A study of the challenges in a school-based mass drug administration of praziquantel in rural KwaZulu-Natal, South Africa

Prosjektoppgave ved Det Medisinske Fakultet

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ABSTRACT

Background. It is estimated that 5.2 million people in South Africa are in need of annual treatment for schistosomiasis. The current treatment strategy recommended by the World Health Organization (WHO) is mass drug administration of praziquantel (PZQ), which targets mainly school-age children and adults at high risk of infection. The WHO advocates the use of schools for implementation, aiming to reach at least 75% of school-age children in the endemic areas.

Objectives. This study aimed to assess the coverage of mass drug administration amongst learners in a South African rural community, as well as to observe and identify some challenges limiting treatment coverage.

Methods. Sixty randomly selected schools in the schistosomiasis endemic area of Ugu District were invited to participate in the mass drug administration implemented by the Department of Health. After parental consent was obtained, a single dose of praziquantel was offered according to bodyweight, 40 mg per kg, to all learners with affirmative consent forms.

Results. In the course of 8 weeks, slightly more than 10 000 learners in 43 primary and high schools were treated, achieving treatment coverage of 44.3%. We found that older age, being in a large school and male gender were significant predictors for low treatment coverage.

Conclusion. Our results indicate that strategies aiming at improving treatment coverage should primarily focus on higher age groups, large schools and male gender.
BACKGROUND

Schistosomiasis (bilharzia) is a water-borne parasitic disease transmitted by freshwater snails. It is recognised as one of the major neglected tropical diseases (NTDs) affecting over 207 million people globally.\(^1\) Sub-Saharan Africa holds 85-93% of the global schistosomiasis burden, with the highest prevalences in school-children, adolescents and young adults.\(^{1, 2}\)

Consequences for individuals affected by schistosomiasis may include anaemia, malnutrition, impairment of growth and development, and low school attendance.\(^{3-5}\) Control of schistosomiasis can have a wide range of health and socioeconomic benefits for the poorest populations.\(^{3, 6}\)

In 2011 the World Health Organization (WHO) estimated that 5.2 million people in South Africa require annual preventive drug therapy for schistosomiasis.\(^7\) Previous studies from KwaZulu-Natal have reported an \textit{S. haematobium} prevalence ranging between 22-55% of school-age children.\(^{8-11}\)

The current strategy recommended by the WHO for the control of morbidity is mass drug administration (MDA) with praziquantel (PZQ), targeting mainly school children and adults at risk of infection, with an aim of 75% coverage.\(^{12, 13}\) The past years pre-school children have also been considered for inclusion.\(^{14, 15}\) In areas exceeding 50% prevalence, the WHO recommends treating all school-age children annually, while biennial treatment is sufficient in areas with prevalence between 10% and 50%. In areas with less than 10% prevalence, two treatments during primary school years are sufficient.

In Brazil, China, Egypt and the Philippines mass screening and treatment have resulted in lasting schistosomiasis control and reduction.\(^{16, 17}\) Although previous MDAs have reported treatment coverage ranging from 50% to over 90%,\(^{18-20}\) suboptimal coverage and lack of efficacy still pose a great challenge.\(^3\) Only 12.2% of people at risk of morbidity due to schistosomiasis worldwide received treatment in 2010.\(^{13}\)
The first control programme in South Africa was implemented in the region of KwaZulu-Natal in 1997. It was a school-based helminth control programme run and administrated by the Department of Health. A three year pilot programme followed in 1998, and implementation guidelines were published in 2008. The first MDA in South Africa since the pilot programme was introduced by the Ugu District Department of Health (DoH) in 2011. The programme included a limited number of schools in Ugu District and was where we made our observations.

The aim of the present study was to assess the coverage of the MDA in a South African setting and to explore some challenges and limitations of the implementation by identifying factors associated with treatment coverage.
MATERIAL AND METHODS

Study area and population
The described treatment campaign was implemented in Ugu District in south-eastern KwaZulu-Natal, South Africa. The district covers 5,866 km² and had an estimated population of 704,030 in 2001, of which 37% were under the age of fifteen. It is comprised of two distinct areas; the coastal strip which is largely urban, and the rural inland expanse. The rural area, where this MDA was conducted, is largely populated by two ethnic groups of people, Zulu and Xhosa, consisting of low-income housing where shanty houses are common and agriculture is the primary economic activity. In 2011 14.1% of households in KwaZulu-Natal did not have access to piped water. This requires water contact in rivers and lakes which exposes the inhabitants to infested waterbodies.

