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Bullying prevalence and numeracy performance among primary school children in Johannesburg: Implications for school-based interventions

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Background: Research has provided evidence about the negative impact of school bullying on the academic performance of primary school children, but studies on the prevalence of school bullying and numeracy performance of children are very scant.

Aim: This study aimed to investigate the prevalence of school bullying and numeracy performance among primary school children, and its implications for school-based interventions.

Setting: The sample comprised 435 children (56.3% females and 43.7% males; Grades 1–7; median age = 11 years) attending six primary schools in three different education districts in Johannesburg, South Africa.

Method: The children self-reported their experience of bullying by peers through a questionnaire. In addition, they completed numeracy tests. For children aged 6 to 9 years, the questionnaire was completed with the assistance of trained field workers.

Results: The results following a linear regression with multiple predictors indicated that numeracy was significantly associated with contextual variables such as grade and home language. Bullying was strongly associated with socio-economic indicators such as school quintile and regional situation. These variables are important in early school support interventions directed at improving learner numeracy performance in the primary school.

Conclusion: The results show a relatively high percentage of bullying in primary schools in the Johannesburg region. The performance in numeracy was significantly associated with the grade and home language of the learner. Contextual variables related to socio-economic situation of learners such as school quintiles and regional situation had strong associations with bullying.

Keywords: bio-ecological systems; bullying; numeracy achievement; prevalence; primary school learners; school-based interventions; survey.

Introduction

The United Nations Educational, Scientific and Cultural Organization (UNESCO 2017) provides the most recent global overview of the nature, extent and impact of school violence and bullying on the academic achievement and mental health of children. It broadly defines school violence as encompassing 'physical violence, including corporal punishment, psychological violence, including verbal abuse; sexual violence, including rape and harassment; and bullying, including cyberbullying' (UNESCO 2017:8). In this definition, UNESCO (2017) highlights bullying, which is the focus of this particular study, as a type of school-based violence which, in essence, would warrant the need for a definition in its own right because it has its own contentious issues (Gladden et al. 2014; Thornberg 2015). In 1993, Dan Olweus coined the first meaningful definition of bullying as 'when someone repeatedly and on purpose says or does mean or hurtful things to another person who has a hard time defending himself or herself' (Olweus et al. 2007:1). Since 1993, several writers (Vreeman & Carroll 2007) have expanded on Olweus's definition of bullying, but kept his original description as a point of departure. Olweus (2016) also emphasised three key criteria for the definition of bullying, namely bullies intentionally harm others, there is repetition, and power issues are at play. Furthermore, he identified relationships and abuse as critical aspects of bullying. The relationship component implies that the bullying occurs over time for individuals, whilst the power part usually indicates that the perpetrators generally have more power than the

individuals they bully. In their definition Volk, Veenstra and Espelage (2017) emphasise the point that bullying is goal-directed and that it is a specific form of aggression which is differentiated from other forms of aggression because of issues of power imbalances. According to Volk et al. (2017), such a definition is theoretically grounded and transdisciplinary. The author adopts the definition of Volk et al. (2017) because it locates bullying as an important component of aggression – both of which are critical aspects of mental health. Furthermore, the author endorses the different definitions of bullying which can be summarised as malicious intent, power imbalances, repeated behavioural transgressions, infliction of emotional distress, and unnecessary provocation. Learners are more likely to define bullying as physical and verbal abuse whilst teachers include social exclusion, power imbalances, and threats to hurt others (Naylor et al. 2006).

Over the last two decades numerous studies have shown bullying to be a global social problem (Bennett-Johnson 2004; Dahlberg 2002; Hymel & Swearer 2015; Nansel et al. 2004; Owusu et al. 2011). A global study by Richardson and Fen Hiu (2018) found that bullying ranged from 26.6% in Central and Eastern Europe and the Commonwealth of Independent States to a high of 53.1% in West and Central African region. South Africa is no exception as several studies have found an escalation in school-based bullying over the last decade (Bennett-Johnson 2004; Fitzpatrick 2006; Pillay & Ragpot 2010; Smith & Smith 2006). An analysis of bullying prevalence in South Africa by Juan et al. (2018) noted an escalation of school bullying ranging from 12% to 61% depending on the location, Socio-economic status (SES), and culture of the school.

