OPEN ACCESS

Effects of school environments on student risk-behaviours: evidence from a longitudinal study of secondary schools in England

Chris Bonell,[1] Emma Beaumont,[2] Matthew Dodd,[2] Diana Ruth Elbourne,[2] Leonardo Bevilacqua,[3] Anne Mathiot,[3] Jennifer McGowan,[3] Joanna Sturgess,[2] Emily Warren,[1] Russell M Viner,[3] Elizabeth Allen[2]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/jech-2018-211866).

[1]Department of Public Health, Environments and Society, London School of Hygiene and Tropical Medicine, London, UK
[2]Department of Medical Statistics, London School of Hygiene and Tropical Medicine, London, UK
[3]Institute of Child Health, University College London, London, UK

Correspondence to
Professor Chris Bonell, Department of Public Health, Environments and Society, London School of Hygiene and Tropical Medicine, London WC1H 9SH, UK; chris.bonell@lshtm.ac.uk

Received 5 November 2018
Revised 29 January 2019
Accepted 29 January 2019

To cite: Bonell C, Beaumont E, Dodd M, *et al*. *J Epidemiol Community Health* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/jech-2018-211866

ABSTRACT

Background The theory of human functioning and school organisation proposes that schools with rigid 'boundaries' (weaker relationships), for example, between staff and students, or learning and broader development, engender weaker student school commitment and sense of belonging, particularly among disadvantaged students, leading to greater involvement in risk-behaviours. Existing studies provide some support but rely on a proxy exposure of 'value-added education' and have not explored effects by disadvantage.

Methods We used longitudinal data from English secondary schools from the control arm of a trial, assessing school-level measures of rigid boundaries, and student commitment and belonging at age 11/12, and student risk-behaviours at age 14/15.

Results Our direct measures were more strongly associated with risk-behaviours than was value-added education. School-level rigid boundaries were associated with increased alcohol use and bullying. Student belonging was more consistently associated with reduced risk-behaviours than was student commitment. Some school effects were greater for students from disadvantaged subgroups defined in terms of poverty, ethnicity and family structure.

Conclusion Our results provide direct support for the theory of human functioning and school organisation and suggest a sense of belonging in school might be particularly protective factor among secondary school students. School effects on risk are generally stronger among disadvantaged students as theorised.

Trial registration number ISRCTN10751359

INTRODUCTION

As well as being sites for education including health education, school environments can directly influence student health.[1] For individual students, lack of commitment to school is associated with multiple risk-behaviours and poorer health.[2 3] US and UK studies of multilevel effects suggest that some schools more successfully engage their students, and that students in these schools are less likely to report violence or use of alcohol and tobacco.[4–9]

Many such studies are informed by the theory of human functioning and school organisation,[10] which offers the most comprehensive model of how school environments influence risk-behaviours and health.[5] This theory proposes that schools with rigid 'boundaries' (ie, weaker relationships) between and among staff and students, between academic learning and broader student development, and between schools and local communities are less successful in engaging students in academic learning or engendering a sense of belonging in the school community because the school is insufficiently focused on the needs and values of students. It is theorised that this will be particularly so for students from disadvantaged backgrounds for whom the middle-class culture of school is more alien and an orientation towards academic learning is not the default. The theory proposes that students not committed to academic learning or feeling they belong in school are more likely to engage in risk-behaviours such as violence or use of tobacco, alcohol and drugs because their lack of commitment to learning at school means they fail to develop the autonomy, reasoning ability and social support to avoid risk, because they do not share school values opposed to these behaviours or because risk-behaviours function as markers of identity when conventional markers of educational success are not available.[11] School-level, and not merely student-level, deficits in belonging and commitment are theorised as important because they encourage the development of school-wide norms supportive of risk-behaviours.

Existing studies of multilevel effects cited above have not enabled a full assessment of this theory for two reasons. First, they rely on a measure of 'value-added education' (VAE) as a proxy for an engaging school environment. The measure of VAE used in these studies draws on administrative data to examine the extent to which student academic attainment and attendance in a school are better than would be predicted by its students' sociodemographic profile. The suggestion is that schools with higher-than-expected attainment and attendance are more successful at engendering student commitment and belonging by having less rigid boundaries, but this is an untested assumption. VAE provides no direct measure of school boundaries or student commitment to learning or sense of belonging in school. Second, existing studies have not explored whether school-level effects on risk-behaviour are greater for socially disadvantaged students, as the theory would predict.

