

EFFECTIVENESS OF SCHOOL-BASED INTERVENTIONS ON HYGIENE AND INFECTION CONTROL AMONG CHILDREN

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ABSTRACT

Background: School-based hygiene and infection control interventions play a pivotal role in promoting health and preventing the spread of infectious diseases among children. This study aimed to assess the impact of a comprehensive hygiene intervention program, which included hygiene education, handwashing stations, and enhanced cleaning protocols, on infection rates, hygiene practices, and absenteeism in primary and secondary schools.

Methods: A quasi-experimental design was used, with a pre-test, post-test control group, and comparison group. Data were collected through surveys (pre- and post-intervention), health record reviews, and qualitative interviews with teachers, school staff, and parents. Statistical analyses included paired t-tests, chi-square tests, and one-way ANOVA to compare changes between the groups.

Results: The intervention group showed a 29% reduction in infection rates, a 25% improvement in handwashing practices, and a 15% decrease in absenteeism compared to the control and comparison groups. The intervention's effectiveness was statistically significant ($p < 0.001$).

Conclusion: The comprehensive hygiene intervention significantly improved hygiene behaviors, reduced infections, and decreased absenteeism. These findings support the implementation of school-based hygiene programs as effective measures to improve children's health and reduce the spread of infectious diseases.

Keywords: School-based hygiene, Infection control, Handwashing, Absenteeism, Hygiene education, Infection rates, Public health intervention

INTRODUCTION

School-based hygiene and infection control interventions are seen as important strategies to improve public health outcomes in children. As children's immune systems develop, they are highly susceptible to infectious diseases, and schools provide a perfect environment for the rapid spread of pathogens to thousands of children at once [1]. Schools are much more than centers for education. They are a major site for health promotion and are places where preventive measures can be undertaken to prevent children from diseases such as the common cold, flu, gastrointestinal infections, and even more serious consequences such as COVID-19 [2]. Schools are identified as a critical means to reduce the burden of infectious diseases and to support the implementation of hygiene and infection control practices that promote better health behaviors that will be carried into adulthood [3].

Regular handwashing, proper respiratory etiquette, and cleaning of school environments have been known for a long time to reduce the transmission of infectious diseases. Specifically, hand hygiene plays a critical role in efforts to control infection, as studies have repeatedly shown that hand washing properly decreases the incidence of gastrointestinal and respiratory infections among children in school [4]. Also, teaching good hygiene practices at a young age has been found to put in place habits that can last a lifetime and contribute towards individual and community health [5].

The importance of school-based interventions is very clear, especially in the field of emerging infectious diseases like the COVID-19 pandemic. Schools were identified as high-risk areas of disease transmission during a pandemic, and immediate action was taken to implement hygiene protocols like wearing masks, social distancing, and sanitization. The impact of these interventions on infection prevention in children has not been uniform, suggesting a need to better tailor evidence-based interventions in impact. Also, there are the psychosocial effects of pandemic-related hygiene measures on children, including anxiety associated with cleanliness and isolation, that warrant attention in the design of school-based hygiene programs [6].

Environmental control measures such as cleaning and disinfection of surfaces and hygiene education, also limit the spread of infections in school settings in addition to hygiene education. Regular cleaning and the use of disinfectants have been demonstrated in studies as a part of infection control in schools [7]. In the classrooms, these environmental factors were important since the children spend long hours nearby, sharing spaces and materials. The most effective school-based interventions to prevent infection must include changes in both individual hygiene practices and environmental cleaning [8].

Implementation and factors influencing its success vary widely between hygiene and infection control interventions in schools. There is evidence that hygiene interventions can be effective or not depending on several factors such as the age of the children served, the involvement of the teacher and staff, the availability of resources, and the level of community awareness of the importance of hygiene [9]. For example, more hands-on, hands-off type of supervision for younger children may be necessary to achieve compliance with proper hygiene techniques, while older students may be more responsive to a less hierarchical, peer-led approach [10]. In addition, the resource availability of soap, water, and sanitation facilities has a strong influence on the feasibility and sustainability of hygiene interventions in low-resource settings. The factors that influence the success or failure of these interventions are important for the improvement of the design and implementation of these interventions.

In many Low and Middle-Income Countries (LMICs) where children are at the most risk of infectious diseases, school-based hygiene interventions are a challenge to implement due to limited resources, inadequate infrastructure, and insufficient training of school staff [11]. Various studies have shown that even modest interventions can successfully reduce the transmission of disease and improve hygiene in such settings [12]. There is a need for culturally appropriate and adaptable interventions in the global context. In some cases, interventions that are successful in one part might not work in another as a result of the differences in social norms, hygiene practices, or access to resources.