Besides the escalation in school bullying incidents, UNESCO (2017) points out some general global trends observed from research conducted with 100 000 young people in 18 countries. Firstly, UNESCO (2017) observed that children experienced bullying largely as a result of their physical appearance, gender or sexual orientation, ethnicity or national origin, or other reasons. Some children are bullied because they are in vulnerable situations and those who live with disabilities, are economically and socially disadvantaged, and those who are asylum-seeking and refugees. Secondly, it appears that boys are more inclined to report physical violence than girls (Walters 2020). Girls reported higher rates of indirect and relational bullying. Thirdly, the highest rates of bullying were observed in primary schools and the incidents of bullying seem to decline between the ages of 11 and 15 years. Lastly, but not least, the prevalence of bullying appears to be higher in developing countries.

The consistent escalation of school bullying in certain parts of the world, as noted in the preceding discussion, has resulted in a plethora of studies focusing on various impacts of bullying on those who are bullied, such as their psychological and mental health (Bradshaw, Waasdorp & Johnson 2015; Fullchange & Furlong 2016; Jack & Egan 2018;

Takizawa, Maughan & Arseneault 2014; Ttofi, Farrington & Losel 2012); school dropout (Cornell et al. 2013); socialising skills (Nansel et al. 2001); physical health (Bogart et al. 2014; McDougall & Vaillancourt 2015); and academic achievement (Ladd, Ettekal & Kochenderfer-Ladd 2017; Nakamoto & Schwartz 2010; Totura, Karver & Gesten 2014). Whilst several studies have alluded to a significant relationship between school bullying and academic success (Buhs, Ladd & Herald 2006; Ladd et al. 2017; Thijs & Verkuyten 2008), not many have focused on the association between school bullying experiences and numeracy achievement, especially in the South African context. Hence, this study sought to extend the findings of previous research (Pillay 2017) on in-school bullying by examining the association between self-reported bullying experienced by primary school children and their numeracy development. The first research question was as follows: What is the prevalence of bullying in Johannesburg schools across age, grade, gender, home language and regions? The second question was this: Is there a significant statistical association between the frequency of being bullied and the numeracy percentage across the variables mentioned in the first question? In this study, numeracy performance is considered by using the numeracy percentage obtained as the dependent variable and the bullying items as independent variables. An investigation on the prevalence of bullying in schools is likely to have social value because it can address strategies on how children could have improved the social interaction and relationships which is a key aspect of Bronfenbrenner's (2005) bioecological systems theory.

The definition of numeracy has been a contentious issue, especially in its relationship to mathematics (De Abreu 2000; Baker, Street & Tomlin 2003; Brooks et al. 2008; Karaali, Hernandez & Taylor 2016) However, for the context of this article the definition by Geiger, Goos and Forgasz (2015) is adopted for its comprehensiveness, that is:

> [N]umeracy is a concept used to identify the knowledge and capabilities required to accommodate the mathematical demands of private and public life, and to participate in society as informed, reflective, and contributing citizens. (p. 531)

A global search for literature and research studies on the association between bullying experiences and numeracy achievement in children proved these to be scant. One can, however, draw from the United Nations Children's Fund (UNICEF) *Innocenti Report Card* 15 (UNICEF 2018) which clearly shows that inequalities exist – even in the world's richest countries – and have a detrimental effect on children's academic outcomes. The report highlights the importance of peer influence on children's academic performance and one could postulate that peer bullying is one of these influences. In fact, most studies, as pointed out earlier, show an association between bullying and academic achievement in general. Three studies in particular, however, show bullying as having a negative impact on numeracy achievement in children (Kibriya, Xu & Zhang 2015; Mundy et al. 2017; Oliveira et al. 2018).

Research methodology

Study design and sample

This cross-sectional study was conducted across three education districts in Johannesburg, Gauteng province. The population of this study was chosen from the Johannesburg district and is not representative of the whole Gauteng province. The total number of primary schools in these districts is 1200 (DoBE 2018:10). The sample consisted of 435 learners (56.3% females and 43.7% males) from six primary schools in and around Johannesburg, who are attending Grades 1 to 7 (0.50% of primary schools in the three districts). The schools were randomly chosen from a list of 12 schools in which the researcher was already actively engaged with other projects (1.0% of schools in the districts). Four schools belonged to Quintile 2 (low socioeconomic status) and two to Quintile 5 (high socioeconomic status) groups. The total number of learners in the six schools was 4412, so the initial sample of 443 learners were a 10% representation of the chosen population. Eight learners were removed during data analysis for reasons mentioned later. The six schools were situated in three regions in the Gauteng province, namely, Johannesburg Central, Ekurhuleni and West Rand. The sample is representative of the 12 schools where the researcher is actively engaged in and is not generalised to the Gauteng population of primary schools.

