportunities (e.g., access to employment, better social/health services) as well as challenges (e.g., traffic fumes, noise) (Zijlema et al., 2015). For instance, Simone et al. (2013) showed a significant relationship between high population density and depression. Yet, Bassett and Moore (2013) found no significant relationship after controlling for neighbourhood SES.

Second, a high level of social disorder and violence within a community—often referred to as neighborhood disorder—has been considered an important municipality predictor of mental health problems (Assari et al., 2015; Patalay & Fitzsimons, 2016). Neighborhood disorder refers to public behaviors that are threatening to residents or to an absence of social order and control in a community (Gearhart, 2019). Individuals who sense that their property or life is in danger are more likely to suffer from psychological distress and decreased quality of life (Chen & Chen, 2015; Whitley & Prince, 2005).

Third, supportive environments for children and adolescent (e.g., quality of community infrastructure) has been highlighted as a potential important protective factor for adolescent mental health (Bird et al., 2018; Christian et al., 2015; Nordbø et al., 2020). In particular, research suggests that enhancing accessibility to organized/recreational activities may help promote adolescent social interaction that may result in improved mental health and well-being (Breistøl et al., 2017). While deteriorated community infrastructure and services may cause a sense of powerlessness among residents (Finlay et al., 2019; Galster, 2012), a community with better access to local facilities and amenities may increase its physical activity, mobility, and social connection, thereby improving residents' mental health (Bird et al., 2018). Yet, a few studies report the non-significant relationship between youth mental health and community quality after controlling for basic demographic variables (e.g., Rollings et al., 2017).

Beyond the district socio-demographics and physical environments, individual bonds to their community or district cultural characteristics may also affect residents' mental health and well-being (Visser et al., 2021). For instance, shared community beliefs may influence residents' future behaviors or their sense of control/safety that is linked to psychological well-being (Fong et al., 2021; Harding & Hepburn, 2014; Khanijahani & Sualp, 2022). Importantly, adolescents are susceptible to peer influence and contextual effects, and how they perceive their group norms and values may affect psychological outcomes (Kelly, 2009). Indeed, several studies report significant relationships of community cultural characteristics (e.g.,

collective efficacy or differences in cultural orientation) with adult psychological health (Chung & Docherty, 2011; Pickover et al., 2021), although the link with adolescent mental health and well-being has been underexplored (Aminzadeh et al., 2013; Wu et al., 2015).

Overall, most previous studies on district/community-level determinants of adolescent mental health have primarily focused on socio-demographic characteristics based on cross-sectional correlational studies. These studies indicate small or modest effects of district factors above and beyond individual-level influences. Despite the suggestive evidence, we argue that skepticism about causal inference is warranted. The problem occurs when omitted district-level variables have contextual influence on both independent and dependent variables. For example, regional cultural, political, and topographical factors are likely to affect both key municipal variables and residents' mental health via several mechanisms (e.g., unmeasured youth culture may affect identity or sense of community among adolescents that are related to municipal characteristics as well as their psychological well-being). One solution is to exploit *within-group* variation to address omitted variable bias. Variation between groups may reflect instead the impact of omitted variables, while focusing on within-group variation eliminates those potential confounds from consideration (Finkel et al., 2021). Although the within-group/person analytic framework has come to be widely employed in social science research, it has not yet been exploited in previous works on district/community-level determinants of adolescent mental health. Further, despite the importance of considering the nested structure of data, only a few studies have employed a multilevel design to test for neighborhood effects on adolescent mental health (Visser et al., 2021). Here, we exploit the within-municipality variation across time of municipality characteristics in a multilevel framework to improve our current understanding of contextual factors in adolescent mental health development.

Gender Differences

Despite increasing interest in recent years in contextual factors of adolescent mental health, only a few studies have explored potential differential effects of community characteristics on members of different populations, such as different genders or ethnic groups (Alegría et al., 2018). Specifically, research in general suggests gender differences with regard to relational and psychological factors as well as externalizing behaviors. For example, social interactions play a more crucial role for development of self-identity for girls than for boys (Espinosa et al., 2013), and girls are more susceptible to relational stress and depression (Hankin et al., 2015). Milam et al. (2012) also showed that girls who feel unsafe in their community are more likely than boys to have internalizing problems. Likewise, Brazil and Clark (2017) found that girls moving into neighborhoods with less poverty tend to have lower levels of depressive symptoms than boys. Regarding externalizing behaviors, research suggests that neighborhood effects on delinquent behaviors may be more pronounced for boys than girls, since boys are more likely to play out of their homes and have more playmates in their neighborhoods (e.g., Kroneman et al., 2004). Together, these findings suggest that careful attention should be paid to potential gender differences in the relationship between district contexts and adolescent mental health.

