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1 **Title:** Pathways linking bullying victimisation and suicidal behaviours among adolescents

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38 **Abstract**

39 **Aims**: To examine the pathways explaining the association between bullying victimisation
40 and suicidal behaviours among school-based adolescents.

41 **Methods:** We used data from the Global School-based Student Health Survey from 90
42 countries conducted between 2003 and 2017. We applied multivariate regression and
43 generalised structural equation models to examine the pathways.

44 **Results:** Of 280,076 study adolescents, 32.4% experienced bullying and 12.1%, 11.1% and
45 10.9% reported suicidal ideation, suicidal planning and suicidal attempt, respectively.
46 Adolescents who experienced bullying had higher rates of hunger (8.7% vs 5.0%), drinking
47 soft drinks (44.0% vs 40.2%), truancy (35.8% vs 22.7%), smoking (14.0% vs 6.9%), alcohol
48 consumption (19.9% vs 11.8%), peer victimisation (54.0% vs 25.6%), peer conflict (47.4% vs
49 20.1%), sleep disturbance (13.7% vs 5.6%), loneliness (18.1% vs 7.6%), no close friends
50 (7.5% vs 5.2%), lack of peer support (64.9% vs 53.3%), lack of parental connectedness
51 (67.0% vs 60.4%) and less parental bonding (64.1% vs 55.2%). Nearly one-fourth (18.7%) of
52 the total association between bullying and suicidal ideation was mediated by loneliness.
53 Similarly, sleep disturbances and alcohol consumption also mediated 4 to 9% of the
54 association between bullying and suicidal behaviours.

55 **Conclusion:** This study suggests targeted policies and early implementation of interventional
56 strategies focusing on addressing loneliness, sleep disturbance and alcohol consumption to
57 reduce the risk of adverse suicidal behaviours among adolescents.

58

59 **Key words:** Bullying, Suicidal behaviours, Loneliness, Sleep disturbance, Pathways

60 **Abbreviations**

61 AOR: Adjusted Odds ratio

62 CDC: United States Centre for Disease Control and Prevention

63 GEE: Generalised estimating equation

64 GSHS: Global School-based Student Health Survey

65 LMIC-HICs: Low to middle-income and high-income countries

66 UNAIDS: United Nations Programme on HIV and AIDS

67 UNESCO: United Nations Educational, Scientific and Cultural Organisation

68 UNICEF: United Nations International Children's Fund

69 WHO: World Health Organization

70

71 **1. Introduction**

72 Suicide is the third leading cause of death among adolescents aged 15-19 years(World Health
73 Organization, 2019), accounting for more than a quarter of all global suicidal deaths(World
74 Health Organization, 2014). Behaviours related to suicide, such as suicidal ideation, suicidal
75 planning and suicide attempts, are also high among adolescents(Tang et al., 2020). Bullying
76 is a significant factor that is associated with preventable suicidality among
77 adolescents(Klomek et al., 2015; Van Geel et al., 2014), with adolescents being bullied at a
78 higher risk of suicidal ideation, suicidal planning and suicidal attempt(Tang et al., 2020). A
79 large number of adolescents experience bullying which tends to be school-based, the setting
80 where most adolescents spend the majority of their time while awake(Biswas et al., 2020).
81 Bullying victimisation among school-going adolescents is a major social and health concern
82 across low to middle-income and high-income countries (LMIC-HICs)(Hong et al., 2019). In
83 addition to increased risk of suicidal behaviour, bullying is also associated with adverse
84 physical, cognitive and mental health disorders(Moore et al., 2017), affects academic
85 performance(Morrow et al., 2014) and results in increased school absenteeism(Dunne et al.,
86 2013) and dropout(Seidu, 2019) among adolescents.

87 Despite the evidence showing the positive association between bullying victimisation and
88 suicidal behaviours among adolescents, currently, there have been no studies investigating
89 the potential factors that associate bullying with suicidal behaviours. Reducing adolescent
90 suicidal deaths through bullying prevention strategies requires an understanding of the
91 intermediate factors involved in this relationship, in particular the mechanisms and pathways
92 through which bullying relates to suicidal behaviour.