Measures

Bullying self-report

The children self-reported school bullying on a specific item of a questionnaire designed to draw on the experiences of the learners in relation to bullying as an act of violence inflicted upon them. The researcher took note of the fact that linguistic, cultural and environmental factors of the South African context may be different from other contexts. For this reason, a local questionnaire pertaining to all aspects of bullying was designed taking into consideration the aspects identified by Olweus (2016). The questions focused, amongst others, on physical bullying (such as hitting), verbal bullying (e.g. bad words, swearing, teasing), indirect bullying (such as spreading rumours, exclusion), cyberbullying (using WhatsApp, SMS, Facebook and other social media), racist bullying (teasing about colour, look, the way you speak, your hair, and so on) and homophobic bullying (including teasing about being gay, lesbian or being boy- or girl-like). Each question was presented with several responses and the learners had to choose one or more options most suited to their experiences. For example, they had to choose a response for a question that asked them when they were last bullied and the response ranged from last week to last year. In order to not limit the range of responses, an 'other' response category was included. Regarding the frequency of bullying, the learners had to choose one of the following: 'no bullying'; 'a little bullying' (at least once a month); and 'a lot of bullying' (at least once a week). However, this was only one item and a nominal measure. The items were not placed on an interval scale and were of a nominal measure consisting of two or three categories.

Numeracy attainment

The children completed the Do-It-Profiler Learner Survey (Do-IT Profiler 2015) which tests:

> [B]asic skills such as shape knowledge and number skills, understanding of the four operands (addition, subtraction, multiplication and division), problem-based questions, and higher mathematics. For each of these, two forms are provided, multiple choice or open-ended questions. (pp. 7–8)

The Learner Profiler Survey is a web-based and multidimensional screening system developed by Do-IT Solutions (United Kingdom) and Shape the Learner (South Africa), two well-known education agencies (Do-IT Profiler 2015). The Learner Profiler is a comprehensive measure of children's academic skills, abilities, strengths and weaknesses. Whilst it has been used in the United Kingdom, Ireland, Malta and Wales, the South African version was especially developed for local children.

The Learner Profiler test developers spent 5 years collecting numeracy data and matched it to the demands of children in South Africa, thus ensuring that the results were appropriate to the need of teacher support. The Learner Profiler uses mathematical tests that have a series of questions presented in the order of difficulty. The computer evaluates where the learner starts in the content and where they end, assigning a score to the level of completion. This mathematics assessment used for the study provides a hierarchy-based set of questions ranked in the order of difficulty developed from testing more than 50 000 South African learners. Reliability ranges from 0.86 to 0.93 have been found depending on the tests used. In the present study, the reliability of scores from the Learner Profiler numeracy tests was Cronbach's alpha = 0.811, which is aligned to the large-scale studies mentioned. The item asking respondents about the extent of bullying was a single variable asking them to respond according to 'no bullying', 'a little bullying' or 'a lot of bullying'. Hence, categorical principal component analysis (CATPCA) was utilised and the Cronbach's reliability was 0.625. It explained 43.0% of the variance present. This value is less than the commonly given value of 0.70 and when dealing with psychological constructs such as bullying it is not seen as unusual for reliability values less than the accepted rule of thumb (Field 2018:823).

Procedure for data collection

The tests were administered during school hours at the schools in the special venues that were allocated by the school management team. The test instruments were electronic tablets with headphones to minimise test interference. The tests were conducted by a specially trained team of 10 test administrators in each school. Typical testing times ranged from 45 to 60 min per learner with a 10-min break in between in order to optimise concentration. Data uploading occurred in real time using the web-based functionalities within the system.