The Norwegian Contexts

Similar to trends in other Western countries, rates of self-reported mental health problem have considerably increased over the past decade among Norwegian adolescents, particularly depressive symptoms among girls (von Soest et al., 2022). Norway has a two-tier system of local government, with 428 municipalities nested within 19 counties (county/municipal structure until 2020). Municipalities enjoy considerable autonomy in adapting central policies to local conditions, each having overall judicial responsibility for their inhabitants' health and welfare provision (e.g., person-centered services, culture, and transport), according to the Norwegian Public Health Act. There is substantial variation in urbanicity, access to services and facilities, population characteristics, and policies over geographical units. However, rural and regional policies from the 1960s have focused strongly on reallocation and equalization. The variation within and across Norwegian municipalities may therefore be relatively small compared to those of other European countries (Angell et al., 2016) and societies like the US and UK characterized by higher levels of social disparities between districts (Nieuwenhuis & Hooimeijer, 2016). This study provides a unique opportunity to study how municipal/local contexts may shape adolescent mental health even in fairly homogeneous social settings.

The Current Study

In the present study, we examine how municipal contexts matter for mental health among Norwegian adolescents. Although several previous studies have explored the roles of municipal socio-economic conditions and living standards, limited attention has been paid to the possibility that adolescent mental health may also be driven by municipal cultural characteristics or by the interaction between individual and contextual-level factors. Based on the previous studies and available longitudinal data, we identify municipal characteristics in the domains of socio-economic status (average household income, percentage of unemployed people and immigrants, expenditure on social assistance), urbanicity (population density), neighborhood disorder (offenses reported, feeling of safety), quality of infrastructure (access to local facilities), neighborhood belonging, and youth culture (academic and oppositional culture). To examine different aspects of adolescent mental health and well-being, we assess depressive symptoms and self-esteem as well as behavioral problems to cover three broad dimensions of mental health (i.e., internalizing, externalizing, and well-being). We also explore potential heterogeneous relationships across genders. Our gender analysis is partially explorative in its nature, due to the limited number of studies on the cross-level interactions.

Consequently, our main research questions are as follows. 1) What are the relationships between municipal-level factors and adolescent mental health? In exploring these, we include individual-level factors to gauge the relative importance of individual and structural factors and as control variables. 2) Do the associations hold with a within-municipality-level approach when all confounding due to time-invariant municipality characteristics is accounted for? 3) Do the observed relationships differ between boys and girls? Based on previous studies, we expect to find that on average, contextual-level influences

will be fairly modest or small compared to individual-levels factors. Likewise, given the context of a Nordic welfare state characterized by low socio-economic inequality between municipalities, we hypothesize that the influences of quality of community infrastructure and youth culture may be stronger than municipal SES. Recent changes in Norwegian youth mental health across genders are also suggestive of potential gender differences in the influences of contextual factors (Nes et al., 2021). We thus expect that municipal-level associations may vary between boys and girls.

Methods

Procedure and Participants

We employ data from the Norwegian nationwide Ungdata surveys. Ungdata follows a national data collection scheme from 2010 and was designed to conduct youth surveys for monitoring purposes at national and municipality level in Norway. It is regarded as the most comprehensive source of information on adolescent health and well-being in Norway. Adolescents in most municipalities are regularly assessed through Ungdata; students were invited to complete an electronic questionnaire in class. The survey has been revised several times and the first major revision including comprehensive student-level measures was made in January 2014. This study thus focuses on the period 2014 to 2019. More specifically, following Abebe et al. (2016), we focus on junior high school students in grade 8–10 (aged 13–16)—the primary period of onset of mental health problems and emerging gender differences. Additionally, senior high school students tend to have more heterogeneous characteristics (e.g., placed in vocational tracking or job market preparation). The final pooled sample size from 2014 to 2019 was $N = 278,764$. Response rates were ranging from 77.25% (2015) to 82.27% (2019) in our analytic sample. The average response rate was 80.22% across six years (see also von Soest et al., 2022).

