

## Original Research Article

# Environmental and water, sanitation and hygiene conditions in schools: a community-based cross-sectional study from North India

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### ABSTRACT

**Background:** Schools environment is essential for children to achieve optimal health and development. Faulty construction leads to inadequate ventilation and moisture accumulation which increase the levels of morbidities. Schools should also serve as demonstration centres of good sanitation to the community hence healthful environment and functional toilets and WASH facilities are of utmost importance for school children.

**Methods:** A community-based cross-sectional study includes randomly selected 50 schools of Sonapat district which were functional for more than 5 years. Schools were recruited by PPS. A schedule was used to assess the environment and WASH conditions. Percentage, proportion and Chi-square test were used as statistical methods. The p-value <0.05 was considered statistically significant.

**Results:** 68.4% government schools and 51.6% private schools were located in a rural area. 68% schools were having multi-storied building, 72% schools were located at appropriate land. Ventilation was inadequate in 58% schools while all schools were having adequate lighting. Ergonomically sitting facilities were observed in one school only. Water treatment was done in 68% schools. Toilets were adequate in 58% schools but cleaning was done daily in 46% schools. Handwashing points were available in 96% schools but soap was observed in 10.4% schools only. Garbage disposal was observed to be sanitary in 52% schools while liquid waste disposal was sanitary in 44% schools.

**Conclusions:** The study points towards deficiency of environment and WASH conditions in schools and recommends the school authorities to take corrective measures.

**Keywords:** Environment, India, School WASH

### INTRODUCTION

Schools are the right place for a healthy start which play a critical role in promoting the health of students.<sup>1</sup> An estimated 6.6 million children and young adolescents have died in 2016.<sup>2</sup> More than 3000 adolescents die every day, mostly from preventable causes.

Regardless of the improvement, the gap in quality of care is contributing to morbidities and deaths among children.<sup>3</sup> Child's physical environment can cause or prevent illness, faulty construction leads to inadequate ventilation and moisture accumulation which increase the levels of morbidities. Therefore, a high-quality school

environment is essential for children to achieve academic goal and good health.<sup>4</sup>

Children spend about 80% of the school time in the classroom doing various activities, which require them to sit for long hours. It is most important that the dimensions of the classroom furniture are suitable for the students.<sup>5</sup>

Schools should serve as demonstration centres of good sanitation. An estimated 2.5 billion people lack basic sanitation worldwide.<sup>6</sup> Poor WASH conditions still account for 842,000 diarrhoeal deaths every year.<sup>7</sup> According to the United Nations, the lack of toilet

facilities contributes to the deaths of around 700,000 children a year from diarrheal diseases.<sup>8</sup> Cleaning and hygiene include hand washing practices and other forms of sanitation such as proper waste disposal in schools and the use of functioning toilets. Therefore, it is important that the school environment is clean, and hygiene is enhanced to avoid the start and exacerbation of diseases or their spread.<sup>9</sup>

The healthful environment and WASH facilities are of utmost importance for school children but many studies have reported that schools lack in these.<sup>10-14</sup> As per the available literature, there is a scarcity of data on the status of school environmental and WASH conditions among schools of district Sonapat, Haryana. Hence, the present study was carried out to assess the school environment and WASH facilities in schools of a district in Haryana, so that appropriate intervention can be suggested.

## METHODS

This community-based cross-sectional study was carried out from June 2018 to June 2020 in the department of Community Medicine, Bhagat Phool Singh Government Medical College for Women, Khanpur Kalan, Sonapat district, Haryana.

### Sample size

Using nMaster 2.0 software taking prevalence of the adequate environmental and sanitary condition in previous study 50% at 95% CI and 15% permissible error, the required sample size was  $\approx 50$ .<sup>10</sup>

### Sampling technique

Three-stage random sampling technique using PPS (Probability Proportional to Size) was adopted for the present study. In stage I one district i.e. Sonapat, was selected randomly from a list of districts of Haryana a northern state of India. Two educational blocks were selected using simple random sampling in Stage II. After which 19 government and 31 private schools were selected from the sampled educational blocks by PPS in stage III.