Ethical measures

Ethical clearance for the study was granted by the Education Faculty Research Ethics Committee at the university in which the author is employed. Written permission for the children to take part in the study was obtained from their parents and respective school principals. The learners were informed about the aims of the study and their right to volunteer to participate or withdraw from the study at any point without any form of penalty. They were assured that their actual names and schools would be kept confidential. Because of the sensitive nature of bullying, psychologists were readily available at each research site to assist learners who might have been re-traumatised.

Data analysis

Statistical package for the social sciences version 26.0 was used to conduct descriptive and comparative analysis of data to determine any differences in numeracy achievement between learners who self-reported experiences of school bullying and their peers who did not report such experiences. Comparisons were conducted across age groups, gender, home language and education districts through multiple linear regression. Also, the researcher utilised Chi-squared, Bayesian loglinear analysis and the odds ratio to analyse the association between the various categorical variables.

Results

Aligned to the research questions the results are presented across gender, age, language and school quintile in terms of frequencies, prevalence of bullying, and the association between numeracy and school bullying.

Frequencies

Table 1 displays the frequencies and percentages of the various independent groups that comprised the sample. It notes that more females (56.3 %) than males (43.7%) participated in the study. Most learners were in grade 4 (23.4%) and 6 (22.0%) aged between 10 (23.7%) and 12 years (23.0%). Majority of the learners did not indicate their home language (60.2%) but Sotho (16.3%) was more common. Most of them were in quintiles 2 and 5 schools where quintile 2 represent low and 5 represent high socioeconomic schools.

Prevalence of bullying

Table 2 shows the frequency of having been bullied at school. The results indicate that of the 435 respondents who completed the questionnaire, a high percentage (47.8%) indicated that they had been bullied, either a little or a lot. The data indicate that 52.4% experienced no bullying, whilst 47.6% experienced some form of bullying behaviour.

Table 3 shows that verbal bullying was the most frequent type of school bullying followed by physical and racist bullying. More girls than boys reported exposure to these three types of bullying. This finding must, however, be

TABLE 1: Frequencies of data across gender, grade, age, language, and school quintile.

Variable	Group	Frequency	`%	Total
Gender	Male	190	43.7	435
	Female	245	56.3	-
Grade	G1-3	77	17.7	435
	G4	102	23.4	-
	G5	84	19.3	-
	G6	99	22.0	-
	G7	73	16.8	-
Age	6–9 years	76	17.5	435
	10 years	103	23.7	-
	11 years	83	19.1	-
	12 years	100	23.0	-
	13+ years	73	16.8	-
Language	English	53	12.2	435
	Nguni	49	11.3	-
	Not set	262	60.2	-
	Sotho	71	16.3	-
School quintile	Q2	148	34.0	435
	Q3	71	16.3	-
	Q4	66	15.2	-
	Q5	150	34.5	-

TABLE 2: Frequencies of the groups formed regarding the extent of being bullied at school.

Extent of bullying	Frequency	Percent	Cumulative percent
Valid			
No	227	52.2	52.2
Yes, a little	129	29.6	81.8
Yes, a lot	79	18.2	100.0
Total	**435**	**100.0**	-

interpreted with caution as more girls than boys participated in the study. Although indirect, homophobic and cyberbullying were reported as low frequency types of school bullying, it is important to know that such forms of bullying exist.

Association between numeracy and school bullying

The three groups in the questionnaire were no bullying, a little bullying and a lot of bullying. Using no bullying as baseline category and a little bullying versus a lot of bullying as dummy variables and making use of Hedge's g, as the sample sizes differed, a moderate effect size was present between the mean numeracy score of the 'little and a lot of bullying' groups.

$M_{A\ little}$ = 23.38, $M_{A\ lot}$ = 21.40, *Hedge's g* = 0.32. This effect size could be classified as moderate (Field 2018:117) and hence bullying has a moderate effect on numeracy achievement of the learners sampled.

As there are other contextual variables present in the sample that could influence the numeracy score, this researcher firstly made use of multiple regression in an attempt to see which of the variables were significant predictors of the numeracy score in the sample.

TABLE 3: Prevalence according to types of bullying.