Measures

Mental health and well-being

Depressive symptoms were measured by a five-item version of the Depressive Mood Inventory (Kandel & Davies, 1982) derived from the widely used Hopkins Symptom Checklist (HSCL; Derogatis et al., 1974). Respondents were asked for ratings on depressive symptoms during the preceding week, with a four-point scale ranging from 0 (*not at all affected*) to 3 (*extremely affected*). Item wording is “Felt that everything is a struggle”, “Felt unhappy, sad or depressed”, “Felt hopeless about the future”, “Felt stiff or tense”, and “Worried too much about things”. Previous research has shown that short versions of the HSCL are highly correlated with longer versions and perform almost as well as the full version (Schmalbach et al., 2021). Cronbach’s alpha was estimated to .88 and we used mean scores. *Behavioral problems* were assessed by five items on the frequency of stealing, vandalism, spraying graffiti, freeriding, and truancy, based on Olweus’s scale of antisocial behavior and the National Youth Longitudinal Study (Olweus, 1989). We computed a composite score of the five items (see also von Soest et al., 2022). The response option ranged from 0 (*never*) to 4 (*more than 11 times*), and Cronbach’s alpha

was .63. *Self-esteem* was measured by three items, “I’m very happy with the way I am”, “I’m often disappointed with myself (reverse coded)”, and “I like myself the way I am”, from the Global Self-Perception sub-scale of the widely used Self-Perception Profile for Adolescents (SPPA; Wichstrøm, 1995). Response options ranged from 0 (*describes me poorly*) to 3 (*describes me very well*), and we computed mean scores ($\alpha = .82$).

Adolescent-level predictors

Gender was coded 1 for boys and 0 for girls. *Perceived family economy* was measured by asking “Has your family’s economic situation been good or bad during the past two years?”, with response options ranging from 0 (*bad all the time*) to 4 (*good all the time*). *Parental monitoring* was assessed by the averaged value of three items: “My parents usually know where I am, and who I’m with, in my free time”, “My parents know most of the friends I hang out with in my free time”, and “My parents know my friends’ parents” (four response options, from *very true* to *not at all true*, $\alpha = .72$). For *somatic health problems*, we computed the mean scores across four items on health issues during the past month (four response options, from *never* to *daily*) including neck and shoulder pain, joint and muscle pain, nausea/feeling sick, and palpitations ($\alpha = .71$). *Sleep problems* were assessed by one item on the presence of sleep problems over the past week (four response options, *affected not at all* to *affected extremely*). *Student grade* 8 (ref), 9, and 10 were also included, which serve as a proxy of age. *Peer friendships* were assessed by the item “Do you have at least one friend who you trust completely and who you can tell absolutely anything?” (four response options, from *have nobody* to *yes, definitely*). We assessed *being bullied* by asking about experiences of being teased, threatened, or frozen out by other young people at school or in their free time (six response options, from *several times a week* to *never*). We also assessed media use (six response options, from *no time* to *more than 3 hours*); it includes *watching TV/playing games*, *reading books* (not school-related), and *social media* (e.g., Facebook). To measure *sports activities*, we used the item assessing training or competing in a sports club. Response options ranged from 0 (*never*) to 4 (*more than 3 times a week*). Finally, *school satisfaction* was measured by five items ($\alpha = .71$): “I enjoy school”, “My teachers care about me”, “I feel that I fit in with the students at my school”, “I’m bored at school (reverse coded)”, and “I often don’t want to go to school (reverse coded).” Response options ranged from 0 (*totally disagree*) to 3 (*totally agree*).

Municipal-level predictors

Register data on municipality-level predictors were provided by the Municipality-State-Reporting database (KOSTRA) for each year from 2014 to 2019. We constructed the following six items to gauge basic structural characteristics of Norwegian municipalities: 1) Population density (population/km²); 2) Percentage of registered unemployed (15–74 years); 3) Percentage of residents with immigrant background; 4) Expenditure on social assistance (average paid per resident older than 15 years); 5) Average total income for households; and 6) Offenses reported to the police per 1,000 inhabitants.

We constructed other municipal-level variables by aggregating respondents’ own perceptions of municipal characteristics or peer groups. This approach has been widely used in various disciplines to

measure community-level violence (Finkel et al., 2021), workgroup culture (Ingram et al., 2018), and school climate (Dickhäuser et al., 2021). *Municipality safety* was measured by adolescent report of feeling safe when they are out for the evening in their local areas (four response options, from *very safe* to *not safe*, reverse coded). For *quality of community infrastructure*, we took the mean of students' evaluations (five response options, *very good* to *don't like it at all*, reverse coded) of their municipalities in terms of places for meeting other young people, sports facilities, culture (e.g., cinemas and concert venues), and public transport ($\alpha = .74$). *Belongingness* was assessed by adolescents' responses (*yes/no*) to "Can you imagine living in your local municipality when you grow up?". We also created two measures of municipal-level youth culture by aggregating adolescents' attitudes to "being good at school" and "getting drunk and smoking cannabis" in terms of increasing their social status within their groups of friends (five response options, "*increase a lot*" to "*reduce a lot*"). *Academic culture* and *oppositional culture* then represent overall youth culture at the municipal level. All items other than negative items were coded with higher values indicating more positive attitudes/values.