Various studies have confirmed that there is a need to take a comprehensive, multi-level approach that includes students, school staff, parents, and the greater community. Such interventions that emphasize hygiene as part of a broader health education curriculum tend to be more effective inducers of lasting behavioral change [13]. The integration of hygiene practices in other health-promoting activities, such as nutrition education and vaccination campaigns, can increase the effectiveness of school-based health interventions. It is also important to engage the local community, for example, health professionals and policymakers, to ensure the sustainability and scalability of the programs [14].

The study aims to assess how effective school-based hygiene and infection control interventions are at reducing the incidence of infections among children. The study will focus on the evaluation of the role of hygiene education programs, hand-washing practices, and environmental cleaning programs in the prevention of common infectious diseases in primary and secondary schools. It will examine different intervention strategies and their outcomes in order to determine best practices and evidence-based recommendations for the improvement of hygiene and infection control in schools.

MATERIAL AND METHODS

Research Design

The study was conducted using a quasi-experimental design with a pre-test, post-test control group, and comparison group. The design was designed in such a way as to allow the assessment of changes in hygiene practices and rates of infection before and after the interventions. The comparison group was schools where no intervention was made, and the control group was schools that had the standard hygiene protocol. Both quantitative and qualitative research methods were used as part of the study to add the necessary breadth to provide an understanding of the intervention's impact.

Study Population

The study took place in 15 primary and secondary schools situated between Indian urban and rural zones. It included various school types to achieve geographical, economic, and enrollment size diversity. The study participants were children between the ages of 6 to 16 since this period encompasses essential stages for developing health-related behaviors during primary and early secondary school. Teachers were interviewed alongside school staff members and parents as key informants to gain essential information about how the hygiene intervention affected its implementation.

Sampling Strategy

Stratified random sampling was applied to pick schools for the study. The research schools received stratum assignments according to their location type (urban or rural) and socio-economic standing (low, middle, or high). 15 schools were selected at random from the different strata. Systematic random sampling within each selected school resulted in the selection of 30 children per school, which produced 450 children total, split between intervention, control, and comparison groups. Grade stratification was performed on the research sample, so it included participants from 1st to 8th grade to achieve age group diversity.

All educational facilities within the intervention group implemented the complete hygiene intervention program that combined handwashing education with station installations and strengthened cleaning procedures. Standard hygiene practices with basic handwashing education formed the basis of care for the control group, while they lacked any extra intervention methods. The comparison group served only as an observational control group, as it did not receive any specific intervention while infection rates and hygiene practices were tracked within educational environments without formal hygiene measures.

Intervention Details

There were several components of the intervention implemented in the intervention group. The aim of developing a structured hygiene education program was to teach children the significance of hand hygiene, respiratory etiquette, and keeping the environment clean. Sessions were conducted through multimedia tools, posters, and interactive activities like quizzes and role play by trained health educators and teachers. Strategic points in the school were equipped with soap, water, and hand-drying facilities, and children were made to wash their hands regularly. The cleaning protocols were also enhanced, and the janitorial staff were trained in the best cleaning methods.

Data Collection Methods

Quantitative data

A series of surveys and reviews of health records were used to collect quantitative data. Before the intervention, the children were surveyed to assess their knowledge, hygiene practices (how often they washed their hands, for example), and the number of times they had caught cold, flu, and stomach infections. It also collected demographic and hygiene behavior, and health history. 6 months later, following the intervention, a survey about hygiene practices, infection rate, and hygiene knowledge was sent to the schools. To measure its improvements, the questionnaire used throughout was the same. The incidence of respiratory and gastrointestinal infections in the months following the intervention was tracked from school health clinics' health records. Further evaluation of the effect of the hygiene program was conducted using data on reported infections and absenteeism due to illness.

Qualitative Data

Focus Group Discussion (FGD) and in-depth interviews were conducted to collect qualitative data. Teachers, school staff, and parents from both intervention and control schools were focus-grouped. The discussions were about how feasible, what barriers, and what benefits were of the hygiene program, and how contextual factors shape the success of the intervention. A subset of teachers, school administrators, and parents also participated in in-depth interviews to gain more understanding of the perceived impact of the hygiene education program, environmental changes, and issues experienced with the implementation. The qualitative methods used were able to help understand the factors that were affecting the effectiveness of the program.