We attempt to overcome these limitations by using existing, reliable measures of student-reported

school commitment and belonging,[12] as well as a new measure of school boundaries based on teachers' reports that we have previously examined in terms of its reliability and criterion validity drawing on baseline data from the INCLUSIVE trial.[13 14] Although inter-item reliability was suboptimal overall, this was better for the subscales examining boundaries between academic/broader learning and schools/local communities.[15] In that cross-sectional analysis, we did not aim to explore whether the measure was causally associated with risk outcomes. But we did undertake an initial assessment of associations to give some indication of the measure's underlying validity. The measure was indeed associated with reduced student-reported commitment and belonging, and increased student-reported smoking. A further baseline analysis found that school-level aggregates of student commitment and belonging (but not school-level VAE) were associated with use of alcohol and tobacco.[16] However, we would stress that these analyses did not aim to assess causality and could not assess temporality of associations. Furthermore, because they drew on data from students aged only 11–12 years, rates of risk-behaviours were low so that the analyses lacked the power to explore subgroup effects. Finally, the baseline analyses did not examine victimisation from or perpetration of bullying, which are also important risk-behaviours with important consequences for health.[13]

Our aim here is to use these measures to examine the effect on risk-behaviours of school-level factors that align with constructs from the theory of human functioning and school organisation. We use longitudinal data from schools in the control arm of the INCLUSIVE trial, with outcome data from when students were aged 14/15 years, including bullying victimisation and perpetration.[13 14] We hypothesise that rigid school boundaries will be associated with increased student risk behaviour while school-level measures of student belonging and commitment, as well as VAE, will be associated with reduced risk, but that associations for our VAE proxy exposure will be weaker than for our other more directly measured exposures. We also hypothesise that associations between the school-level factors and student risk-behaviours will be stronger among disadvantaged students.

METHODS

Design

Our analysis follows STROBE guidance[17] and draws on data from 20 English secondary schools participating in the control arm of the INCLUSIVE randomised controlled trial (RCT), excluding data from the 20 schools in the intervention arm to avoid problems with confounding from intervention effects. The trial was conducted 2014–2017 and evaluated a whole-school intervention to reduce bullying and aggression. Here, we provide a summary of the trial. For full details including sample size calculation, see the protocol and trial report.[13 14]

We undertook a two-arm parallel cluster RCT involving state schools rated by government inspectors of schools as 'requires improvement' or above, recruited by the trial team via emails. Schools rated by inspectors as 'inadequate' were deemed likely to lack the capacity to participate in the trial. Participating schools were representative of those in south-east England. Using computer-generated random numbers, schools were allocated by the trial team 1:1 to intervention or control stratified by school: single-sex versus mixed-sex status; student free-school-meal (FSM) eligibility rates, indicating poverty; and General Certificate of Secondary Education (GCSE) results accounting for school-level baseline attainment. Students judged competent to consent were surveyed prior to random allocation at baseline at the end of year 7 (the first year of secondary school) in 2014 (age 11–12 years), and at interim 24-month follow-up and final 36-month follow-up in 2016. Student data were collected using paper questionnaires in classrooms under examination conditions by trained fieldworkers blind to allocation.

Measures

VAE, school boundaries and student commitment were measured at baseline because these were hypothesised exposures so measured temporally prior to our outcomes.

VAE: As per previous studies,[4–9] administrative data on school attainment and absence rates were used to construct our continuous measure of VAE. Attainment rates were 5-year (2009–2013) averages of the proportion of year-11 students passing at least five GCSE examinations graded A*–C (5 A*–C). Absence rates were measured as 5-year (2009–2013) averages of the proportion of half-days missed. First, we estimated two logistic regression models using school-level 5 A*–C and absence rates as outcomes with the following sociodemographic exposures: proportion of white students; proportion of females; Income Deprivation Affecting Children Index (IDACI)[18]; proportion of students eligible for FSM; proportion of students speaking English as an additional language (EAL); proportion of students scoring ≥6 (from range 0 to 9) on the family affluence scale (FAS) as a measure of student socioeconomic status.[19] Data on FSM, IDACI, EAL and the proportion of female students were from government websites. Data on the proportion of white students and FAS were from our survey. Standardised residuals from each model represent differences between observed attainment and absence rates, and those predicted based on each school's sociodemographic profile. We then undertook a principal components analysis of residuals from each model, which identified a single factor explaining 68.1% of variance with factor loadings of +0.71 for attainment and −0.71 for attendance residuals, comparable with previous research.[4] This variable was termed 'VAE' and standardised so that +1 represented schools with performance one SD above average and −1 indicated schools with one SD below average.