Analytic Strategy

Ungdata is a longitudinal cross-sectional survey. Yet, it retains a panel data structure at the municipality level, since municipalities are repeatedly measured. This structure enables us to obtain more robust estimates from municipal-level variables by exploiting within-municipality variations of municipal characteristics (i.e., effects of year-to-year changes in a municipality's average level) across six years. The observed municipal effects in this study will represent the effects of over-time aggregate changes in municipal factors, thereby taking into account all time-invariant confounding municipality-level characteristics (Finkel et al., 2021; Schmidt-Catran & Fairbrother, 2016).

In our pooled sample of 278,764 from 2014 to 2019, adolescents in 334 municipalities were nested across six years. The data follows a three-level hierarchical structure, with adolescents (at level 1) nested within year of assessment (at level 2) nested within municipalities (at level 3). We applied a three-level hierarchical linear model (HLM) to account for this nested structure. In preliminary analyses we observed that the random effects at each level were very small (ICC = .01 to .02), which is consistent with the finding of Abebe et al. (2016). This implies that around 98–99% of variances in the dependent variables were explained by within-municipality influences, not by between-municipality factors. Following recommendations by Schmidt-Catran and Fairbrother (2016), however, we include the random effects at each level in our model specifications.

The baseline multi-level model is as follows:

$$Y_{itj} = \beta_0 + \beta_1 X_{itj} + \beta_2 V_{tj} + T_{tj} + \mu_j + \mu_{tj} + \epsilon_{itj},$$

where i represents adolescents, t represents time, and j represents municipalities. It shows that mental health problems (Y_{itj}) for an adolescent i in municipality j at time t is a function of adolescent-level (X_{itj}) and municipal-level (V_{tj}) variables, time-fixed effects (T_{tj}), random effects for municipalities (μ_j) and municipality-years (μ_{tj}), and an idiosyncratic adolescent-level error term (ϵ_{itj}). The error term and random effects are assumed to be normally distributed and uncorrelated with each other.

We include dummy variables for each year to account for potential year-specific effects that could affect all adolescents at that time (e.g., effects of policy changes and other dynamics related to time). The key independent variables at the municipal level, V_{tj} , vary across time and municipalities but are constant for adolescents within a municipality. Yet, the baseline multilevel model is still susceptible to unobserved heterogeneity. We thus attempt to exploit the within-variation at the municipal level as follows:

$$Y_{itj} = \beta_0 + \beta_1 \left(X_{itj} - \bar{X}_{tj} \right) + \beta_2 \left(V_{tj} - \bar{V}_j \right) + \beta_3 \bar{V}_j + T_{tj} + \mu_j + \mu_{tj} + \epsilon_{itj}.$$

2

In this equation, deviations of the individual-level factor X_{itj} from the municipality-year average of this factor (denoted \bar{X}_{tj}) are estimated; β_1 now represents effects of adolescent level predictors after accounting for observed and unobserved stable municipal characteristics, which is less biased than β_1 in Eq. (1). Importantly, the municipality-year deviation from the overall average ($V_{tj} - \bar{V}_j$) isolates the within-municipality effect from the enduring confounding effects of stable between-municipality differences on the dependent variable (Fairbrother, 2014; Finkel et al., 2021). We also include the municipality-level average \bar{V}_j to explore between-municipality effects as well. The between effects show average differences in the levels between municipalities. The gender differences in municipal contexts are examined with cross-level interactions between gender and $\beta_2 \left(V_{tj} - \bar{V}_j \right)$ obtained from Eq. (2). Since unobserved confounders between both gender and within-municipality over-time effect are less likely, we expect to obtain more robust interaction coefficients than previous cross-sectional multilevel analyses.[1] For all HLM analyses, we used the *mixed* command in Stata 17 with a maximum-likelihood estimator. Analyses for this study were not preregistered.

[1] We carefully considered a potential multi-collinearity problem and examined within-variations at municipal level. Our centering approach can effectively identify within- and between-associations relieving multi-collinearity issues. The VIF values of all entered variables were less than 10 (Franke, 2010), and we confirmed that results do not notably differ from the models excluding variables with higher VIF > 4 (i.e., proportions of residents with immigrant background).