Bullying type	Male	%	Female	%	Total	%
Physical (hitting)	25	5.7	30	6.9	55	12.6
Verbal (bad words, swearing, teasing, etc.)	43	9.9	52	11.9	95	21.8
Indirect bullying (spreading rumours, exclusion, etc.)	10	2.3	21	4.8	31	7.1
Cyberbullying (using WhatsApp, SMS, Facebook, etc.)	10	2.3	8	1.8	18	4.1
Racist bullying (teasing about colour, look, the way you speak, your hair, etc.)	18	4.1	33	7.6	51	11.7
Homophobic bullying (teasing about being gay, lesbian or being boy or girl like, etc.)	11	2.5	12	2.8	23	5.3
No	75	17.2	87	20.0	162	37.2
Total	**192**	-	**243**	-	**435**	-

Multiple regression with the numeracy score as outcome and other variables in the questionnaire

The researcher made use of multiple categorical predictors with the numeracy score as dependent variable and grade, home language, extent of bullying, school quintile and region of school as independent variables or predictors. To eliminate multicollinearity Mahanalobis distances were utilised using age as independent variable and eight respondents removed, as the probability values were less than 0.001 (Tabachnick & Fidell 2012). In addition, the correlation between present grade and age in years was close to one and highly correlated ($r = 0.99$). To eliminate collinearity the researcher considered only the particular grade of the respondent (Field 2018:401). As there were four categories of first language and five grade categories the researcher created dummy variables as one of the assumptions of a linear model is that all predictor variables must be quantitative or categorical with only two categories (Field 2018:388).

The Pearson correlation coefficient indicated that the following predictors were significantly correlated with the numeracy score as dependent variable:

- No bullying with a lot of bullying ($r = -0.085$, $p = 0.035$).
- Grade 4 with Grade 7 ($r = -0.257$, $p = 0.000$).
- Grades 1–3 with Grade 7 ($r = -0.107$, $p = 0.013$).
- English with not selected ($r = 0.165$, $p = 0.000$).

The regression model building method was forward stepwise, using the Akaike information criterion (AIC) rather than the R^2, as this criterion uses the smallest AIC value as best fitting one (Field 2018:401). The smallest AIC value indicated that the four categorical variables with significant correlations should serve as predictors of the numeracy outcome. The results of this regression are given in Table 4.

The equation for this model would be:

$$Numeracy\ score = 24.25 + (-1.68\ bullying) + (-4.63\ G4\ vs.\ G7) + (-3.12\ G1 - 3\ vs.\ G7) + 2.47\ English.$$

[Eqn 1]

As the predictors extent of bullying, G4 versus G7, G1–3 vs G7 are negative this suggests that as they increase in size so the numeracy score decreases. The size of this b value indicates the degree to which each predictor affects the outcome if the effects of all other predictors are held

TABLE 4: Multiple linear regression with numeracy as outcome several categorical predictors.

Model 1	b	SE B	β	p
Constant	24.25 (23.86, 27.07)	0.45	-	0.000***
D2. No bullying vs a lot of bullying	-1.68	-0.79	-0.096	0.035*
G4 vs. G7	-4.63 (-6.10, -3.16)	0.75	-6.197	0.000***
G1–3 vs G7	-3.12 (-4.74, -1.49)	0.83	-3.770	0.000***
English vs not set	2.47 (0.625, 4.31)	0.94	0.120	0.009**

***$p < 0.0005$, **$p < 0.001$, *$p < 0.05$, F (4430) = 14.93, $P = 0.000$, $r = 0.12$, 95% bias corrected confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples.

constant (Field 2018:414). The largest effect was in the difference between G4 and G7 numeracy scores (β = -0.6197, $p < 0.0005$), followed by the effect size difference between G1 to 3 and G7 (β = -0.3770, $p < 0.0005$), English as home language (β = 0.120, $p = 0.009$) and then No bullying versus a 'lot of' bullying (β = -0.095, $p < 0.05$). For the grade of the learner, G7 was the baseline (coded as 0) and hence as one goes from 0 to 1 (a unit change in the predictor), G4 numeracy score decreases by -0.6197 standard deviations and for G1 to G3 it decreases by -3.77 standard deviations. With respect to home language, a limitation was the large percentage of respondents (60.2%) who did not provide their home language. Only English as home language group versus the not set (baseline group) showed a significant difference in mean numeracy scores. The standardised Beta value of β = 0.120, $p < 0.01$ indicated that as one proceeds from not set (coded 0) the numeracy score of the English home language group increases by 0.12 standard deviations. Bullying (no bullying, a lot of bullying) with no bullying as baseline, showed that respondents who indicated 'a lot of' bullying deceased in numeracy score by 0.096 standard deviations. In addition, the data in Table 2 showed that the effect of the difference in numeracy scores between a little and a lot of bullying had an effect size of 0.32. Beta coefficients are standardised and hence comparable. Females (49.4%) reported more 'little' and 'lots of bullying' than males (45.3%) did, but the difference was not significant.