### Inclusions and exclusions criteria

It comprises schools located in the district Sonapat, Haryana which were functional for more than 5 years and granted permission for the study. Schools which were shut down/ non-functional and primary schools were excluded.

### Study tools and data management

The data was collected on environmental and sanitary conditions of schools, using a schedule by referring to school health committee<sup>15</sup> guidelines. One classroom from each sampled school was selected by lottery method

to assess the classroom ventilation, lighting, per capita space and seating facilities provided to the students using study tool. Collected data were entered in Microsoft excel version 2019, coding and tabulation was done.

### Ethical consideration

The approval of the Institutional Ethics Committee of BPS GMC for Women Khanpur Kalan was obtained before conducting the study. Permission to conduct this study in schools was taken from District Education Officer of Sonapat district.

Informed written consent was taken from the head of the school for assessment of the environment and sanitary conditions in the school. To maintain anonymity, codes were given to the schools.

### Statistical analysis

Percentage and proportion were calculated for qualitative data. Chi-square test was used for the categorical variable. SPSS software was used for statistical analyses. The p value  $< 0.05$  was considered statistically significant.

## RESULTS

A sample size of 50 schools included 19 (38%) government and 31 (62%) private schools located in rural (58%) and urban (42%) areas.

**Table 1: Distribution of schools under the study area based on building status.**

Attributes	Govt n=19	Private n=31	Total n=50	P value
<b>Approachability by roads</b>				
Yes	19 (100)	30 (96.8)	49 (98)	1.000
No	0 (0)	1 (3.2)	1 (2)	
<b>Away from polluting atmosphere</b>				
Yes	13 (68.4)	18 (58.1)	31 (62)	0.464
No	6 (31.6)	13 (41.9)	19 (38)	
<b>School building</b>				
Single storied	13 (68.4)	3 (9.7)	16 (32)	0.000
Multi storied	6 (31.6)	28 (90.3)	34 (68)	
<b>School site</b>				
Below ground level	9 (47.7)	5 (16.1)	14 (28)	0.017
At or above ground level	10 (52.6)	26 (83.9)	36 (72)	
<b>Thickness of exterior wall of schools</b>				
$\geq 10$ inches	19 (100)	31 (100)	50 (100)	-

\* Figures in parenthesis are percentages

Majority of the government schools were located in a rural area while private schools show almost equal distribution in both rural and urban area. 98% of schools were placed with approachable roads and situated away

from polluting atmosphere. 62% of schools were away from the market/busy traffic area.

**Table 2: Distribution of schools under the study area based on environmental conditions of classroom.**

Attributes	Govt n=19	Private n=31	Total n=50	P value
<b>Ventilation to floor area</b>				
Adequate	10 (52.6)	11 (35.5)	21 (42)	0.233
Inadequate	9 (47.4)	20 (64.5)	29 (58)	
<b>Cross ventilation</b>				
Yes	18 (94.7)	27 (87.1)	45 (90)	0.637
No	1 (5.3)	4 (12.9)	5 (10)	
<b>Height of classroom windows from floor</b>				
Adequate	18 (94.7)	27 (87.1)	45 (90)	0.637
Inadequate	1 (5.3)	4 (12.9)	5 (10)	
<b>Lighting</b>				
Adequate	19 (100)	31 (100)	50 (100)	-
<b>Per capita space</b>				
Adequate	13 (68.4)	23 (74.2)	39 (78)	0.498
Inadequate	6 (31.6)	8 (25.8)	11 (22)	
<b>Sitting facility</b>				
On ground	2 (89.5)	0 (0)	2 (4)	0.140
Benches	17 (10.5)	31 (100)	48 (96)	
<b>Ergonomically good furniture for students</b>				
Yes	0 (0)	1 (3.2)	1 (2)	1.000
No	19 (100)	30 (96.8)	49 (98)	