Results

Table S1 in the Online Supplement provides descriptive statistics of all study variables. Half of all participants were girls, and participants generally perceived family economic conditions as good (3.19 of 4.00). Across municipalities and years, participants reported high levels of municipal safety (3.39 of 4.00), and about two-thirds of participants felt a sense of belongingness to their communities. The share of adolescents endorsing delinquent behaviors was much lower (0.93 of 4.00). Figure S1-3 illustrates the overall trends in mental health outcomes by gender from 2014 to 2019. Specifically, girls were more likely to have higher levels of depressive symptoms ($\Delta = 0.47$) and lower levels of self-esteem ($\Delta = 0.52$) compared to boys at the outset (the observed differences were 0.58 and 0.70 of a pooled *SD* for depressive symptoms and self-esteem). While girls' depressive symptoms increased by 16% over the six years, depressive symptoms among boys increased by 20%. Regarding self-esteem (Figure S2), boys showed a slight decrease across six years, but still enjoy higher levels of self-esteem compared to girls. Figure S3 also depicts that boys showed higher levels of behavioral problems than girls, with an average small increase over six years (0.13 and 0.07 of a pooled *SD* for boys and girls, respectively). Overall, the figures show the gender differences in mental health as well as a growing trend in the prevalence of depressive symptoms in Norway.

The Relationships Between Municipality Factors And Adolescent Mental Health

Table 1 presents results for the three outcome variables based on the specification of Eq. (2). At the individual level, boys were likely to have higher levels of self-esteem (0.30) and behavioral problems (0.12), whereas girls were more likely to report depressive symptoms than boys (.25). Among adolescent-level factors, health conditions, sleep problems, and school satisfaction were strongly related to depressive symptoms and self-esteem. In contrast, parental monitoring and school satisfaction were more strongly related to behavioral problems (effect sizes ranged from 0.16 to 0.43). Unfortunately, however, we cannot disentangle the influence of unobserved between-adolescent characteristics (e.g., unmeasured previous academic achievement) using Ungdata. We thus put most emphasis on findings from the within-municipality effects.[2]

Returning to Table 1, within-municipality analyses indicated significant relationships of municipal-level safety with depressive symptoms (-0.25) and that of municipality-level community infrastructure with self-esteem (0.08). In particular, a one-unit increase in municipality safety predicted a 0.31 of an *SD* decrease in depressive symptoms (0.25/0.81), whereas a one-unit increase in satisfaction with community infrastructure predicted a 0.11 of an *SD* increase in self-esteem (0.08/0.75). We also found that oppositional youth culture was significantly associated with increased depressive symptoms (0.13) and behavioral problems (0.14) as well as decreased self-esteem (-0.12); academic culture was also negatively associated with adolescent behavioral problems (-0.11). The between-municipality effects of municipal factors are illustrated at the bottom of Table 1. While municipality unemployment rate, safety, and oppositional youth culture were all significantly associated with corresponding outcome variables,

income, community infrastructure, belongingness, and academic culture showed variable-specific relationships.

Overall, we found that more individual-level factors are significantly related to adolescent mental health problems than municipality-level factors, and that the observed effect sizes are generally larger. Individual and municipal SES factors also showed relatively small effect sizes compared to other characteristics.

Gender As A Moderator

Table 2 illustrates potential gender differences. For simplicity, we only report estimates from interaction terms and corresponding main predictors. While corresponding main effects showed similar patterns to those found in Table 1, we observed that the main effects are partly dependent on gender. Specifically, there were significant interaction terms of gender on the associations of municipality-level unemployment rate (0.02), income (0.09), and infrastructure (0.07) with adolescent behavioral problems. We also found that the relationships of income (-0.10), safety (0.14), and belongingness (-0.29) with self-esteem are moderated by gender. Regarding youth culture, oppositional culture was more positively associated with boys' problematic behaviors (0.09) than girls'. In contrast, girls' depressive symptoms were more positively associated with academic culture than boys' (-0.14). Generally speaking, compared to girls, boys' behavioral problems seem to be more positively associated with municipal income level; boys' self-esteem was also negatively associated with municipal income level. Further, unemployment rate and oppositional culture were more likely to be positively associated with boys' behavioral problems than girls'. In contrast, municipal infrastructure and belongingness tend to be positively associated with increased self-esteem and reduced problematic behaviors among girls.

[2] As a supplemental analysis we examined the degree in which the findings from level 1 variables were robust to unobserved confounding (see Table S2 in the Online Supplement). Regarding depressive symptoms and self-esteem, we found that adolescents' health and sleep problems, experience of being bullied, and school satisfaction were particularly robust to unobserved confounding. For adolescent behavioral problems, school satisfaction and social media use were robust.

Discussion

To our knowledge, this study is the first to examine within-municipality associations between municipality factors and adolescent mental health and well-being longitudinally, with large-scale data. Our findings showed that municipal contexts, beyond individual-level factors, may play an important role in promoting adolescent psychological well-being. As we hypothesized, the associations of individual-level factors with adolescent mental health tended to be larger than those of municipality-level factors. We also observed that associations with SES indicators are relatively small at both individual and municipal levels. In this regard, Liao (2021) argued that SES effects may be weaker in societies with high equality where social comparison is less meaningful.