In South Africa primary school ranges from grades 0⁴ to 7 and high school from 8 to 12. Some areas have intermediate schools dedicated to grades 7 to 9. Official education statistics from KwaZulu-Natal report a gross enrolment ratio (GER) of 92%.⁵

There are 491 public schools and 16 independent schools with a total of 218,242 learners in the Ugu District.⁶ Sixty schools were randomly selected for the MDA. Class lists were collected in 54 schools, covering 31,584 learners. Due to time constraints, the study excluded eleven schools (24% of total learners).

Design and inclusion criteria
In the period between May 20th and September 12th 2011, operational research was conducted in a cross-sectional study of randomly selected high schools and their adjacent primary and intermediate schools. In order to optimise treatment coverage and minimise the risk of re-

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⁴ Grade 0 (also called grade R) is the pre-grade 1 level available in some schools.
infection, family members, teachers and non-enrolled children were also invited to receive treatment.\textsuperscript{[12, 28]}

\textbf{Communication with the schools}

Letters from the Ugu District Departments of Education and Health were brought to the school after a brief introduction over phone. School inclusion and practical issues were discussed with the principals, the school governing bodies, parents and staff in accordance with the advice from the local contact persons. A tracking team obtained class lists from each school along with information about the school, whether or not it had a feeding scheme, exam dates and other dates when treatment would be unsuitable.

\textbf{The treatment days}

The MDA was implemented during the cold months of May to September when transmission of schistosomiasis is low due to reduced water contact. This reduces the risk of immediate re-infection\textsuperscript{[9]} and also increases the effectiveness of the drug, as PZQ is highly effective at killing adult worms, but does not kill immature schistosomes (from recent infections).\textsuperscript{[29, 30]}

Treatment team size, quantity of consumables, and equipment brought to schools were arranged in advance, and varied according to the school size. Tablet distribution only commenced after school lunch to ensure that the children had eaten prior to treatment, and to cut food costs for the programme. Bread and bananas were brought to the schools to ensure food intake for learners who had not received a school meal.

The MDA was implemented in a classroom or in an assigned room, and depended on the advice of school officials. Learners with completed consent forms were weighed and the dose of praziquantel was calculated at 40 mg per kg of bodyweight.\textsuperscript{[12]} After each child to be treated had eaten, a designated health worker directly observed ingestion of all tablets by
counting the number of tablets in each learner's hand and observing hand-to-mouth intake (DOT). For smaller children, tablets were split in two. Sweets were given afterward to reduce the tablets' taste. The treatment team remained in the school for some time after treating the last class, giving the learners the opportunity to report side effects.

In schools with less than 75% treatment coverage a second treatment day was immediately scheduled and prepared. New parental consent forms were distributed, often on the original treatment day, and collected soon after.

**Permissions**
The MDA was conducted by the Ugu District DoH School Health Teams in collaboration with the Ugu Department of Education (DoE). Participation by the school was voluntary. In South Africa praziquantel is classified as a schedule 4 drug and only registered nurses or medical doctors are permitted to dispense.\[^{23}\]

Consent forms were distributed three to ten days prior to the scheduled treatment day. Teachers would distribute them to the learners, and collect the completed forms prior to the treatment day. Late forms were collected and registered on the treatment day.

Only learners who returned complete, affirmative consent forms were treated. According to South African law, learners below the age of 12 need their guardian's consent to receive medical treatment, whereas learners above the age of 18 may grant self-consent. Learners between the ages of 12 and 18, may also grant self-consent, but must be advised on the importance of gaining parental consent for future health services.\[^{22,31}\] At the time of the MDA medical staff only accepted self-consent forms from learners above the age of 18 to be on the safe side.
**Ethical considerations**
This observational research was granted permissions by the Biomedical Research Ethics Administration, University of KwaZulu-Natal, on February 2010 (Ref BF029/07) and the Department of Health, Pietermaritzburg, KZN, February 3, 2009 (Ref HRKM010-08). The Regional Ethics Comittee of East Norway gave ethical clearance on September 17, 2007 (Ref 469-07066a1.2007.535). In Ugu District, permissions by the DoH and DoE were granted on February 15, 2008 and December 14, 2010, respectively. Data was anonymised before analysis.

**Data management and statistical analysis**
A data collection team computerised class lists including learners’ names (both English and Zulu), date of birth, guardian information, gender, grade and school. Consent status was registered (affirmative/refused/blank) along with weight, number of tablets to be given according to weight, and whether or not the learner received the medication. The term 'treatment coverage' refers to the percentage of learners who received treatment in the visited schools.

Schools with less than 350 learners were defined as small schools. Schools with between 350-700 students were defined as medium-sized, and schools with more than 700 learners as large.