93 In general, both bullying and suicidal behaviours are outcomes of multiple factors that
94 adolescents experience in different settings(Holt et al., 2015; Liu et al., 2018). To understand
95 the adverse suicidal behaviours of adolescents, we need to understand the pathways involving

96 multiple factors including but not limited to lifestyle behaviours, peer connections and
97 parental support in the relationship between bullying and suicidal behaviours. Understanding
98 these pathways are prerequisite to developing effective early intervention for suicide and
99 bullying prevention strategies. Therefore, we aimed to determine to what extent bullying is
100 associated with suicidal behaviours and through which pathways bullying victimisation is
101 linked with the suicidal behaviours of adolescents.
102

103 **2. Methods**

104 ***2.1 Data***

105 This study used data from the Global School-based Student Health Survey (GSHS)
106 administered in LMIC-HICs during 2003-2017 with heterogeneity across countries in the
107 survey years. In collaboration with organisations including the United Nations International
108 Children's Fund (UNICEF), The United Nations Educational, Scientific and Cultural
109 Organisation (UNESCO), and The Joint United Nations Programme on HIV and AIDS
110 (UNAIDS), the GSHS was jointly developed by the World Health Organization (WHO) and
111 the United States Centre for Disease Control and Prevention (CDC). The GSHS was designed
112 to produce national-level estimates on adolescent health behaviours to help countries in
113 developing priorities and setting strategies for school-based programmes and policies. The
114 GSHS collected information on ten core modules that addressed the leading causes of
115 morbidity and mortality among adolescents. In brief, the modules included tobacco use,
116 alcohol use, drug use, dietary behaviours, hygiene, physical activity, sexual behaviours,
117 unintentional injury and violence, and mental health. The GSHS employed a two-stage
118 cluster sampling strategy to collect information. The first stage of sampling constituted the
119 random selection of schools and the second stage of sampling included specific classes from
120 each selected school. The GSHS uses uniform methodology and questionnaire to allow cross-

121 country comparison of indicators. Project-related design, organisation, and implementation
122 have been described elsewhere(World Health Organization, 2020).
123

124 ***2.2 Participants***

125 The participants in this study were adolescent students, aged 13-17 years, of both genders.
126 We included 90 countries with available information about bullying victimisation and any
127 form of suicidal behaviours. A list of studied countries with respective survey year and
128 sample size are provided in the supplementary (**Table S1**). We used the most recent data
129 from those countries that had collected data in multiple rounds. We dropped cases for whom
130 no information on bullying was available. Also, we excluded cases with missing information
131 for all items related to suicidal behaviours.
132

133 ***2.3 Ethical statement***

134 The GSHS surveys received approval from each country, by federal administrations, such as
135 the Ministry of Health or Education, and an Institutional Review Board or ethics committee.
136 GSHS obtained written informed consent from the participants or their guardians before the
137 survey.
138

139 ***2.4 Variables***

140 ***2.4.1 Outcome variables***

141 **Suicidal ideation**: Suicidal ideation was measured by the question "During the past 12
142 months, did you ever seriously consider attempting suicide?" The response to this question
143 was dichotomous and coded as 0 "No" and 1 "Yes".

144 **Suicidal planning**: Suicidal planning was collected from the question "During the past 12
145 months, did you make a plan about how you would attempt suicide?" Similar to suicidal
146 ideation, suicidal planning was dichotomous and coded as 0 "No" and 1 "Yes".
147 **Suicidal attempt**: The GSHS used the question "During the past 12 months, how many times
148 did you actually attempt suicide?" with the responses "0 times", "1 time", "2 or 3 times", "4
149 or 5 times", and "6 or more times" to evaluate suicidal attempt. In line with the previous
150 study(Tang et al., 2020), an adolescent was considered to attempt suicide if s/he attempted
151 suicide at least 1 time, otherwise not.
152