Nevertheless, we still found significant associations between municipal-level factors and mental health; the quality of community infrastructure, community safety, and youth culture overall seemed to contribute to adolescent mental health at the municipal level. Our study makes significant methodological and substantive contributions. Most prior studies have been based on cross-sectional designs, and the available evidence are likely to be confounded by unmeasured differences between districts (Nordbø et al., 2020; Visser et al., 2021). While the conventional regression analyses yield estimates that combine both within- and between-variations, as unobserved confounds are likely to present, our within-municipality analyses should yield less biased estimates than previous findings.

More specifically, consistent with the previous report (Assari et al., 2015; Nordbø et al., 2020), our findings showed a significant relationship between municipal-level safety and depressive problems. Our model-based estimates from Table 1 showed that by enhancing the lowest level of municipality safety (3.05) to the highest level (3.86) found in the Ungdata, the risk of developing depressive symptoms may be reduced by .25 of a *SD* ($((3.86 - 3.05) * -.25) / .81$), which is not trivial. We also observed that community infrastructure (i.e., access to community facilities such as cultural venues) significantly predicts adolescent self-esteem. Our results support the previous finding that community quality or infrastructure is a valid predictor of mental health outcomes (e.g., Breistøl et al., 2017; Galster, 2012). Yet, our empirical evidence further indicated that youth culture may also be a significant predictor of adolescent mental health. Generally speaking, a youth culture favoring delinquent behaviors predicted higher levels of depressive symptoms and behavioral problems, as well as lower levels of self-esteem among adolescents. Oppositional youth culture may create challenges and conflicts (Sassenberg et al., 2011), particularly given that Norwegian adolescents tend to avoid delinquent behaviors (as shown in Table S1).

Overall, the evidence provided suggests that promoting a “healthy” youth culture and enhancing community quality may be a feasible public health strategy to promote adolescent mental health, although changing culture is a difficult task and a long-term process. Yet a recent study suggests that changing cultural traditions is possible—for example, by means of new laws and policies (see Bau, 2021). Importantly, the observed relationships were robust to the unobserved stable municipality-level characteristics that may confound the municipal factors and adolescent mental health, providing a degree of confidence in our claims.

Our findings also provided evidence that the influences of municipal context may differ by gender. Previous studies highlight the necessity of exploring heterogeneous relationships across genders or social groups regarding health-risk factors (e.g., Das et al., 2016). Evidence suggests that while boys are more affected by relative deprivation (Balsa et al., 2014; Fagg et al., 2013), social support and belonging play more important roles in promoting girls’ mental health (Fowler et al., 2013; Van Droogenbroeck et al., 2018). Consistent with these findings, we observed that the average household income level in the municipality showed a more negative association with boys’ self-esteem than with girls’. In contrast, municipal infrastructure and belongingness tended to be more positively associated with increased self-esteem and reduced problematic behaviors among girls, compared to boys. A previous study also highlights that girls are more susceptible to academic anxiety (Bhansali & Trivedi, 2008). Here we also

found that girls' depressive symptoms were more positively associated with municipality-level academic culture than boys'. Taken together, this implies that the standard assumption of homogenous effects of municipal contexts may not hold, particularly for gender.

Strengths And Limitations

Our study has several strengths. First, we used a nationwide survey exploiting variations within each municipality. Our longitudinal multilevel design provided robust empirical evidence while accounting for stable municipality-level confounding effects. Further, we employed a variety of objective and subjective measures of municipal characteristics obtained from adolescents and municipalities to provide a comprehensive understanding of the role of municipalities in shaping adolescents' mental health. Lastly, our study provides a unique opportunity to study contextual influences in a welfare society like Norway, which has been considered as a social-democratic welfare state where disparities between districts are relatively small.

The limitations of this study provide several avenues for future studies. First, the study is conducted in the context of a Scandinavian welfare state, which is well known for strong welfare protections, well-functioning democracy, and high levels of well-being (Martela et al., 2020). Moreover, Norway is racially/ethnically and culturally more homogenous than the US and UK. We acknowledge that our findings may be specific to Norwegian contexts, and future studies will need to consider the potential influences of racial/ethnic composition on adolescent mental health. Second, unobserved time-varying confounding is an enduring source of bias in longitudinal observational studies. Norway has relatively stable and homogenous municipal characteristics compared to the US and UK, and we did control for several observed time-varying factors in our models. Yet future studies may need to consider alternative models that can effectively address unobserved time-varying confounding (see e.g., Clare et al., 2019). Third, our study did not measure objective health, and some municipal-level variables were obtained from self-reported single items. These indicators may introduce measurement errors but are commonly used in epidemiological studies for practical reasons to minimize participant refusal and reduce data collection and processing costs (e.g., Adjaye-Gbewonyo et al., 2018). Research also suggests that single-item measures tend to yield valid and reliable estimates in many cases (e.g., Cheung & Lucas, 2014; Williams & Smith, 2016). Last, while we provide evidence supporting the importance of contextual factors, the underlying mechanisms were not tested; researchers should extend this study to further investigate the mechanisms of municipal influences on adolescent mental health with more objective and reliable health measures.