All statistical analyses of the collected data were computed using Statistical Package for the Social Sciences (SPSS), version 19 (SPSS inc., Chicago, Illinois, USA). Age data was presented as median because age was not normally distributed. Chi-square tests and odds ratio (OR) with 95% confidence intervals (95% CI) were used to explore the association between MDA coverage and consent form compliance when comparing different groups, defined by gender, school size, age and school phase. Logistic regression analysis was used to assess the
association between selected predictors and outcome variables. The outcome variables included treatment coverage, number of consent forms returned and whether or not consent was given. Gender, school size, school phase and age were used as predictor variables. A significance level of 5% was used. Predictor variables were included in the multivariate regression analysis if the p-value from the crude association was less than 0.20. If the Spearman rank correlation between two predictor variables was above 0.70 or below –0.70, only one of these variables was included in the multivariate regression analysis.
RESULTS

Basic demographics
During the 8 weeks of the MDA, 43 schools covering 24 005 learners were reached for treatment (Table 1). These included 29 primary schools, 2 intermediate schools, and 12 high schools. Categorised by size, 10 were small schools, 19 were medium-sized, and 14 were large schools.

Gender was registered in 79.9% (19 185/24 005) of learners (Table 1). For the remainder of cases, gender was not specified in the class lists received from the schools. The sex ratio (male:female) was 9 773:9 412 (1.04). Date of birth was only available for 60.9% of learners. Median age was 14 (range 3-32), 12 years of age for learners who received treatment and 15 for those who were not treated.

Treatment coverage
Most schools required a second treatment day in order to acquire higher treatment coverage. The overall treatment coverage after a second school visit was 44.3% (10 632/24 005), ranging from 14.5-82.6% in the different schools. The associations between treatment coverage and gender, age, school phase and size are demonstrated in Figure 1 and Table 2. Multivariate analysis shows that belonging to a higher age group, being in a large school and male gender, were all significant predictors for low treatment coverage. We performed a separate analysis to explore if reduced treatment coverage amongst high school learners was related to school size. Controlling for gender, the analysis shows that significantly fewer high school learners received treatment, independent of school size (OR 0.50, 95% CI 0.47 – 0.54, P <0.001)
**Consent forms**

Consent forms were returned by 56.4% (13 548/24 005) of learners. Of these, 86.9% (11 771/13 548) consented, while 13.1% (1 777/13 548) refused. The remaining 43.9% (10 542/24 005) of consent forms were either not returned or illegible. There were 2 099 consenting learners who were not treated and 958 learners were registered as treated where consent status was not recorded.

Table 3 shows that 60.9% of female learners returned consent forms, compared to 54.4% of male learners. Multivariate analysis shows that learners in small schools and primary schools returned significantly more consent forms than learners in large schools and high schools.

Of learners who returned consent forms, 91.3% consented to treatment in large schools compared to 84.1% in small schools (OR 2.32, 95% CI 1.91 – 2.81, P <0.001). Additionally, the odds of consenting to treatment was 44% lower for learners in high schools compared to learners in primary schools (OR 0.56, 95% CI 0.49 – 0.63, P <0.001).

On average 2-3 learners in each school reported side effects or transient nausea, vomiting, stomach ache or head ache.
DISCUSSION

The MDA achieved treatment coverage of less than 50%. This is substantially lower than reports from similar studies of MDAs in Africa, which have achieved treatment coverage as high as 80-90% amongst enrolled school-aged children.\[^{[20,32-35]}\] However, there are also studies reporting treatment coverage from school-based distribution as low as 30\%\[^{[36]}\]. Treatment coverage is better in community-based distribution compared to school-based distribution, mainly due to the high number of non-enrolled school-aged children who are not reached by school-based programmes.\[^{[33,34,36]}\] To our knowledge treatment coverage has not been reported in South Africa previously.

Several studies have explored reasons for low treatment coverage. These include insufficient training of distributors, poorly structured health systems, inadequate community mobilization and lack of health education.\[^{[10,19,35-39]}\] Other common reasons are lack of credibility and perceived benefits of the treatment, fear of adverse reactions, and a divergence between local and medical understandings of schistosomiasis. Absenteeism in schools is a major contributing factor for lack of treatment, possibly reaching 30\% in some areas.\[^{[9,10,33]}\]

We found female gender, younger age, and small school size to be positively correlated with treatment coverage and compliance in returning consent forms. Several factors may contribute to this, although specific, statistical causes are outside the scope of this study.