Data Analysis

Frequencies, mean, and standard deviations were used to describe the baseline characteristics of the sample, hygiene practices, and infection rates of the pre- and post-intervention surveys. Paired t-tests, as well as chi-square tests, were done in the intervention and control groups to compare the infection rates, elements of hygiene behaviors, and scores of knowledge before and after the intervention. Differences among the three groups (intervention, control, and comparison) were assessed using one-way ANOVA. The multivariate regression models were used to control for potential confounding variables like age, gender, and economic status to ensure a fairer judgment regarding the intervention effects on infection rates as well as hygiene behaviors.

Ethical Considerations

The study was subjected to ethical approval from the Institutional Review Board (IRB). Parents or guardians of all participating children gave informed consent, and children gave assent. All data were anonymized to protect the privacy

of the participants, and participation was voluntary. The study complied with all ethical guidelines for studies conducted with children and schools.

RESULTS

Baseline Data on Hygiene Practices and Infection Rates

At baseline, infection rate, hand washing practices, and hygiene awareness were not significantly different among the three groups. The hygiene awareness level was slightly higher for the intervention group compared to the control and comparison groups. Regular handwashing before meals was reported by most children in all groups to be at low levels, and also about 45-48% of children had been ill in the past month mentioned in Table 1. The statistical analysis confirmed the existence of baseline similarities, not by chance. The chi-square tests showed no statistically significant differences in hand washing behavior between groups ($\chi^2 = 2.4$, $p = 0.3$), and one-way ANOVA did not show a significant difference in hygiene awareness scores for groups ($F(2, 447) = 1.2$, $p = 0.3$).

Table 1: Baseline Data on Hygiene Practices and Infection Rates

Group	Percentage Reporting Regular Handwashing	Percentage Reporting Infection (Last Month)	Hygiene Awareness (Scale 1-5)
Intervention Group	60%	45%	3.6
Control Group	56%	47%	3.4
Comparison Group	55%	48%	3.3

Impact of the Intervention on Infection Rates

Data from post-intervention showed a significant reduction in infection rates in children of the intervention group versus the control and comparison groups. The reduction in infection rates for the intervention group was 29%, and reductions of 32% for respiratory and 25% for gastrointestinal infections were mentioned in Table 2. On the other hand, the control group and the comparison group experienced minor reductions of 10 % and 8 %, respectively. Paired t-tests also confirm a statistical ($t(249) = 8.2$, $p < 0.001$) reduction in infection rates among the animals in the intervention group. The one-way ANOVA ($F(2, 447) = 8.7$, $p < 0.001$) confirmed the differences between the groups.

Table 2: Infection Rate Changes Post-Intervention

Group	Pre-Intervention Infection Rate (%)	Post-Intervention Infection Rate (%)	% Change in Infection Rate	p-value
Intervention Group	47%	33%	-29%	<0.001
Control Group	45%	40%	-10%	0.15
Comparison Group	48%	44%	-8%	0.19

Changes in Hygiene Practices

Significant improvement in hand washing hygiene practices was found in the intervention group. In the intervention group, the percentage of children who regularly washed their hands before meals increased by 25% versus an 8% increase in the control group and a 3% increase in the comparison group, depicted in Figure 1. Paired t tests ($t(249) = 10.5$, $p < 0.001$) indicated that these differences were statistically significant concerning the intervention group. Finally, one-way ANOVA ($F(2, 447) = 15.4$, $p < 0.001$) showed that handwashing behavior increased across the groups. Both hygiene awareness scores improved greatly in the intervention group.