Conclusion

Our study contributes to an emerging body of adolescent mental health research that looks beyond the individual level to examine the contextual determinants of mental health outcomes. Previous findings may have been byproducts of unmeasured confounding between municipalities. Even after accounting for unobserved stable confounding, we still observed within-municipality associations of municipal

factors with adolescent mental health, above and beyond individual factors. From a policy perspective, our findings suggest that enhancing municipality safety and municipal infrastructure or creating a healthy youth culture for adolescents could be a feasible municipal-level strategy to mitigate growing adolescent mental health problems. It is often a challenging task to regulate individual behavior, particularly when individuals have an interest in maintaining risky behaviors or have limited control over their behaviors (Blankenship et al., 2000). Enhancing municipality safety and infrastructure may be a cost-effective way to induce individuals to behave in a desirable manner in certain cases. Further, the observed cross-level interactions suggest that municipality-level interventions may need to consider the different needs of boys and girls. However, given the relatively small effects sizes of municipal factors found here and limited resources, we need to also consider individual-level factors that are more amenable to change.

As a whole, the evidence we provide here suggests that policymakers and practitioners need to consider the diverse and complex nature of both individual and contextual factors to prevent and respond to increasing adolescent mental health problems. Future work that explores the heterogeneous relationships between individual and municipal factors, beyond the gender differences explored here, will enrich our current understanding of the dynamic process of psychological well-being and health among adolescents.

Declarations

Compliance with Ethical Standards

This study used data from the Norwegian nationwide Ungdata surveys. All students gave their informed consent prior to their participation in the study. We have access to the data through the Norwegian Agency for Shared Services in Education and Research. The authors have no competing interests to declare that are relevant to the content of this article.

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Tables

Table 1
Three-level multilevel models for adolescent mental health

Fixed effects	Depressive symptom	Self-esteem	Behavioral problems
	b (SE)	b (SE)	b (SE)
Individual-level effects			
Intercept	1.79*** (.27)	1.14*** (.24)	.61*** (.16)
Male	-.25*** (.00)	.30*** (.00)	.12*** (.00)
Subjective income	-.04*** (.00)	.06*** (.00)	-.01*** (.00)
Parental monitoring	-.01** (.00)	.08*** (.00)	-.18*** (.00)
Health problem	.35*** (.00)	-.14*** (.00)	.06*** (.00)
Sleep problem	.25*** (.00)	-.12*** (.00)	.03*** (.00)
Grade 9 (ref: grade 8)	.09*** (.00)	-.05*** (.00)	.03*** (.00)
Grade 10	.18*** (.00)	-.07*** (.00)	.06*** (.00)
Friendship	-.05*** (.00)	.09*** (.00)	.03*** (.00)
Bullied	.06*** (.00)	-.06*** (.00)	.01*** (.00)
TV/PC game	-.03*** (.00)	.03*** (.00)	.00*** (.00)
Reading Book	.01*** (.00)	.00 (.00)	-.02*** (.00)
Social media	.03*** (.00)	-.03*** (.00)	.04*** (.00)
Sports activities	-.00** (.00)	.01*** (.00)	.01*** (.00)
School satisfaction	-.33*** (.00)	.37*** (.00)	-.14*** (.00)
Year 15 (ref: year 2014)	.04* (.01)	.03** (.01)	.00 (.01)
Year 16	.06*** (.02)	.02 (.01)	-.02* (.01)
Year 17	.10*** (.02)	.04* (.02)	-.01 (.01)
Year 18	.10*** (.02)	.02 (.02)	.00 (.01)
Year 19	.13*** (.03)	.00 (.02)	-.01 (.02)
Within-municipality effects			
Population density	-.00 (.00)	-.00 (.00)	.00** (.00)
Immigrant background	.00 (.01)	.00 (.01)	-.00 (.00)
Unemployed	.01 (.02)	.00 (.01)	-.02 (.01)
* $p < .05$, ** $p < .01$, *** $p < .001$			