Staff reports of school boundaries: This drew on staff reports of school organisational climate using a new scale,[15] which was assessed for reliability at baseline[15] and then amended so that it included 26 items maximising reliability of the overall scale, with subscales measuring whether authority is shared among staff, staff–student relationships, integration of students' academic education and broader development, and school–community relationships (table 1). Data for this measure were collected via structured telephone interviews just after the trial baseline in September–November 2014 with one member of each school's senior leadership team and two other members of staff identified by this individual. Staff were asked to rate their level of agreement with various statements, with responses scored between 1 (strongly agree) and 4 (strongly disagree). The proportion of staff interviewed who completed all items for the four subscales ranged from 80.0% to 81.7%. Items were re-coded so that a higher score indicated what, from the perspective of our theory, would represent more rigid boundaries. Responses were summed first within subscales to obtain the subscale scores, and then across the subscale scores to obtain the overall score.

Student commitment to learning and to the school community: These were respectively assessed at baseline by the four-item 'commitment to academic values' and the eight-item 'sense of belonging' subscales (table 1) of the Beyond Blue School Climate Questionnaire.[12] The proportion of students who participated

Table 1 Measures of school climate

Staff view on school organisation climate: new scale	
Subscale/items	**Source**
Authority distributed among staff	
The head teacher takes most of the decisions with little staff consultation	Avon Longitudinal Study of Parents and Children head teacher questionnaire*
Teachers participate on a regular basis in the development of school policies	Avon Longitudinal Study of Parents and Children head teacher questionnaire*
The senior leadership team consult with staff when making decisions	New question
Teachers in this school have a sense of collective responsibility for student learning	The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
Teachers in this school have a sense of collective responsibility for student well-being	The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
Teachers and other staff in the classroom work collaboratively	The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
Staff relationships with students	
In my school, students participate in decision-making	Adapted from The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
Teachers in this school always show respect towards students	Adapted from Avon Longitudinal Study of Parents and Children head teacher questionnaire*
Students' views are listened to and taken seriously by staff in this school	Avon Longitudinal Study of Parents and Children head teacher questionnaire*
Teaching strategies at this school enable students to build their own knowledge	Adapted from The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
There are opportunities for students to take responsibilities for their own learning in school	Adapted from The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
In this school, the senior leadership team makes decisions without consulting students	New question
Teachers at this school are often involved in extracurricular activities	Adapted from Avon Longitudinal Study of Parents and Children head teacher questionnaire*
In my school, teachers mix with students at break times	New question
In my school, teachers mix with students at lunch time	New question
In my school, teachers avoid intervening in students disputes outside the classroom	New question
Integration of students' academic education and broader social development	
The school has a system for rewarding students who achieve in non-academic areas, for example, sport, arts	Adapted from Avon Longitudinal Study of Parents and Children head teacher questionnaire*
Our school provides a broad range of extracurricular activities for students (eg, plays, athletics, music, dance)	The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
The school development/improvement plan has targets related to student health and well-being	Adapted from School Health Research Network school questionnaire‡
School INSET/training days often focus on student health	Adapted from School Health Research Network school questionnaire‡
The school has a comprehensive written policy to address student smoking, drugs or alcohol use	Adapted from School Health Research Network school questionnaire‡
The school teaches a social and emotional learning curriculum	Adapted from School Health Research Network school questionnaire‡
School–community relationships	
Parents often visit the school	The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
This school engages parents in school improvement efforts	Adapted from The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
This school aims to build community support for the school's improvement efforts	Adapted from The Impact of School Leadership on Pupil Outcomes Key Staff Questionnaire—Secondary Schools†
Parents give a lot of support to the work of the school	Avon Longitudinal Study of Parents and Children head teacher questionnaire*
Beyond Blue School Climate Questionnaire	
Subscale/items	
Student sense of belonging in school community	
I feel very different from most other students here	
I can really be myself at this school	
Other students in this school take my opinions seriously	
I am encouraged to express my own views in my class(es)	
Most of the students in my class(es) enjoy being together	
Most of the students in my class(es) are kind and helpful	
Most other students accept me as I am	