Grade 7 respondents had the highest mean numeracy (M = 25.85, SD = 6.48) and differed statistically significantly from the G4 respondents (M = 19.50, SD = 6.10). Respondents in Grades 1 to 3 (M = 21.06, SD = 5.86) also differed significantly from G7 respondents as did G5 respondents (M = 22.84, SD = 6.98). The data thus tend to show an increase in numeracy scores from G1 to G7 with G4 being an anomaly. The reason why G4 learners performed most poorly in numeracy, needs further investigation. However, this

researcher did briefly survey the G1 to G6 Annual National Assessment (ANA) performance in mathematics and in Gauteng; the G4 learners achieved the lowest percentage namely 44.4% (DoBE 2014). Inspection of the memorandum indicates that learners had to have a good foundation in the fundamentals of addition, subtraction, multiplication and division and should be able to apply this knowledge to practical situations. The low average percentage in Grade 4 mathematics (numeracy) is disconcerting, for as Van den Bergh (2015) notes that most learning deficits are identified in the middle of primary school closing doors for such learners.

Learner performance in numeracy in this investigation was mostly dependent on the particular grade of the learner, home language and extent of bullying experienced. In addition, cross-tabulations of categorical variables indicated that the largest percentage of learners who indicated a little and 'a lot of' bullying were in Quintile 5 schools (57.3%), in Grade 4 (45,7%) with 10 years of age (45.7%) and situated in the Johannesburg central region (53.1%). This suggests that contextual variables are also associated with bullying.

The relationship between bullying and other contextual variables in the sample

The relationship of bullying to other categorical variables needs further investigation. The researcher utilised Chi-squared, Bayesian log linear analysis and the odds ratio to analyse the association between the various categorical variables. Bullying in two categories (yes, no) was tested for association with quintile grouping, and the region reported. Both quintile groups and region could be an indication of the socio-economic status of the respondents. Odds ratios are useful in understanding 2×2 contingency tables. Hence, the researcher used the odds ratio as follows:

$$odds_{\text{Grade in saying yes relative to no}} = \frac{Number\ saying\ yes\ to\ being\ bullied}{Number\ saying\ no\ to\ being\ bullied}$$

[Eqn 2]

Taking the various quintile groups, the relationship between them and being bullied or not can be investigated using the formula provided. As an example, the various categorical tests used are summarised for the relationship between quintile groups and regions and responding yes or no to experiencing bullying at school. The null hypothesis is that there is no statistically significant association between these categorical variables and bullying.

The data in Table 5 indicate that both quintile groupings and the regional context of the schools are significantly associated with bullying. The reciprocal of Bayes factor and the Chi-squared test gives strong evidence for supporting the alternative hypothesis namely that there is a significant relationship between quintile grouping and bullying as well as for school region and bullying. The probability of the data is 111.1 (quintiles) and 18.5 (regions) times greater given the alternative hypotheses than given the null (Field 2018:859).

TABLE 5: Tests of association of various categorical variables for association to bullying.

Quintile grouping	Chi-squared (p-value)	(1/BF)	Odds (yes: no)
Q2	0.000**	111.1	0.87
Q3	-	-	0.97
Q4	-	-	0.35
Q5	-	-	1.34
Region			
Johannesburg Central	0.002**	18.5	1.13
Ekurhuleni	-	-	0.80
West rand	-	-	0.42

**$p < 0.001$.

The odds of answering yes relative to no to bullying is largest in Quintile 5 schools (1.34) and in the Johannesburg central region (1.13). Both the quintile and region relate to relatively favourable socio-economic conditions. This suggests that the more favourable the socio-economic situation the learners are associated with the greater is the likelihood of being bullied at school.