Treatment percentage declined proportionally with older age in accordance with previous studies.\[^{[18,40]}\] This may partly be attributed to a closer teacher follow-up and parental control in younger children. Also, teenagers have been found to be less likely to visit health facilities.\[^{[40]}\] This indicates the importance of targeting the higher age groups when planning an MDA.
The significantly higher treatment coverage in small schools may be due to the higher educator-to-learner ratio, resulting in a closer follow-up of learners and closer cooperation between school staff, guardians and treatment teams. Moreover, large schools may be challenging to treat within a limited time frame.

Using trained teachers has proved effective in minimising challenges related distribution of treatment.\cite{12, 19, 41} Treatment campaigns where teachers distributed medication have achieved coverage as high as 80% to 90%.\cite{35} Currently, these measures cannot be implemented in South Africa due to regulations permitting only certified health workers to distribute medication.\cite{23} It is therefore important to develop a close relationship between the treatment teams and teachers.

Almost one fifth of consenting learners were not treated. The most probable reason for this was absenteeism on treatment day. In accordance with existing literature, school attendance rates are important for the success of school-based medical programs.\cite{10, 33, 42}

Consent forms were only returned by 56.4% of learners. Of these, 86.9% consented to treatment. This poor return of consent forms may have limited treatment coverage markedly. Observed reasons include absenteeism, forgetting forms, not understanding how to fill out forms, refusal of treatment and lack of a guardian to sign the consent form. Solutions suggested to maximise the return of consent forms are requesting consent as a part of the schools’ yearly registration procedure,\cite{10} or obtaining written consent from head teachers at each school after prior agreement with guardians.\cite{43}

Information about the possible side effects from treatment, focusing on their temporary nature and the overwhelming benefits of receiving treatment may be a useful strategy for improving knowledge and promoting acceptance of treatment.

In 2011 the South African Department of Health, in collaboration with the Department of Basic Education, revised the National School Health Policy.\cite{22} The new policy introduced
deworming as a health service until grade 6, possibly being one step closer to a national control programme for schistosomiasis.

The large number of learners involved is a major strength of this study. Although a large sample size may result in even small effect sizes being statistically significant we consider the results presented to be of both statistical and clinical significance.

A limitation of the study was the lack of a system for registering reasons for refusing treatment and for registering side effects, both of which could have provided useful information for improving later MDAs. Furthermore, our results only cover the final treatment coverage, including both first and second treatment days, when applicable. Separate data on coverage before and after second treatment rounds would be useful in determining the cost and usefulness of re-approaching the school.

In this MDA only learners above the age of 18 were allowed to self-consent. Future MDAs may benefit from increased participation by adhering to the guidelines, and granting learners between the ages of 12-18 self-consent.\[22, 31\]

**CONCLUSION**

The described MDA achieved treatment coverage of 44.3%, which is significantly lower than recommended for schistosomiasis control. We have assessed limitations to achieving satisfactory treatment coverage, and have suggested some approaches to accomplishing higher coverage in subsequent MDAs. We found that belonging to a higher age group, being in a large school and male gender, were all significant predictors for low treatment coverage. In addition we observed contributing factors such as absenteeism and low submission of consent forms. Addressing and targeting these key issues may be of assistance in planning and implementing future MDAs.
TABLES AND FIGURES

Table 1: Treatment coverage across gender and school phase

<table>
<thead>
<tr>
<th></th>
<th>Female / Total (%)</th>
<th>Male / Total (%)</th>
<th>Total (%)</th>
<th>Gender not recorded (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(43)</td>
<td>4382/9412 (46.6)</td>
<td>4190/9773 (42.9)</td>
<td>10632/24005 (44.3)</td>
<td>2060/4820 (42.7)</td>
</tr>
<tr>
<td>Primary school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>2878/5357 (53.7)</td>
<td>2882/5846 (49.3)</td>
<td>7159/14162 (50.6)</td>
<td>1399/2959 (47.3)</td>
</tr>
<tr>
<td>Intermediate school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>279/583 (47.9)</td>
<td>253/610 (41.5)</td>
<td>551/1231 (44.8)</td>
<td>19/38 (50.0)</td>
</tr>
<tr>
<td>High school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>1225/3472 (35.3)</td>
<td>1055/3317 (31.8)</td>
<td>2922/8612 (33.9)</td>
<td>642/1823 (35.2)</td>
</tr>
</tbody>
</table>

a Gender not stated on class list
b Usually grade 1 to 7, but occasionally only to grade 4.
c Usually grade 7 to 9
d Usually grade 8 to 12
### Table 2: Bivariate and multivariate analysis for factors influencing the treatment coverage