Continued

Table 1 Continued

Staff view on school organisation climate: new scale	
Subscale/items	**Source**
I feel I belong at this school	
Student commitment to learning	
I try hard in school	
Doing well in school is important to me	
Continuing or completing my education is important to me	
I feel like I am successful in this school	

*Children ALSoPa. Questionnaire for Head teacher http://www.bristol.ac.uk/alspac/researchers/resources-available/data-details/questionnaires/documents/ques-s07-questionnaire-for-the-head-teacher.pdf 2002.
†Day C, Sammons P, Hopkins D, *et al*. The Impact of School Leadership on Pupil Outcomes Interim Report. London: Department for Education; 2007.
‡DECIPHer. Schools Health Research Network http://man301110a.decipher.uk.net/en/content/cms/research/research-projects/shrn/ 2014.

in the survey and who completed all items for the two subscales were respectively 97.8% and 94.4%. Students were asked to rate their level of agreement with items, with responses scored between 3 (yes, totally agree) and 0 (totally disagree). Responses were summed and then multiplied by 10 to obtain the overall score. In our baseline analysis,[16] inter-item reliability for these subscales was good.

Bullying victimisation: This was assessed at 36-month follow-up by the Gatehouse bullying scale, a 12-item validated self-report measure of being the subject of teasing, name-calling, rumours, being left out of things, and physical threats or actual violence from other students, including face-to-face and cyber-bullying, within the last 3 months.[20] Students reported the frequency and upset related to each experience. Items were summed to make a total bullying victimisation score (higher represents more frequent upsetting bullying).

Bullying perpetration: Also assessed at 36-month follow-up, this used the modified aggression scale bullying subscale, a five-item measure of the frequency (never; 1 or 2 times; 3 or 4 times; 5+ times) of physical and verbal bullying perpetration measured at follow-up only (range 0–15). Higher scores indicated greater bullying.[21]

Use of tobacco, alcohol and drugs: Validated age-appropriate questions taken from national surveys[22] were used to assess cigarette smoking (smoking in previous week; ever smoked regularly), alcohol use (use in previous week; number of times really drunk; binge drinking) and illicit drug use (last month; lifetime use) at 36-month follow-up.

Covariates: We measured the following school-level factors at baseline drawing on data from government websites: school size, neighbourhood IDACI[18] and FSM eligibility. We also measured the following student-level factors drawing on our baseline student survey: sex, ethnicity, family structure, levels of household worklessness and FAS.

Analysis

The initial analysis used data from students in control schools completing surveys at baseline and follow-up surveys. We present descriptive data on prevalences before examining longitudinal associations between each of our school-level variables measured at baseline and the student risk-behaviours measured at 36-month follow-up. We calculated unadjusted associations before examining potential confounders, first assessing for interactions and then undertaking adjusted analyses. Logistic mixed-regression models for binary outcomes and linear mixed-regression models for continuous outcomes were fitted with random effects for school to account for clustering. Prespecified covariates were added to models and where there was evidence of confounding (determined by a 10% change in the effect estimate), the covariate was retained in multivariate analysis. Once a final adjusted model had been agreed, all covariates that had not originally been retained in the model were added again to further check for any confounding. All continuous variables were assumed to have linear effects on outcomes. All variables were assumed to be normally distributed.

Where evidence ($p \leq 0.01$) of interactions was found, we report stratified analyses. It would be impractical to present results stratifying for any more than two variables simultaneously. In such cases, we priorised stratification by family affluence over other measures of economic disadvantage. Clear reporting of stratified results required dichotomisation of variables. Continuous measures were dichotomised around the median. Ethnicity was separated into white British and other. Family structure was separated into two biological parents and other. Parental working was separated into any versus no adults working.