**Table 3: Distribution of schools under the study area based on water facility.**

Attributes	Govt n=19	Private n=31	Total n=50	P value
<b>Source of water</b>				
Ground water	5 (26.3)	9 (29)	14 (28)	0.736
Surface water	4 (21)	9 (29)	13 (26)	
Both	10 (52.7)	13 (42)	23 (46)	
<b>Water treatment</b>				
Treated	8 (42.1)	26 (83.9)	34 (68)	0.002
Not treated	11 (57.9)	5 (16.1)	16 (32)	
<b>Drinking water storage</b>				
Sanitary	19 (100)	31 (100)	50 (100)	-

\* Figures in parenthesis are percentages

Only 24% of schools were located on suitable land not subject to inundation or dampness. Sixteen (32%) schools were single-storied (68.4% government and 9.7% private (p value=0.0000)). All the schools had 10-inch thick exterior walls (Table 1).

Out of 50 schools, 21 (42%) schools had adequate ventilation to floor area ratio and 45 (90%) schools had cross ventilation and windows placed suitable height in their classrooms. Eleven (22%) schools had overcrowding in the classrooms which was observed to be less among the government schools. Sitting facilities for students were provided in 48 (96%) schools. Majority

of schools (98%) did not have ergonomically adequate furniture (Table 2).

All schools had an adequate water supply with groundwater supply in 14 (28%) schools, surface water in 13 (26%) schools and both in 23 (46%) schools. Water treatment was observed in 34 (68%) schools (42.1% government and 83.9% private (p-value=0.0020)). The storage facility for water was observed to be sanitary in all schools. (Table 3).

**Table 4: Distribution of schools under the study area based on hygiene conditions.**

Attributes	Govt n=19	Private n=31	Total	P value
<b>No. of toilets</b>				
Adequate	12 (63.2)	17 (54.8)	29 (58)	0.562
Inadequate	7 (36.8)	14 (45.2)	21 (42)	
<b>Frequency of cleaning of toilets</b>				
Daily	1 (5.3)	16 (51.6)	17 (34)	0.000
Occasionally	18 (94.7)	15 (48.4)	33 (66)	
<b>Separate toilets for teachers/staff</b>				
Yes	19 (100)	29 (93.5)	48 (96)	0.258
No	0 (0)	2 (6.5)	2 (4)	
<b>Dustbin in girls' toilets</b>				
Dustbin with lid	3 (17.6)	15 (50)	18 (38.3)	0.036
Dustbin without lid	6 (35.3)	10 (33.3)	16 (34)	
No dustbin	8 (47.1)	5 (16.7)	13 (27.7)	
<b>Handwashing points</b>				
Present	18 (94.7)	30 (96.8)	48 (96)	0.7212
Absent	1 (5.3)	1 (3.2)	2 (4)	
<b>Soap at handwashing points</b>				
Present	0 (0)	5 (16.7)	5 (10.4)	0.06
Absent	18 (100)	25 (83.3)	43 (89.6)	

\* Figures in parenthesis are percentages

The number of toilets was adequate in 29 (58%) schools (62.1% rural and 52.4% urban (p value=0.5620)). In 17 (34%) schools, the washrooms were cleaned daily (5.3% government schools and 51.6% private schools (p value=0.000)). Most (96%) of the schools had separate toilet facilities for teachers/staff. Among rural schools, 28 (96.6%) schools and 20 (95.2%) of urban schools had handwashing points but soap at handwashing points was not available in 25 (89.3%) rural schools and 18 (90%) urban schools. Among 47 schools with female students, 18 (38.3%) schools had dustbins with lid, 16 (34%) had dustbins without lid and 13 (27.7%) had no dustbin in girls' toilets. (Table 4).