153 ### *2.5 Exposure*

154 **Bullying victimisation**: To measure bullying, the GSHS requested respondents to read a
155 definition of bullying stating that bullying occurs when a student or group of students say or
156 do bad and unpleasant things to another student. It is also bullying when a student is
157 unpleasantly teased a lot or when a student is left out of things on purpose. It is not bullying
158 when two students of about the same strength or power argue or fight or when teasing is done
159 in a friendly and fun way. After reading the provided definition of bullying victimisation,
160 respondents then answered the question: "During the past 30 days, on how many days were
161 you bullied?" ("0 days", "1 or 2 days", "3 to 5 days", "6 to 9 days", "10 to 19 days", "20 to 29
162 days" and "All 30 days"). Aligning with previous research(Biswas et al., 2020), we created a
163 dichotomous variable to define bullying victimisation where a respondent is defined as
164 experiencing bullying victimisation if they reported experiencing bullying at least once in the
165 past 30 days. We coded the dichotomous responses as 0 "No", meaning 0 days of experiencing
166 bullying and 1 "Yes", meaning they experienced bullying at least once.
167

168 ### *2.6 Framework of determinants*

169 We did a literature search to find evidence of bullying victimisation and suicidal behaviours.
170 Evidence reveals significant associations of suicidal behaviours with hunger(Romo et al.,
171 2016), physical activity(Lee et al., 2013; Vancampfort et al., 2018), sleep disturbances(Harris
172 et al., 2020), drinking soft drinks(Pengpid and Peltzer, 2020), consuming fast foods(Jacob et
173 al., 2020), smoking(Poorolajal and Darvishi, 2016), alcohol consumption(Darvishi et al.,
174 2015), truancy(Pandey et al., 2019), absenteeism in class(Campisi et al., 2020), no close
175 friends(Campisi et al., 2020), lack of peer support(Campisi et al., 2020), peer
176 victimisation(Campisi et al., 2020), conflict with peers(Campisi et al., 2020),
177 loneliness(Pandey et al., 2019), lack of parental supervision(Pandey et al., 2019), lack of
178 parental connectedness(Pandey et al., 2019), and lack of parental bonding(Pandey et al.,
179 2019).
180 Bullying victimisation has been shown to have a significant association with adverse suicidal
181 behaviours (Barzilay et al., 2017; Koyanagi et al., 2019). The mediating role of some factors,
182 such as loneliness, is well reported in this association(Cao et al., 2020). Despite this evidence
183 on factors associated with suicidal behaviour, we were not able to find any pre-defined
184 frameworks that provided links of all intermediate factors in the association between bullying
185 victimisation and suicidal behaviours. Therefore, we developed an evidence-based conceptual
186 framework based on pre-identified factors that were associated with suicidal behaviours
187 among adolescents (**Figure 1**). In the conceptual framework, we use arrows to illustrate
188 potential directionality. However, this is just for illustrative purposes and we recommend
189 longitudinal studies for further exploration to understand and conceptualise the bidirectional
190 linkages among the factors. From the GSHS data, we identified a set of variables for
191 measuring these factors. We treated these variables as dichotomous (0 = No, 1 = Yes). A
192 detailed description of these variables is provided in the supplementary material (**Table S2**).
193

194 ***2.7 Statistical analyses***

195 We estimated the weighted pooled proportion of bullying victimisation and suicidal
196 behaviours. We also calculated these across adolescent's age and gender to understand how
197 these behaviours varied across these characteristics. We used a complex survey design
198 procedure to account for the variations in error due to cluster sampling design and sampling
199 weights.

200 To determine the extent to which bullying victimisation is associated with suicidal
201 behaviours, we first visualised how suicidal behaviours differ among those who experienced
202 bullying. We then examined the association of outcomes with bullying victimisation using
203 generalised estimating equation (GEE) models, adjusted for adolescent's age and gender, and
204 controlled the variations due to cluster sampling design.

205 To examine the pathways through which bullying victimisation might contribute to suicidal
206 behaviours, we first used multivariate-adjusted GEE models to check the association between
207 the proposed intermediate factors and bullying victimisation. We then used generalised
208 structural equation models with logit link from the binomial family to examine the potential
209 links between bullying victimisation and suicidal behaviours. In the model, we considered all
210 the potential variables identified in our proposed conceptual framework (**Figure 1**). The
211 strengths of each potential pathway were measured through the coefficients from the
212 regression analysis. We also calculated the percentages of total associations that are mediated
213 by the mediators in the relationship between bullying and suicidal behaviours. We considered
214 p-value<0.05 as a threshold for describing the statistical significance of results. We used
215 statistical software Stata (version 13.0 SE) to analyse the data.