As differences between students who completed both baseline and follow-up surveys and those who only completed baseline were observed, we used multiple imputation by chained equations to impute missing data for participants with incomplete outcome data. Model building was initially done using the complete-case-analysis group and adjusted models were re-run using imputed data.

Ethics

Parents of students were informed about the study and could withdraw their children from research.

RESULTS

At baseline, 3337 (92.7% of those on school registers) completed surveys. Of these, 2485 (74.2%) completed 36-month follow-up questionnaires, and 2297 students (61.4%) completed all three waves of surveys. Attrition reflected students moving school, being absent or refusing consent. On average, schools scored low for the rigidity of boundaries and high for student commitment and belonging (table 2). At baseline, just over half of students were female. Over half reported ethnicities other than white British. Just under two-thirds lived with both biological parents (online supplementary table S1). Just over a tenth reported that no adult in their household had a job. Over a third reported living in less-affluent families.

At final follow-up, the mean score on the measure of bullying perpetration was 2.76 out of a possible 15. The mean score on the measure of bullying victimisation was 0.33 out of a possible

Table 2 Descriptive data on school-level exposures

Variable	Categories	Mean (SD)	N (%)
School-level strong boundaries	–	–0.28 (0.46)	–
School-level student commitment	–	36.5 (0.47)	–
School-level student belonging	–	30.0 (1.09)	–
School level value added	–	0.09 (1.01)	–
School size	Small	1189 (326.34)	11 (55)
	Large		9 (45)
School neighbourhood deprivation	Low score	0.27 (0.20)	10 (50)
	High score		10 (50)
Free school meal eligibility	Low score	0.35 (0.19)	10 (50)
	High score		10 (50)
	High affluence	–	1415 (63.23)

3. Around a fifth of students reported smoking tobacco ever, with about a third of these reporting smoking in the previous week. About a tenth of students reported consuming alcohol in the previous week with about double this number reporting they had ever been really drunk and just over a tenth reporting they had ever engaged in binge drinking. About a tenth of students reported ever using drugs with around two-thirds of these reporting use in the previous month.

Differences were observed in key characteristics between students completing all surveys and those completing baseline only (online supplementary table 1), with loss to follow-up higher among students with non-working parents or not living with two biological parents.

In adjusted analyses using multiple imputation (complete-case analysis is presented in online supplementary tables 2 and 3), school-level VAE was the school-level exposure least strongly associated with our student risk-behaviours. Indeed, it was not significantly associated with any in the adjusted analyses using multiple imputation (table 3), although in the complete case analysis, there was an association between school-level VAE and decreased smoking both ever and in the previous week among students from less-affluent families (online supplementary table 2). Our measure of rigid school-level boundaries was associated with increased bullying perpetration among boys, bullying victimisation among boys from less-affluent families, drunkenness among those from affluent families, and with both binge drinking and drug use in the previous week among all students. School-level student commitment was associated only with decreased bullying victimisation among non-White British students, smoking ever among non-White British students from less-affluent families, alcohol use in the last week among less-affluent students and drug use ever (table 4). There was also an association of borderline statistical significance with decreased binge drinking. School-level student belonging was associated with decreased bullying perpetration and victimisation among males, ever smoking, smoking in the previous week, alcohol use in the previous week and drunkenness among affluent students, binge drinking among students living with two parents, and drug use ever and in the last month.

Table 3 Adjusted and stratified associations between school-level exposures (rigid boundaries and value-added education) and student risk-behaviours with multiple imputation