Taking the odds further and determining the odds ratio between Quintile 5 schools and the other quintile schools the largest odds ratio was between the Quintile 5 schools and the Quintile 4 School, namely 3.19. (1.34/0.42) Hence, learners in Quintile 5 schools, where the school fees are in the region of R600.00 per month for 10 months of the year compared to the Quintile 4 School where the fees are considerably less, indicate much higher odds of being bullied. It is also possibly home language related as the Quintile 4 School fell in the 'language not set' category. The school involved indicates that they cater for Sesotho and Sepedi home language learners and these categories were not specified in the language categories. Hence, 57.6% of the learners in this Q4 School fell in the 'not set' category. English versus 'not set' was one of the significant predictors in the linear regression with multiple indicators (see Table 4). The odds ratio of saying yes to no or bullying of Johannesburg central versus Westrand-1 also had the largest odds ratio (2.67) when comparing regions. This correlates well with the Quintile finding as the Quintile 4 School was in West Rand. The question arising is 'why should bullying perceived to be larger in the better socio-economic situation schools', which is difficult to answer. One possible reason was that there was only one quintile 4 school and hence numbers were limited. Yet the odds of yes to no regarding bullying was low at 0.35 in the one school in the West Rand region (Quintile 4) whilst it was high in the two quintile 5 schools at 1.43 and 1.45. This suggests that bullying is possibly school related. This finding needs further investigation as more bullying is reported at wealthier schools because it is contrary to bullying being more prevalent in socio economically deprived situations.

Discussion

This study resulted in some important findings. Firstly, it found a high prevalence of school bullying (46.9%) which was self-reported by the participants in Johannesburg, Gauteng province. However, this finding needs to be

interpreted with caution because the sample was representative of 10% of the population involved in this study. Other South African studies have noted school bullying to range within the 30% to 45% range which is more or less similar to Johannesburg as found in this study. For example, Liang, Flisher and Lombard (2007) reported 41% prevalence in Cape Town and 33% in Durban in their large-scale study; and Cluver, Bowes and Gardner (2010) confirmed that 34% of the children in their study reported being bullied in urban parts of Cape Town. Even though it is difficult to identify specific reasons for this escalation, studies have shown that all forms of abuse (Dawes, Bray & Van der Merwe 2007; Dussich & Maekoya 2007) and violence (Kahn et al. 2000) generally contribute to school bullying and there is the possibility that abuse and violence may be more prevalent in Johannesburg and surrounding areas.

Secondly, it was found that bullying was more common in higher SES children in terms of school quintiles and region locations. Most studies seem to indicate that bullying is more common amongst children from low SES groups (Noble, Wright & Cluver 2006; Tippett & Wolke 2014). Bullying may be more common amongst children from high SES because they may believe that they have more power and popularity by virtue of the resources they have (Shetgiri, Lin & Flores 2012). As such, one would expect cyberbullying to be high but it did not emerge as such in this study. This could probably be because of the fact that in most public schools, cell phones are not allowed to be used during teaching time. This could reduce the possibility of cyberbullying during school time.

Thirdly, the findings indicate that there is an association between bullying experiences and numeracy achievement, that is, children who are bullied tend to perform poorly in numeracy tests in comparison to their peers who did not report being bullied. This finding should be noted with caution because the focus of this study was on associational rather than causal relationships between bullying experiences and numeracy performance. Also, it is important to note that there is no certainty on whether bullying contributes to poor numeracy performance or vice versa. Children with bullying experiences may avoid school or not engage in classroom activities and this could account for poor numeracy performance. This point is aligned to social referencing theory that would postulate that children gather information about bullying experiences in their environment and interpret this information to determine how they will act (Feinman et al. 1992). Or children could be more vulnerable to bullying because of their poor performance. In this regard Huber et al. (2018) show how social acceptance of children in the classroom by both teachers and other learners can have a positive or negative impact on them. Bullying usually provides negative feedback to children resulting in social withdrawal.