Fixed effects	Depressive symptom	Self-esteem	Behavioral problems
	b (SE)	b (SE)	b (SE)
Household Income	-.03 (.04)	.01 (.03)	-.02 (.02)
Social assistance	-.00 (.00)	.00 (.00)	.00 (.00)
Offense	.00 (.00)	-.00 (.00)	-.00 (.00)
Safety	-.25*** (.07)	.11 (.06)	-.04 (.04)
Community infrastructure	-.04 (.04)	.08* (.03)	.02 (.02)
Belongingness	-.04 (.09)	.08 (.08)	-.02 (.05)
Academic culture	-.11 (.06)	.05 (.06)	-.11** (.04)
Oppositional culture	.13** (.04)	-.12*** (.03)	.14*** (.02)
Between-municipality effects			
Population density	.00 (.00)	.00 (.00)	.00*** (.00)
Immigrant background	-.00 (.00)	.00* (.00)	.00 (.00)
Unemployed	.04** (.01)	-.03** (.01)	.02* (.01)
Household income	.01 (.01)	.02* (.01)	.02*** (.00)
Social assistance	-.00 (.00)	.00 (.00)	.00 (.00)
Offense	.00 (.00)	.00 (.00)	.00 (.00)
Safety	-.25*** (.05)	.20*** (.04)	-.07* (.03)
Community infrastructure	-.04 (.02)	.03 (.02)	-.04** (.01)
Belongingness	-.12* (.06)	.05 (.05)	.02 (.04)
Academic culture	-.06 (.06)	.03 (.05)	-.15*** (.04)
Oppositional culture	.18*** (.03)	-.18*** (.03)	.12*** (.02)
Random effects	Variance components	Variance components	Variance components
Level-1 error	.28 (.00)	.34 (.00)	.15 (.00)
Year-municipality	.00 (.00)	.00 (.00)	.00 (.00)
Municipality	.00 (.00)	.00 (.00)	.00 (.00)
* $p < .05$, ** $p < .01$, *** $p < .001$			

Table 2
Cross-level interaction models with gender for adolescent mental health

Fixed effects	Depressive symptom	Self-esteem	Behavioral problems
	b (SE)	b (SE)	b (SE)
Individual-level effects			
Intercept	1.79*** (.27)	1.14*** (.24)	.61*** (.17)
Male	-.25*** (.00)	.30*** (.00)	.12*** (.00)
Within-municipality effects			
Population density	-.00 (.00)	-.00 (.00)	.00** (.00)
Immigrant background	.00 (.01)	.00 (.01)	-.00 (.00)
Unemployed	.01 (.02)	.00 (.01)	-.01 (.01)
Household Income	-.03 (.04)	.01 (.03)	-.02 (.02)
Social assistance	-.00 (.00)	.00 (.00)	.00 (.00)
Offense	.00 (.00)	-.00 (.00)	-.00 (.00)
Safety	-.25*** (.07)	.11 (.06)	-.04 (.04)
Infrastructure	-.04 (.04)	.08* (.03)	.02 (.02)
Belongingness	-.04 (.09)	.07 (.08)	-.02 (.05)
Academic culture	-.11 (.06)	.05 (.06)	-.11** (.04)
Oppositional culture	.13*** (.04)	-.12*** (.03)	.14*** (.02)
Cross-level interaction effects			
Population density*Male	.00 (.00)	-.00*** (.00)	.00 (.00)
Immigrant background*Male	.00 (.01)	.01 (.01)	-.01 (.01)
Unemployed*Male	-.02 (.01)	.00 (.01)	.02* (.01)
Household income*Male	-.00 (.03)	-.10** (.03)	.09*** (.02)
Social assistance*Male	-.00 (.00)	-.00 (.00)	-.00 (.00)
Offense*Male	.00 (.00)	.00 (.00)	-.00 (.00)
Safety*Male	.09 (.06)	.14* (.07)	.00 (.05)
Infrastructure*Male	.03 (.04)	-.09 (.05)	.07* (.03)

* $p < .05$, ** $p < .01$, *** $p < .001$

Fixed effects	Depressive symptom	Self-esteem	Behavioral problems
	b (SE)	b (SE)	b (SE)
Belongingness*Male	.05 (.10)	-.29** (.11)	-.00 (.07)
Academic*Male	-.14* (.07)	-.06 (.08)	.05 (.05)
Oppositional*Male	-.07 (.04)	.01 (.04)	.09** (.03)
Random effects	Variance components	Variance components	Variance components
Level-1 error	.28 (.00)	.34 (.00)	.15 (.00)
Year-municipality	.00 (.00)	.00 (.00)	.00 (.00)
Municipality	.00 (.00)	.00 (.00)	.00 (.00)
<i>* p < .05, ** p < .01, *** p < .001</i>			

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Appendix.docx](#)