	School-level exposures						
	Rigid boundaries				Value-added education		
Student risk-behaviours	Variables for which evidence of moderation indicates need for stratified analysis		Association—overall or stratified where evidence of moderation	P value	Variables for which evidence of moderation	Association—overall or stratified where evidence of moderation	P value
Bullying perpetration	Female		0.13* (–0.50, 0.75)	0.69	Low affluence	–0.19† (–0.50, 0.12)	0.22
	Male		0.61* (–0.01, 1.23)	0.05	High affluence	0.06† (–0.22, 0.33)	0.69
Bullying victimisation	Low affluence	Female	0.05 (–0.05, 0.16)	0.31	–	–0.01 (–0.04, 0.02)	0.47
		Male	0.15 (0.05, 0.25)	0.003			
	High affluence	Female	–0.03 (–0.11, 0.05)	0.54			
		Male	0.06 (–0.02, 0.14)	0.14			
Smoking tobacco ever	–		1.34‡ (0.79, 2.27)	0.28	Low affluence	0.79 (0.62, 1.02)	0.07
					High affluence	0.94 (0.75, 1.17)	0.58
Smoking tobacco in previous week	–		1.33§ (0.71, 2.52)	0.27	Low affluence	0.72 (0.51, 1.01)	0.06
					High affluence	0.92 (0.70, 1.21)	0.55
Alcohol in previous week	–		1.31¶ (0.78, 2.20)	0.31	–	0.81 (0.56, 1.19)	0.29
Really drunk ever	Low affluence		1.04** (0.56, 1.92)	0.91	–	0.82 (0.59, 1.13)	0.23
	High affluence		1.90** (1.08, 3.32)	0.03			
Binge drinking ever	–		2.23†† (1.33, 3.73)	0.002	–	0.82 (0.56, 1.19)	0.29
Drugs ever	–		1.59 (0.80, 3.13)	0.18	–	0.91 (0.67, 1.24)	0.29
Drugs in previous month	–		2.36‡‡ (1.06, 5.22)	0.04	–	0.81 (0.54, 1.21)	0.31

Variables adjusted for:
*Size, deprivation, ethnicity, family structure, parent working, family affluence.
†Size, sex, deprivation,family structure, parent working.
‡Parent working, sex.
§Deprivation, parent working.
¶Size, deprivation, FSM.
**Deprivation size.
††Size, deprivation.
‡‡Size, parent working.

Table 4 Adjusted and stratified associations between school-level exposures (student commitment and sense of belonging) and student risk-behaviours with multiple imputation

	School-level exposures						
	Student commitment				Student belonging		
Student risk-behaviours	Variables for which evidence of moderation indicates need for stratified analysis		Association—overall or stratified where evidence of moderation	P value	Variables for which evidence of moderation	Association—overall or stratified where evidence of moderation	P value
Bullying perpetration			–0.45* (–0.119, 0.29)	0.25	Female	–0.14† (–0.40, 0.13)	0.31
					Male	–0.76† (–1.02, –0.49)	<0.0001
Bullying victimisation	White British		0.03‡ (–0.07, 0.12)	0.58	Female	–0.01 (–0.05, 0.02)	0.46
	Other		–0.09 (–0.17, –0.02)	0.02	Male	–0.07 (–0.10, –0.03)	<0.0001
Smoking tobacco ever	Low affluence	White British	0.67§ (0.31, 1.45)	0.31	White British	0.68 (0.53, 0.86)	0.002
		Other	0.46§ (0.23, 0.92)	0.03			
	High affluence	White British	0.98§ (0.49, 2.00)	0.97	Other	0.80 (0.64. 1.00)	0.05
		Other	0.68§ (0.35, 1.30)	0.24			
Smoking tobacco in previous week	Low affluence	Two parents	0.80¶ (0.31, 2.09)	0.65		0.68** (0.53, 0.86)	0.002
		Other family structure	0.50¶ (0.19, 1.39)	0.19			
	High affluence	Two parents	1.39¶ (1.13, 8.90)	0.43			
		Other family structure	0.89¶ (0.34, 2.33)	0.81			
Alcohol in previous week	Low affluence		0.42†† (0.18, 0.88)	0.05	Low FSM	1.06 (0.81, 1.38)	0.68
	High affluence		0.88†† (0.45, 1.74)	0.72	High FSM	0.55 (0.40, 0.75)	<0.0001
Really drunk ever			0.61‡‡ (0.33, 1.14)	0.12	Low affluence	0.81§§ (0.62, 1.06)	0.13
					High affluence	0.65§§ (0.51, 0.83)	0.001
Binge drinking ever			0.54‡‡ (0.26, 1.11)	0.09	Two parents	0.64 (0.48, 0.87)	0.004
					Other family structure	0.79¶¶ (0.57, 1.11)	0.18
Drugs ever			0.43‡‡ (0.18, 1.01)	0.05		0.65 (0.48, 0.88)	0.005
Drugs in previous month			0.36†† (0.12, 1.11)	0.08		0.50 (0.34, 0.73)	<0.0001

Variables adjusted for:
*Size, deprivation, ethnicity, family structure, parent working, family affluence.
†Size, deprivation.
‡Parent working.
§Size, deprivation, FSM.
¶Deprivation, FSM, ethnicity, parent working.
**Deprivation.
††Size, deprivation, FSM, ethnicity, parent working.
‡‡Size, deprivation, FSM, ethnicity.
§§IDACI, FSM.
¶¶ IDACI.
FSM, free school meal; IDACI, Income Deprivation Affecting Children Index.