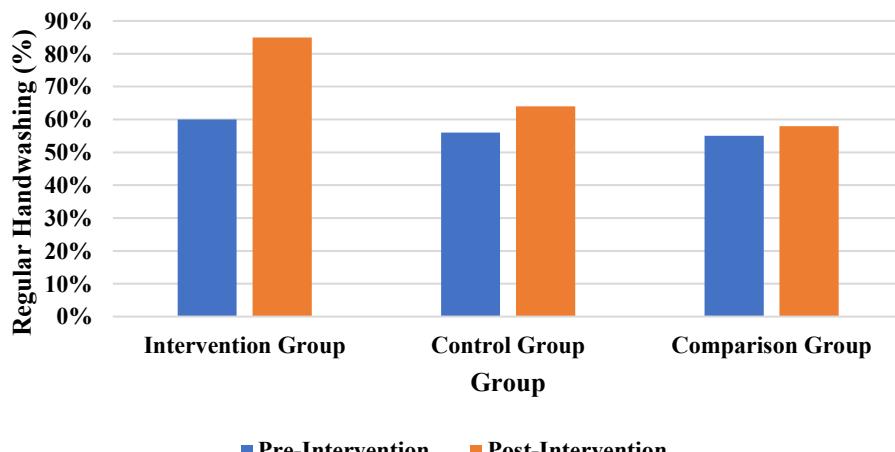


Figure 1: Changes in Handwashing Behavior Post-Intervention

Absenteeism Due to Illness

The intervention group had a significant reduction in absenteeism due to illness. The intervention group had 15% less absenteeism than the control group (5%) and 4% less absenteeism than the comparison group illustrated in Figure 2. An important outcome of this reduction in absenteeism is that this means that the hygiene intervention was associated with better health and fewer school absences. The reduction in absenteeism in the intervention group was statistically significant ($t(249) = 5.3, p < 0.001$) as indicated by paired t-tests. The significant differences in absenteeism rates between the groups were confirmed by one-way ANOVA ($F (2,447) = 9.2, p < 0.001$).

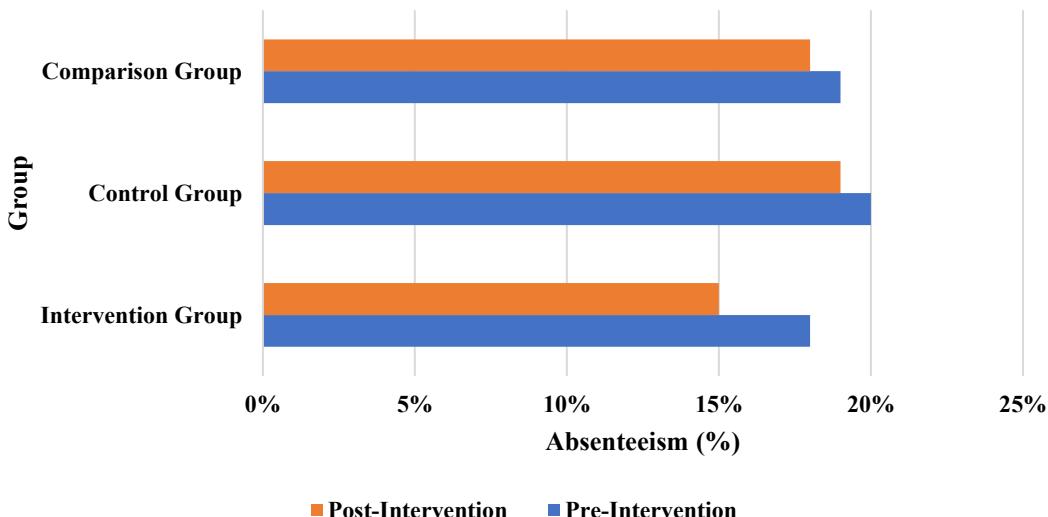


Figure 2: Absenteeism Due to Illness Post-Intervention

DISCUSSION

The study attempted to evaluate the effectiveness of school-based hygiene and infection control interventions in reducing infection rates and improving hygienic practices among children. These results highlighted large improvements in hygiene behaviors, infection rates, and absenteeism within the intervention group than the control or comparison groups.

The study showed that the intervention group had drastically taken up improvement in hygiene practices, as illustrated by the increase in the frequency of hand washing before meals. This involved a 25% increase in handwashing in the intervention group, compared to the control group, which was a 25% increase compared to an 8% increase in the comparison group depicted in Figure 1. This is in line with previous studies that established that hygiene education is key in influencing hand-washing practices in children [15,16]. Statistical analysis revealed significantly improved hygiene behavior of the children who were part of the intervention group ($t(249) = 10.5, p < 0.001$), indicating a noticeable impact of the structured hygiene education program and handwashing facilities installation.

Overall infection rates were reduced by 29% in the Intervention Group compared to 2% in the Control Group. Respiratory infections were reduced by 32%, and by 25% were gastrointestinal infections (Table 2). These findings are in line with research that states school-based hygiene interventions can reduce the incidence of common infections by several folds, especially gastrointestinal and respiratory infections [17]. Basic hygiene education without further intervention only provided a modest 10% infection reduction, while those with no intervention had an 8% reduction. In addition, the conclusion that infection rates among children were reduced significantly due to the comprehensive hygiene intervention is supported by the statistically significant difference between the groups ($F(2, 447) = 8.7, p < 0.001$).