216

217 **3. Results**

218 ***3.1 Sample characteristics***

219 We analysed a total of 280,076 adolescents, 13-17 years of age of both genders (female:
220 48.6%). Among them, 20.8%, 28.0%, 24.4% and 26.8% were aged 13y, 14y, 15y and 16+ y
221 old respectively (data not shown). The distribution of intermediate factors is summarised in
222 **Table S3**.
223

224 ***3.2 Bullying victimisation***

225 Overall, one-third (32.4%) of adolescents experienced peer bullying with slightly higher
226 reports of bullying among males (34.5%) than females (30.1%). Adolescents' experience of
227 bullying victimisation changed with age, with 33.8% of 13y olds experiencing bullying
228 victimisation compared to 29.5% of 16+y olds (**Figure 2**).
229

230 ***3.3 Suicidal behaviours***

231 The prevalence of suicidal ideation, suicidal planning and suicidal attempt was 12.1%, 11.1%
232 and 10.9% respectively. Suicidal behaviours were higher among female adolescents than
233 males (suicidal ideation 14.0% vs. 10.2%, suicidal planning 12.3% vs. 9.8% and suicidal
234 attempt 11.6% vs. 10.0% (**Figure 2**). The increasing prevalence of suicidal behaviours with
235 increasing age were also apparent. Compared to adolescents 13y of age, adolescents 16+y of
236 age reported a higher rate of suicidal ideation (16+y: 14.6%, 13y: 10.0%), suicidal planning
237 (16+y: 12.2%, 13y: 9.8%) and suicidal attempt (16+y: 11.7%, 13y: 9.8%) (**Figure 2**).
238

239 ***3.4 Bullying and suicidal behaviours***

240 Compared to adolescents who were not bullied, adolescents who experienced bullying
241 reported a substantially higher rate of suicidal ideation (19.0% vs 8.9%), suicidal planning
242 (17.2% vs 8.1%) and suicidal attempt (20.0% vs 6.5%) (**Figure 2**). Multivariate regression
243 analysis showed that adolescents who experienced bullying were likely to have 2.36 times

greater odds than adolescents who were not bullied into having suicidal ideation (Adjusted Odds ratio AOR 2.36, 95% CI 2.30-2.41, p-value<0.001). Also, bullying victimisation was significantly associated with increased odds of suicidal planning (AOR 2.15, 95% CI 2.10-2.20, p-value<0.001) and suicidal attempts (AOR 2.80, 95% CI 2.72-2.88, p-value<0.001) among adolescents after controlling for age, gender and cluster design (**Figure 2**).

3.5 Intermediate factors between bullying and suicidal behaviours

Compared with adolescents who were not bullied, adolescents who were bullied showed an increased risk of hunger, physical inactivity, drinking soft drinks, consuming fast food, truancy, smoking, alcohol consumption, peer victimisation, peer conflict, sleep disturbances, loneliness, having no close friends, lack of peer support, less parental supervision, less parental connectedness and less parental bonding (**Table 1**). All of these factors were also associated with an increased risk of suicidal behaviours. See **Table S4** in the supplementary section for details.

In pathway models considering all proposed intermediate factors, we found evidence of significant links between bullying victimisation and suicidal behaviours. In particular, all the intermediate factors showed significant links between bullying and suicidal planning (**Figure 3**). Also, bullying victimisation was associated with suicidal ideation (**Figure 4**) and suicidal attempt (**Figure 5**) through the proposed pathways except for physical inactivity, fast food consumption, absenteeism in a physical education class and lack of parental supervision with suicidal ideation and physical inactivity and absenteeism in a physical education class with suicidal attempt. The indirect paths through these factors showed a significantly positive association of bullying victimisation with suicidal ideation (β= 0.52, 95% CI 0.48-0.55, p-value<0.001), suicidal planning (β= 0.48, 95% CI 0.44-0.52, p-value<0.001) and suicidal attempt (β= 0.67, 95% CI 0.63-0.71, p-value<0.001). The strongest links in the relationship

between bullying victimisation and suicidal behaviours were through loneliness (that mediates 18.7%, 15.1% and 10.9% of the total associations of bullying on suicidal ideation, suicidal planning and suicidal attempt, respectively), sleep disturbances (that accounted for 8.6%, 8.4% and 6.0% of the total effects of bullying on suicidal ideation, suicidal planning and suicidal attempt, respectively), and alcohol consumption (that accounted for 4.5%, 4.5% and 3.9% of the total effects of bullying on suicidal ideation, suicidal planning and suicidal attempt, respectively) (**Table 2**).