DISCUSSION

Summary of key findings

Supporting our hypotheses, VAE was the school-level variable least strongly associated with student risk-behaviours. This probably reflects its status as a proxy measure of organisational factors theorised as affecting student health. Our school-level measure of student belonging was most consistently associated with student risk-behaviours, more so than student commitment to education.

In many cases, school-level exposures interacted with student-level characteristics to influence risk-behaviours. In most cases, the effects of school-level factors were strongest for the most disadvantaged students, as would be predicted by the theory of human functioning and school organisation. This suggests the importance of schools in promoting health and also in reducing health inequalities.

Limitations

Our study is the first to examine exposures aligning with the theory of human functioning and school organisation using direct measures, drawing on longitudinal data and with a large enough sample to examine how effects vary by social disadvantage. While retention was good, outcome data were not complete, hence our use of multiple imputation. Our school-level measure of boundaries has limited reliability so that its being associated with few outcomes might simply reflect non-differential measurement error. Our adjusted models did not adjust each school-level exposure for each other since these are theorised as lying on a causal pathway and so interpretation of any such adjustment would be unclear. Our analysis did not attempt to separate out the relative contribution of deficits in student belonging and commitment occurring at the individual and school levels since we hypothesise that these lie on a common theorised pathway to student risk-behaviours, rendering the interpretation of such adjustment uncertain.

Implications for research and policy

Our research is supportive of the theory of human functioning and school organisation as an explanation of how rigid boundaries within schools may erode student sense of commitment and

What is already known on this subject

- The theory of human functioning and school organisation proposes that schools with rigid boundaries (weaker relationships), for example, between staff and students or between academic and broader development, engender weaker student commitment to learning and sense of belonging in school, particularly among disadvantaged students, leading to more student involvement in risk-behaviours.
- Existing studies provide some support for this but rely on a proxy exposure of 'value-added education' and have not explored effects by disadvantage.

What this study adds

- Our results provide more direct support for the theory of human functioning and school organisation.
- Student sense of belonging in school is most strongly associated with reduced risk-behaviours among these secondary school students.
- School effects on risk are generally stronger among disadvantaged students as the theory predicts.

belonging, and encourage student risk-behaviours particularly among socially disadvantaged students. Our findings suggest that risk-behaviours might be most prevalent in those schools that fail to encourage a sense of belonging rather than academic commitment. However, this might reflect our study sample involving students who are not yet facing public academic examinations. Our results suggest the need for interventions addressing the school environment. Adding to the weight of existing evidence for this approach,[23] the INCLUSIVE trial, from the control group of which we drew our data, reports on the effectiveness of such an approach for a range of health outcomes including bullying victimisation and use of alcohol, tobacco and drugs.[13] Our schools were representative of those in south-east England, but generalisation to other settings is uncertain. Further research is required on the mechanisms by which the school environment shapes students' health. Key gaps to address include research in primary schools, effects on mental health and the precise mechanisms by which lack of student commitment or belonging influence risk taking.[5]

Acknowledgements We are grateful to the staff and students of participating schools for their dedication to the intervention and completion of the outcome surveys and process evaluation surveys and interviews. We are very grateful for the advice and support of our Trial Steering Committee and Data Monitoring Committee. We acknowledge the work of and mourn the loss of Dr Farah Jamal during the trial, whose death at the age of 30 was a tragic loss for public health research.

Contributors CB and RMV directed the trial from which the data are drawn. CB conceived of the paper. EA, MD, EB and CB designed the analysis for this paper. EB and MD implemented this design and undertook the analysis. DRE provided additional statistical expertise. CB drafted the paper with inputs and editing from all other authors.

Funding This project is funded by a grant from the National Institute for Health Research Public Health Research programme (grant PHR 12/153/60).