<table>
<thead>
<tr>
<th>Age group</th>
<th>Treatment given (%)</th>
<th>OR (95% CI)(^a)</th>
<th>P</th>
<th>Adj. OR (95% CI) (^b)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-9</td>
<td>1894/3232 (58.6)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10-14</td>
<td>2646/5364 (49.3)</td>
<td>0.69 (0.63-0.75)</td>
<td>&lt;0.001</td>
<td>0.70 (0.63-0.78)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>15-19</td>
<td>1728/5128 (33.7)</td>
<td>0.36 (0.33-0.39)</td>
<td>&lt;0.001</td>
<td>0.39 (0.35-0.43)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>20-24</td>
<td>223/866 (25.8)</td>
<td>0.25 (0.21-0.29)</td>
<td>&lt;0.001</td>
<td>0.28 (0.23-0.33)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>25-35</td>
<td>3/26 (11.5)</td>
<td>0.09 (0.03-0.31)</td>
<td>&lt;0.001</td>
<td>0.10 (0.03-0.35)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School level</th>
<th>Treatment given (%)</th>
<th>OR (95% CI)(^a)</th>
<th>P</th>
<th>Adj. OR (95% CI) (^b)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school</td>
<td>7159/14162 (50.6)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Intermediate school</td>
<td>551/1231 (44.8)</td>
<td>0.79 (0.71-0.89)</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>2922/8612 (33.9)</td>
<td>0.50 (0.48-0.53)</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Treatment given (%)</th>
<th>OR (95% CI)(^a)</th>
<th>P</th>
<th>Adj. OR (95% CI) (^b)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>4382/9412 (46.6)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4190/9773 (42.9)</td>
<td>0.86 (0.81-0.91)</td>
<td>&lt;0.001</td>
<td>0.91 (0.85-0.99)</td>
<td>0.018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School size</th>
<th>Treatment given (%)</th>
<th>OR (95% CI)(^a)</th>
<th>P</th>
<th>Adj. OR (95% CI) (^b)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;350 pupils</td>
<td>1185/2108 (56.2)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>350-700 pupils</td>
<td>4597/9753 (47.1)</td>
<td>0.69 (0.63-0.76)</td>
<td>&lt;0.001</td>
<td>0.48 (0.40-0.58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;700 pupils</td>
<td>4850/12144 (39.9)</td>
<td>0.52 (0.47-0.57)</td>
<td>&lt;0.001</td>
<td>0.47 (0.39-0.56)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

\(^a\) Odds ratio (OR) with 95% confidence interval (CI)  
\(^b\) Adjusted odds ratio, three factors were included in the multivariate analysis  
\(^c\) School level was not included in the multivariate analysis as there is a causal factor between school level and age.
Table 3: Bivariate and multivariate analysis for factors influencing the percentage of consent forms returned

<table>
<thead>
<tr>
<th></th>
<th>Consent form returned (%)</th>
<th>Bivariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)(^a)</td>
<td>P</td>
<td>Adj OR (95% CI)(^b)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5735/9412 (60.9)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5314/9773 (54.4)</td>
<td>0.76 (0.72-0.81)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.74 (0.70-0.79)</td>
</tr>
<tr>
<td><strong>School size(^c)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;350</td>
<td>1363/2108 (64.7)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>350-700</td>
<td>5878/9752 (60.3)</td>
<td>0.83 (0.75-0.92)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.92 (0.82-1.03)</td>
</tr>
<tr>
<td>&gt;700</td>
<td>6308/12143 (51.9)</td>
<td>0.59 (0.54-0.65)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.62 (0.55-0.69)</td>
</tr>
<tr>
<td><strong>Primary(^d) school</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>8739/14161 (61.7)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Intermediate(^e) school</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>660/1231 (53.6)</td>
<td>0.72 (0.64-0.81)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.75 (0.66-0.84)</td>
</tr>
<tr>
<td><strong>High(^f) school</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>4150/8611 (48.2)</td>
<td>0.58 (0.55-0.61)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.57 (0.53-0.61)</td>
</tr>
</tbody>
</table>

\(^a\) Odds ratio (OR) with 95% confidence interval (CI)
\(^b\) Adjusted odds ratio, all three factors were included in the multivariate analysis
\(^c\) Number of pupils in the school
\(^d\) Usually grade 1 to 7, but occasionally only to grade 4
\(^e\) Usually grade 5 to 7
\(^f\) Usually grade 8 to 12
Figure 1: Treatment coverage in different age groups and gender

![Bar chart showing treatment coverage by age group and gender](image-url)
REFERENCES