6. Discussion

Bullying victimisation and associated adolescent suicide behaviours present a globally prevalent public health challenge, with substantial, detrimental ripple effects on friends, families and communities. Our findings, for the first time, shed light on some of the key intermediate factors involved in the relationship between school-based bullying victimisation and suicidal ideation, suicidal planning and suicide attempts. To effectively address adolescent suicidal behaviour through school-based bullying prevention initiatives, these intermediate factors must be considered within the intervention design. Furthermore, since suicidal behaviour presents a continuum of risk spanning from suicidal ideation, planning and attempt, our study parsed out the factors for each aspect of suicidal behaviour such that our findings can inform the design of behaviour specific and stage-appropriate interventions.

Our findings identify sleep disturbance as a significant intermediate factor between bullying victimisation and all three aspects of suicidal behaviour. Insufficient or poor-quality sleep can result from several factors, including bedtime fears, insomnia, environmental stressors and sleep disturbances such as obstructive sleep apnea and periodic limb movement disorder. A recent meta-analysis showed that sleep disturbances in adolescents predicted the risk of

294 suicidal ideation but not suicidal attempts, and depression did not moderate the associations
295 between sleep disturbances and suicidal ideation or attempts in adolescents(Liu et al., 2019).
296 Several studies have shown that sleep deprivation places adolescents at an increased risk of
297 depression and anxiety(Hardway, 2006), and those who were bullied were found to be at an
298 increased risk of experiencing anxiety(Lereya et al., 2015). Thus, pathways are multi-
299 factorial and longitudinal studies are needed to further elucidate the links. Our findings
300 suggest that sleep disturbance may increase the risk of suicidal behaviour associated with
301 bullying victimisation or conversely that good quality sleep may serve as a protective factor
302 between bullying victimisation and suicidal behaviour. Sleep disturbances have been reported
303 previously in both bullies and victims(J.Meltzerb, 2018). Sleep-based interventions that
304 promote good sleep health among adolescents may prove effective against suicidality and
305 importantly serve as a potential protective factor helping to reduce the risk of suicidal
306 behaviour associated with bullying.
307
308 Another significant intermediate factor identified in our study was loneliness. Peer
309 relationships are critical for adolescent development and well-being(Deater-Deckard, 2001).
310 Students experiencing loneliness, with limited peer support, are vulnerable to being
311 victimised. Furthermore, loneliness is also a significant outcome of chronic peer bullying,
312 suggesting a positive feedback loop between bullying and social isolation(Pavri, 2015). In
313 addition, sleep loss can also result in social withdrawal and loneliness(Ben Simon and
314 Walker, 2018). Previous evidence has clearly demonstrated the negative effect of peer
315 victimisation on mental health(Boulton, 2008) and the risk for suicidal ideation and
316 behaviour(Holt et al., 2015). As a result, several interventions have been designed and
317 implemented to increase community connectedness for adolescents(C.D.C, 2005). A recent
318 randomised trial reported the positive effect of a community mentorship program on social