Disclaimer This report presents independent research commissioned by the National Institute for Health Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, MRC, CCF, NETSCC, the Public Health Research programme or the Department of Health.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Viner RM, Ozer EM, Denny S, *et al*. Adolescence and the social determinants of health. *Lancet* 2012;379:1641–52.
2 Fletcher A, Bonell C, Hargreaves J. School effects on young people's drug use: a systematic review of intervention and observational studies. *J Adolesc Health* 2008;42:209–20.
3 Resnick MD, Bearman PS, Blum RW, *et al*. Protecting adolescents from harm. Findings from the national longitudinal study on adolescent health. *JAMA* 1997;278:823–32.
4 Aveyard P, Markham WA, Lancashire E, *et al*. The influence of school culture on smoking among pupils. *Soc Sci Med* 2004;58:1767–80.
5 Bonell C, Jamal F, Harden A, *et al*. Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis. *Public Health Res* 2013;1:1–320.
6 Markham WA, Young R, Sweeting H, *et al*. Does school ethos explain the relationship between value-added education and teenage substance use? A cohort study. *Soc Sci Med* 2012;75:69–76.
7 Tobler AL, Komro KA, Dabroski A, *et al*. Preventing the link between SES and high-risk behaviors: "value-added" education, drug use and delinquency in high-risk, urban schools. *Prev Sci* 2011;12:211–21.
8 Bisset S, Markham WA, Aveyard P. School culture as an influencing factor on youth substance use. *J Epidemiol Community Health* 2007;61:485–90.
9 Markham WA, Aveyard P, Bisset SL, *et al*. Value-added education and smoking uptake in schools: a cohort study. *Addiction* 2008;103:155–61.
10 Markham WA, Aveyard P. A new theory of health promoting schools based on human functioning, school organisation and pedagogic practice. *Soc Sci Med* 2003;56:1209–20.
11 Jamal F, Fletcher A, Harden A, *et al*. The school environment and student health: a systematic review and meta-ethnography of qualitative research. *BMC Public Health* 2013;13.
12 Sawyer MG, Pfeiffer S, Spence SH, *et al*. School-based prevention of depression: a randomised controlled study of the *beyondblue* schools research initiative. *J Child Psychol Psychiatry* 2010;51:199–209.
13 Bonell C, Allen E, Warren E, *et al*. Initiating change in the school environment to reduce bullying and aggression: a cluster randomised controlled trial of the learning together (LT) intervention in English secondary schools. *The Lancet* 2018;392:2452–64.
14 Bonell C, Allen E, Christie D, *et al*. Initiating change locally in bullying and aggression through the school environment (inclusive): study protocol for a cluster randomised controlled trial. *Trials* 2014;15.
15 Shackleton N, Fletcher A, Jamal F, *et al*. A new measure of unhealthy school environments and its implications for critical assessments of health promotion in schools. *Crit Public Health* 2017;27:248–62.
16 Bonell C, Shackleton N, Fletcher A, *et al*. Student- and school-level belonging and commitment and student smoking, drinking and misbehaviour. *Health Educ J* 2017;76:206–20.
17 Elm Evon, Altman DG, Egger M, *et al*. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ* 2007;335:806–8.
18 Department for Education, 2015. IDACI score and RANK of IDACI London: DfE. Available: http://www.education.gov.uk/cgi-bin/inyourarea/idaci.pl
19 Currie C, Molcho M, Boyce W, *et al*. Researching health inequalities in adolescents: the development of the health behaviour in school-aged children (HBSC) family affluence scale. *Soc Sci Med* 2008;66:1429–36.
20 Bond L, Wolfe S, Tollit M, *et al*. A comparison of the Gatehouse bullying scale and the peer relations questionnaire for students in secondary school. *J Sch Health* 2007;77:75–9.
21 A4: Modified Aggression Scale. Measuring bullying victimization, perpetration, and bystander experiences. In: Hamburger ME, Basile KC, Vivolo AM, eds. *A compendium of assessment tools*. 12. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 2011p.
22 Bridges S, Gill V, Omole T. *Smoking drinking and drug use among young people in England in 2010*, 2011.
23 Langford R, Campbell R, Magnus D. The WHO health promoting school framework for improving the health and well-being of students and staff. In: *Cochrane database of systematic reviews*. 2011, 2014.