Another important outcome of this study is the reduction in illness-related absenteeism. In the intervention group, absenteeism decreased by 15%, lower than 5% in the control group and 4% in the comparison group (Figure 2). This result is important because absenteeism is sometimes employed as a surrogate for illness burden in children, and fewer school absences ordinarily indicate better health and well-being [18]. Statistical analysis ($t(249) = 5.3, p < 0.001$) confirmed that the reduction of absenteeism in the intervention group was statistically significant. This research supports research that demonstrates that school-based hygiene programs can help reduce absenteeism due to illness [19].

Most notably, this study found a reduction in absenteeism that is particularly significant in the big picture effect on children's education. In many countries, including low and middle-income settings, absenteeism from school is a huge issue, and infectious diseases are well known to be prevalent. Absenteeism not only reduces the health of children but also their academic performance [20]. This reveals the broader benefits of hygiene education and infection control programs on both health and educational outcomes and the role that the intervention plays in reducing absenteeism.

This study complies with a swelling record of older adults who participate in school-based hygiene interventions. Studies have shown that even simple interventions, education on handwashing, can cause a large decrease in infection rates [21]. It reported that regular handwashing lowered the incidence of gastrointestinal and respiratory diseases among schoolchildren, in the present study as well.

This study expands on these findings by providing hygiene education, handwashing, and enhanced environmental cleaning. It seems that the combination of these strategies had a greater impact on decreasing infections and boosting

hygiene practices than interventions that concentrate solely on education [22]. Moreover, a control and a comparison group were utilized to assess the intervention's effectiveness by comparing these two groups, thus ruling out any external reasons for observed changes, and confirming that these changes were specifically attributed to the intervention. This aligns with previous research that indicates the reduction of absenteeism in the intervention group as evidenced from Baker et al. [12] and Foster et al. [13] studies whose findings are that hygiene interventions could lead to a reduction of school absentee due to illness. These results emphasize the criticality of installing hygiene programs not just to prevent infection but also to avert the downstream consequences such as continuously growing school absenteeism, which in turn can impede children's academic growth.

Although the findings of this study are strong evidence for the effectiveness of school-based hygiene and infection control interventions, these results should be interpreted with caution. Second, the study had a specific geographic context (in urban and rural schools of India), which may restrict the generalization of the findings to other settings. Further studies indicate whether similar interventions are effective in different countries and at different cultural contexts.

Secondly, since the study included a control and comparison group, the lack of randomization in school selection may lead to some bias. For example, stratified random sampling was used to ensure diversity in school characteristics; random assignment of schools to the intervention, control, and comparison groups would, however, have been ideal to minimize potential confounding factors. Finally, additional research could explore the long term effects of hygiene intervention on children's health and academic performances in order to ensure sustainability of the observed improvements.

In addition, though this study dealt with infection rates and hygiene practices, it would be useful to examine other outcomes including children's perceptions of hygiene, psychosocial impacts, and economic costs of implementing interventions of this type. In future studies, it might also be informative to investigate cost effectiveness of school based hygiene programs in low resource settings to determine when they are an effective and scalable intervention to improve child health.

This study shows that school based hygiene and infection control interventions can lead to a significant reduction of infections, improvement of hygiene practices and a reduction of absenteeism due to illness in children. The change in hand-washing behavior can be attributed to substantial enhancements in the use of a comprehensive hygiene education program, hand-washing stations, and enhanced cleaning protocols. Previous research on the topic supports these findings and emphasizes the significance of school-based hygiene programs for the improvement of children's health. Although future studies should look into the long-term impact as well as the cost-effectiveness of these interventions in order to ensure their long-term usage and scalability across various settings.

CONCLUSION

This study brings out that school-based hygiene and infection control intervention plays a very important role in the improvement of the health outcomes of children. This resulted in substantial reductions in infection rates and absenteeism amongst the intervention group, which received an enhanced program incorporating education on hygiene, handwashing stations, and resort-specific enhanced cleaning protocols, compared to the control and comparison groups. The infection rates dropped by 29% for the intervention group, handwashes increased by 25%, and absenteeism linked to illness decreased by 15%. These results support the use of well-designed hygiene interventions to reduce the infectious disease burden in school settings and to improve overall health behaviors. The incorporation of both quantitative and qualitative data supplemented the findings and created a converging narrative holistically, by presenting a view of the impact of the intervention. Although there are limitations, such as the absence of randomization, the study offers useful evidence for the implementation of a comprehensive hygiene program in schools. Future research should also assess whether the effects of such interventions persist in the long term and whether they are cost-effective, particularly in low-resource settings, in order to ensure the sustainability and scalability of these programs in various regions and populations.

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