Final disposal of garbage was found to be sanitary in 26 (52%) schools (27.6% rural and 85.7% urban (p value=0.000)). Final disposal of liquid waste was found to be sanitary in 22 (44%) schools (6.9% rural 95.2% urban (p value=0.000)). Final disposal of menstrual

absorbent was found to be sanitary in 18 (38.3%) schools (25.9% rural 11% urban (p value=0.042)). (Table 5).

**Table 5: Distribution of schools under the study area based on waste disposal practices.**

Attributes	Rural n=29	Urban n=21	Total n=50	P value
<b>Final garbage disposal</b>				
Sanitary	8 (27.6)	18 (85.7)	26 (52)	0.00
Insanitary	21 (72.4)	3 (14.3)	24 (48)	
<b>Final liquid waste disposal</b>				
Sanitary	2 (6.9)	20 (95.2)	22 (44)	0.00
Insanitary	27 (93.1)	1 (4.8)	28 (56)	
<b>Menstrual absorbent disposal</b>				
Sanitary	7 (25.9)	11 (55)	18 (38.3)	0.042
Insanitary	20 (74.1)	9 (45)	29 (61.7)	

## DISCUSSION

The school environment constitutes a major influencing factor for students' health. Out of the total 50 randomly selected schools, private schools (62%) were observed to be more than government schools (38%). A similar pattern was observed by Periyasamy (72.1% private and 27.9% government schools).<sup>12</sup>

But according to Jiya, the proportion of public schools (73.6%) was more than private schools (26.4%) in their study area.<sup>16</sup> In our study, 13 (68.4%) government schools were in the rural area while six (31.6%) were in the urban area. Sixteen (51.6%) private schools were located in the rural area and 15 (48.4%) schools in the urban area.

Similarly, the 8th AISES observed that majority of the government schools (91%) were situated in the rural area while more of private schools were situated in urban areas.<sup>17</sup> This may be because many of the private schools were constructed outside the municipal limit area because of the availability of cheaper land.

Schools should normally be centrally situated with proper approachable roads.<sup>15</sup> In our study except for one private school of the urban area, all the schools i.e. 49 (98%) were well placed with approachable roads. A lesser proportion was observed by Majra (75%), and Joseph (83.3%).<sup>10,11</sup> This may be due to the better road network in the state of Haryana which leads to the better approachability to schools by road.

Schools should be at a fair distance from busy places and roads, factories, railway tracks and market places.<sup>15</sup> We observed that 19 (38%) urban schools had these problems, more among private schools (41.9%) than government schools (31.6%). Joseph has observed that 83.3% of schools were placed at a fair distance from busy places like markets.<sup>11</sup> Periyasamy found that 72.1% of the schools were situated well away from the busy roads and

Kofoworade found that 13.3% were in industrial areas.<sup>12,13</sup>

The problem of air/noise pollution among schools observed in this study may be because of their location in the congested and/or industrial town. The site of schools should be on suitable high land.<sup>15</sup> We observed that 14 (28%) schools were located below the ground level which was observed to be more among government schools (47.4%) than private schools (16.1%).

Thirty-six (72%) schools were located on suitable land. Similarly, Majra has revealed that 75% of schools were situated on properly drained lands.<sup>10</sup> School buildings should be single-storied.<sup>15</sup> We observed that single-story buildings were seen in only 16 (32%) schools.

Multi-story buildings were a common characteristic of private schools (90.3%) (p value=0.000). In contrast to the present study, a higher number of single-storied building were observed by Joseph (46.7%) and Periyasamy (57.4%).<sup>11,12</sup> This may be due to more availability of land to government schools. All the schools under this study had 10-inch thick exterior walls, which prevents the students from excessive hot and cold temperature.<sup>15</sup> Our findings are higher than findings of a study by Periyasamy (88.5%).<sup>12</sup>

Ventilation is an important factor for a favourable indoor environmental quality since it dilutes and removes pollutants, odours and excessive moisture.<sup>18</sup> We observed that 21 (42%) schools had adequate ventilation to floor area ratio (52.6% government and 35.5% private schools (p value=0.233)). A higher proportion was observed by Majra et al (60%), Joseph (96.7%), Kofoworade (95.3%) and Periyasamy (96.7%).<sup>11-13</sup>