The fourth significant finding was that bullying was most prevalent amongst children aged 10 who were mostly in Grade 4 (44.7%). These children were also found to have the lowest score on the combined numeracy test and differed statistically significantly from learners in Grade 7, the 12- and 13-years' age groups at the 1% level of significance. Whilst this study did not determine any particular reasons to explain why the Grade 4 group had the lowest mean score in the numeracy test, the results confirm the findings of the Annual National Assessments (DoBE 2014). The finding that bullying is more prevalent in the early grades corroborated other studies which observed a decline in the incidents of school bullying in older learners (Salmivalli 2002; Seals & Young 2003; Selekman & Vessey 2004; Van der Ploeg, Steglich & Veenstra 2020). Some researchers noted that the reason for this could be because of children having to leave the safety of the home environment and venturing into a new school climate for the first time where their social difficulties could be detected (Vlachou et al. 2011).

Implications for school-based interventions

The above findings are significant from a bio-ecological systems theoretical perspective because they implicitly highlight the importance of viewing school bullying and numeracy achievement as operating within multiple systems and levels (Divecha & Brackett 2020). At the individual level, it infers that there are traits within the children themselves that contribute to bullying behaviour and numeracy achievement. Particularly within the context of this study, grade, home language and socio-economic status were identified as important categorical variables to consider in relation to school bullying and numeracy achievement. With reference to grade, it was found that school bullying was most frequent amongst children in Grades 1 to 6 and declined in Grade 7 as they grew older. This suggests the importance of implementing anti-bullying programmes from the primary school level. Also, the support for numeracy development associated with bullying should begin in the early years of schooling. Regarding gender, girls in this study were more engaged in verbal bullying and boys in physical bullying. Fullchange and Furlong (2016) indicate that boys generally display more aggression than girls. This indicates the need for specific interventions for boys and girls and, more importantly, a focus on specific strategies to combat aggressive behaviour in boys.

Finally, all interventions directed at addressing school bullying should take socio-economic environments into consideration, as noted in the differences amongst quintile groupings and education districts in this study where the high socio-economic status schools and districts displayed increased levels of bullying. Other studies noted converse findings where bullying was more prevalent in low SES settings (Tippett & Wolke 2014). Both high and low findings show the need for SES to be considered when anti-bullying strategies are implemented in schools (Greeff & Grobler 2008; Liang et al. 2007; Noble et al. 2006; Seals & Young 2003).

The above findings imply that school management teams should be geared at ensuring that schools are safe places for teaching and learning to occur. There should be increased access to mental health services and support for victims of bullying as well as those who bully others, such as individual and group counselling programmes. Anti-bullying programmes should be infused across the school curriculum and in the early years it should be concretely directed at developing social skills as well as behaviour and emotion regulation skills (Vlachou et al. 2011). Also, it is crucial that school-based interventions should be directed at providing academic support for children who experience bullying to improve their school performance, especially in numeracy achievement, within the context of this article.

Limitations and conclusion

The study relied on self-report measures, which always have the possibility of inaccuracy and intentional distortion, which could be a limitation of the findings. Another limitation was that the schools which participated in the study were the ones that chose to stay until the completion of the research, so selection bias cannot be excluded. Furthermore, the sample was representative of 10% of the population and may not necessarily be a true reflection of schools and learners who participated in the study. Also, the study was dominated by female learners and learners who used English as home language. Despite these limitations, this study confirms that bullying is highly prevalent in primary schools in and around Johannesburg, and it is associated with numeracy performance. It is vital to note that the study focused on associations and in no way insinuated causal relationships between bullying prevalence and numeracy achievement. The results emphasise the need for primary school-based interventions to prevent bullying and to support children who are experiencing numeracy difficulties associated with bullying. From a bio-ecological systems perspective, one would emphasise the importance of school-based interventions operating on multiple systems levels because the battle against school bullying could only be won through strong collaborations of parents, learners, schools, government, nongovernmental, religious and community-based organisations. Such collaborations are essential for the provision of school mental health services to successfully combat the negative repercussions of school bullying and its association with poor numeracy achievement in children. The findings in this study and the implications for school-based interventions discussed are likely to have global value because bullying and numeracy are prevalent in all primary schools.

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Competing interests

The author declares that he has no financial or personal relationships that may have inappropriately influenced him in writing this article.

Author's contributions

J.P. is the sole author of this research article.

Ethical considerations

Ethical clearance was granted by the Ethics Committee, Faculty of Education, University of Johannesburg. 2018-036.

Data availability

The data that support the findings of this study are available from the author, (J.C.), upon request.

Disclaimer

The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of any affiliated agency of the author.

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