319 connectedness, but not on suicidal ideation(King et al., 2019) which indicates that we need
320 additional studies to delineate the pathways. In our study, we observed a strongly significant
321 association of peer victimisation with bullying victimisation, and of loneliness with suicidal
322 ideation, planning and attempt, although bidirectional relationships were not explored. Our
323 findings are timely given the context of COVID-19 where disease containment measures such
324 as social distancing, school closures and stay at home orders may exacerbate feelings of
325 loneliness(Loades et al., 2020), while also increasing exposure to cyberbullying through
326 increased time spent online(Gao et al., 2020). In light of the likely increased impact of
327 loneliness among adolescents as a result of COVID-19, suicide and bullying prevention
328 strategies must consider the roles of peer connection and peer isolation.
329
330 Adolescence is an important neurodevelopmental period, and alcohol consumption during
331 adolescence can be detrimental to neuropsychological functioning(Squeglia and Gray, 2016;
332 Squeglia LM, Jacobus J, 2009). Our study identified alcohol consumption as a third
333 intermediate factor to affect suicidal behaviours. Previous studies have clearly indicated that
334 adolescents who consume alcohol exhibit increased suicidal behaviour(Wang and Yen,
335 2017). There are multiple pathways by which alcohol consumption may contribute to suicidal
336 behaviour. For example, higher levels of depression symptoms were associated with earlier
337 onset of alcohol use, increased frequency of consumption and intoxications. Similarly, higher
338 levels of anxiety among girls were also shown to be associated with alcohol
339 consumption(Johannessen et al., 2017). The effect of alcohol consumption on sleep
340 disruption is also well documented(Brant P. Hasler, Adriane M. Soehner, 2015), which may
341 further precipitate suicidal behaviour. Lastly, loneliness is associated with increased alcohol
342 consumption among adolescents(Stickley et al., 2014), which emphasizes the importance of

343 healthcare, peer, parental and community support networks in decreasing suicidal tendencies
344 among young adults(O'Carroll et al., 1994; Renaud et al., 2009).
345
346 Our study has several limitations. First, our inference was not causal due to the cross-
347 sectional nature of data coupled with the variation in the time periods of the exposure and
348 outcome variables (e.g. suicidal behaviour is based on experience over the past 12 months
349 whereas bullying victimisation is based on experience over the past 30 days). Nevertheless,
350 through using generalised structural equation models we have attempted to shed light on the
351 underlying causal processes by investigating the potential intermediate factors and pathways
352 through which bullying victimisation might contribute to suicidal behaviours. Longitudinal
353 studies should be employed to understand the directionality of the associations. Second, the
354 self-reported GSHS data may contain recall bias. However, we believe this bias will be
355 uniform across groups. This study may also incorporate selection bias, as it contains
356 responses only from the students who were present at the school, at the time of the survey,
357 potentially missing students with high levels of absenteeism and truancy. Nevertheless, the
358 strength of this study lies in the data set and large sample size comprising 280,076 male and
359 female adolescents, 13-17 years of age. The study population includes 90 different countries,
360 representing diverse cultural and socioeconomic contexts, and responses were collected using
361 a standard questionnaire. Our study is the first to consider multiple pathways at multiple
362 levels (social, lifestyle behaviours, substance use, academic activities, violence, mental
363 health, peer attachments and parental support) to help explain the detrimental effects of
364 bullying victimisation on different suicidal behaviours. However, there may be some other
365 socio-cultural factors of adverse suicidal behaviours that can vary from one setting or context
366 to another. While we were unable to control for or explore these socio-cultural factors within
367 the data we analysed, it is important that initiatives and interventions addressing bullying

victimisation and suicidal behaviours should consider the local context and socio-cultural factors.

The overall prevalence of bullying victimisation reported in this study is marginally higher (approx. 2%) than the prevalence of bullying victimisation reported in other studies using the same dataset(Biswas et al., 2020; Due et al., 2008). These marginal differences are likely due to differences in the study samples with variations in the number of countries analysed and the age range of participants. As GSHS surveys were conducted between 2003 and 2017, there could be some epidemiological, structural and behavioural changes for adolescents across this time span. While we were unable to directly count or control for the potential effects of time related changes, our approach did control for the effect of cross-country clustering, which may to some extent, partially control the effect of the time period. Despite the well-reported links between depression and both sleep disturbance and suicidal behaviours, we were unable to control for the effect of depression on suicidality or sleep disturbance due to the lack of data on depression across all the GSHS administered countries. This signals the need for better reporting of depression data across all the GSHS administered countries. Since the GSHS is ongoing, a periodic data analysis report from this survey is critical to identify any changing patterns.

In conclusion, we found the strongest links between bullying and suicidal behaviours through adolescents' loneliness, sleep disturbance and alcohol consumption. This highlights the importance of screening adolescents for these intermediate factors and designing community-wide policies and programs that promote social engagement, good sleep health and less alcohol consumption among adolescents. Prospective studies are warranted to better understand the relationship with directionality.

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Conflict of interests

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