We observed that 45 (90%) of schools (94.7% government and 87.1% private schools (p value=0.637)) had cross-ventilation but a lesser finding was observed by Majra. (40%) and Periyasamy (80.3%) had cross ventilation.<sup>12</sup> Kofoworade found that all public schools had adequate ventilation, in contrast to private schools where 90.6% had adequate ventilation.<sup>13</sup> Ventilation to floor area ratio is lesser in our study as the size of windows in our study area was found smaller, which may be because of extreme temperatures during summer and winter.

The adequacy and penetration of light may have an important role with regards to stress on the eyes of the students and disinfection of the classroom.<sup>19</sup> For this, the windows should be at a height of 2'-6" from the floor level.<sup>15</sup> We observed that the majority (90%) of the schools had windows placed at the right height which is more than the finding of Joseph (73.3%).<sup>11</sup> In our study, the visibility to read the newspaper print was found to be adequate in all schools that is much higher than observed by Majra (30%).<sup>10</sup>

This may be because of better placement of windows in the schools of the study area. Per capita space for students in a classroom should not be <10 sq. ft.<sup>15</sup> In our study, 11 (22%) schools (31.6% government and 25.8% private schools (p value=0.498)) had inadequate space in the classrooms which is lesser than the finding of Joseph (33.3%) and Majra (90%).<sup>10-11</sup> The crowded classrooms affect the teaching-learning process which may pose difficulty in focused personalized teaching of every student in the class and maintaining discipline.<sup>20</sup>

Separate Minus sign desks and benches/chair with backrest are recommended for use in schools.<sup>15</sup> In our study, benches with backrest were observed in 28 (58.3%) schools which is higher than the findings of Joseph (37%) and Periyasamy (0%).<sup>11,12</sup> In our study, only one private school was found to be providing minus desk to their students. This is much lower than the other studies like Joseph, (23.3%), Nasim, (34%), and Periyasamy S (41%).<sup>11,12,21</sup> Children spend 80% of the school time in the classroom performing various activities. This requires them to sit continuously for long hours, therefore, lack of appropriate arrangements may lead to neck-shoulder pain and lower back pain.<sup>5,22</sup>

The provision of WASH facilities in school secures a healthy school environment and protects the children from illness and exclusion. Schools should have an independent source of safe and potable water supply, which should be continuous.<sup>23</sup> In our study, all schools had an adequate water supply. This is better than the findings of Majra (90%), AISES report (89.37%), Periyasamy (88.5%) and Javeed (30%).<sup>10,12,17,24</sup> In our study, all schools had sanitary drinking water storage facilities, while treatment of water was done in 34 (68%) schools which is better than the findings of Nasim (60%), Joseph (26.6%) and Periyasamy (0%).<sup>11,12,21</sup>

In our study, water treatment was observed to be more among private schools (83.9%) than the government schools (42.1%). Joseph reported a similar trend.<sup>11</sup> A low level of water treatment seen in the government schools put the children at risk of water-borne diseases like gastroenteritis, jaundice, typhoid, cholera, diarrhoea and hepatitis A. This can result in absenteeism and low academic performance.<sup>25</sup>

Every person in the school community should have access to adequate, clean and well-maintained toilets, which should be separate for staff as well as for gender.<sup>15</sup> Girls are particularly vulnerable to dropping out of school when toilets and washing facilities are inadequate. When schools have appropriate and gender-separated facilities, an obstacle to attendance is removed.<sup>26</sup> In our study, 29 (58%) schools had adequate toilets, which is better than Majra (50%), but worse than Joseph (66.7%).<sup>10,11</sup>

In this study, 33 (66%) schools had their toilets not being cleaned daily (94.7% government schools and 48.4% private schools (p value=0.000)), while Javeed found that

75% of the schools were not having their toilets cleaned.<sup>24</sup> In this study, 48 (96%) schools had separate toilet facilities for teachers/staff except for one private school from each rural school and urban school respectively which is much higher than other studies like 8th AISES (72.86%), Agbo (15.1%) and Kofoworade OO (14.1%).<sup>13,17,27</sup> In our study, all schools had separate gender-specific toilets. This is higher than the findings of Periyasamy (80.3%), Joseph (73.3%), Agbo (54.7%).<sup>11,12,27</sup>

Disposal bins must be placed within the toilet or very close by and must be ideally provided for each cubicle.<sup>28</sup> We observed that among 47 schools with female students, 18 (38.3%) schools had dustbin with lid, 16 (34%) schools had dustbin without lid and 13 (27.7%) schools (47.6% government and 16.7% private schools (p value=0.036)) did not have a dustbin in girls' toilet. In our study, sanitary disposal of menstrual absorbent was observed in 38.3% schools (25.9% rural and 55% urban schools (p value=0.042)). The problem of no dustbins was observed to be more by Javeed S, that only 95% of the schools had no dustbin available in the toilets.<sup>24</sup>

School is an ideal setting for teaching good hygiene behaviours which children can also carry home.<sup>29</sup> In our study, handwashing facilities were present in 48 (96%) schools which is much higher than Ade AD (81%).<sup>14</sup> In our study, five (10%) schools (0% government and 16.7% private schools (p value=0.06)) had the facility for handwashing with soap and water.

Similarly, Majra JP, Javeed S and Olatunya observed that handwashing facilities were pitiable in most of the schools, while Ade AD and Periyasamy S found that none of the schools in their study had soap for handwashing.<sup>10,12,14,24,30</sup> Handwashing with soap reduces the risk of diarrhoeal diseases.<sup>31</sup> Hence, WASH should be enforced in the schools to prevent sanitation-related illness among the children. In this study, garbage disposal practices were found to be insanitary in 48% schools (more among government schools than private schools and more in rural schools than urban schools (p value=0.000)).

The problem of insanitary disposal of waste was reported being much lesser as 6.7% by Joseph, 40% by Majra whereas as high as 80.5% by Kofoworade.<sup>10,13</sup> In our study, liquid waste disposal practices were found to be insanitary in 28 (56%) schools (more among government schools than private schools and more in rural schools than urban schools (p value=0.000)). The problem of insanitary disposal of waste reported much lesser as 30% by Majra, whereas as high as 80.5% by Kofoworade. Insanitary water disposal leads to water borne diseases and can cause a high burden on absenteeism.<sup>10,13,32</sup>

Observations, if considered, are likely to make a significant policy change. This study is based on a statistically adequate and representative sample. It



includes randomly selected government and private schools located in urban as well as rural areas. This study was conducted in only one district, so it may not represent the whole state or country. We chose one classroom randomly for environment component of schools but other classes in schools may show some variations.

## CONCLUSION

Our study shows that a lot has been done and much more is required to be done on the issue of the school environment and WASH conditions. A good number of schools were found to be falling short of several essential requirements regarding these facilities. School administration and concerned authorities need to identify and improve the deficiencies related to environment and WASH conditions in their respective schools for the health promotion of students.

Based on this study it is recommended to implement the guidelines related to the school building, ventilation and overcrowding in classrooms, ergonomically sitting facility, adequate number and gender-specific toilets, promotion of sanitary liquid, solid waste and menstrual waste disposal practices; and handwashing facilities in schools should be strictly adhered.

## Recommendations

The important points of reference on the posterolateral surface of the skull are asterion, inion, apex of the mastoid process and suprameatal crest. The objectives of the present study were to determine the type of asterion depending on the presence or absence of sutural bone, to measure the linear distances of asterion from various bony landmarks, the nearest distance of the same from sigmoid and transverse sinus and also the thickness at the centre of the asterion that may be of importance to anthropologists, anatomists, forensic pathologists and neurosurgeons.

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