

## **The Effectiveness of Handwashing Health Education Session on Raising School Children's Knowledge and Skills of Proper Handwashing Technique. a Pre test- Post Test Design**

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### **Abstract**

*Background:* Hand washing is one of the core interventions to prevent diarrhea and pneumonia among children and is the single and only cost-effective intervention.

*Objective:* The main objective of this study is to evaluate the effectiveness of handwashing health education session on raising school children's knowledge and skills of proper handwashing technique.

*Methods:* The study design will be a quasi-experimental pre test- post test single group design. A sample of 108 school children studying in primary grade 4, and 5 at two Public schools (One urban: Gacurabwenge primary school and one rural school: Kibali primary school) in Northern Province participated in the study after a stratified systematic sampling. The study was done in October 2016 and data were analyzed in SPSS version 16.0 using paired t-test for normally distributed data and Wilcoxon rank test for data which were not normally distributed. The mean score was computed and theoretical and skills score were categorized as excellent (80-100%=16-20), very good (70-79%=14-15.9), good (60-69.9%=12-13.9), fair (50-59%=10-11.9) and poor (0-49%=0-9.9)

*Results:* In urban school, the results of pretest theory revealed that 70.4% had excellent knowledge, 11.1% had very good knowledge. The post test theory in the same school was 70.4% for excellent knowledge, 18.5% for very good knowledge. The difference between theory pretest and posttest in urban school was statistically significant ( $p=0.007$ )

The results of pretest theory in rural school were different from those found in urban school with only 27.8% with excellent knowledge, 37% with very good knowledge. The post test theory for the same school was 48.1%, 40.7% for excellent and very good knowledge respectively. The difference between theory pretest and posttest in rural school was statistically significant ( $p<0.001$ )

There was a significant increase in handwashing skills from pretest to post test in both urban and rural school. In urban school the pretest revealed 22.22% of school children with excellent handwashing skills, and in post test almost all (94.4%) school children in urban school demonstrated excellent skills of handwashing. The difference between pretest and post test skills was statistically significant ( $p<0.001$ ). In rural school, the same difference has been found from pretest to post test handwashing skills; in pretest, only 9.26% of school children had excellent handwashing skills and in posttest in the same school, all school children (100%) had excellent handwashing skills and the difference between pretest and post test skills was statistically significant ( $p<0.001$ ).

*Conclusion:* Handwashing health education was effective to increase the knowledge and skills of school children regarding proper technique of handwashing in urban and rural public primary school and there is a need to teach other school children the detailed technique of handwashing with emphasis on those studying in rural area as their baseline handwashing knowledge and skills are poor compared to urban school children.

**Keywords:** Effectiveness, handwashing, school children, health education, knowledge, skills.

## **Introduction**

### **Background**

The World Health Organization (WHO, 2016) states that diarrhea causes 760,000 deaths in children with around 1.7 billion diarrhea-related morbidity every year, globally. The Center for disease control and prevention (CDC, 2013) approximated that diarrhea kills 2,195 children every day around the World. In Rwanda, in 2011, diarrhea was the second leading cause of death in children and 80% of disease burden in Rwanda was linked to poor hygiene and sanitation (United Nations Children's Funds (UNICEF), 2011). Rwanda's aim is to reduce the prevalence of diarrhea among children from 13% in 2010 to 9% by 2018 through efforts in promotion of handwashing practices with special focus in school-going children (Rwanda Ministry of Health, 2014)

Hand washing is one of the core interventions to prevent diarrhea and pneumonia among children and is the single and only cost-effective intervention (CDC, 2013; Maternal and Child Survival Program (MCSP), 2015). Hand hygiene is a fundamental way to prevent infection as in most feco-oral infections, hands are an important vector. If handwashing is done effectively, it becomes an important measure to limit the spread of microbes (CDC, 2009; Nair, Hanumantappa, Gurushantswamy, Siraj, & Raghunath, 2014; WHO, 2015). Encouraging handwashing habits among children is comparable to the anti-diarrheal vaccine and can prevent diarrhea-related illness and deaths (UNICEF, 2012)

One study in India revealed that many children do not always use soap when they are washing hands and almost half (47.3%) never used soap (Ray, Amarchand, Srikanth, & Majumdar, 2011). When hands are washed with soap, children's diarrhea death would be decreased by 47% (UNICEF, 2011). Education about proper hand hygiene reduces the occurrence of diarrhea in children by half. Proper handwashing before eating and after using the bathroom/toilet can reduce exposure to germs and improve children's development and welfare (CDC, 2013).

In 2012, the UNICEF reported that in Rwanda, only two per cent of the population practice handwashing in urban and rural areas (UNICEF, 2012)

In Rwanda, the Rwanda village concept project (RVCP) conducted handwashing education sessions in primary schools in Southern province and helped children to learn how to wash hands and maintaining their body healthy (Global Giving, 2013).

### **The problem statement**

The presence of *Escherichia coli* (*E. coli*) on hands after hand washing in school children when they came from the toilet (Saboori, Greene, Moe, Freeman, Caruso, Akoko, & Rheingans, 2013) can be resulted from improper hand washing and there is a need to teach school children the detailed technique of handwashing.

In Rural Kenya, Patel, Harris, Juliao, Nygren, Were, Kola, ... Quick, 2012) trained teachers on handwashing in order to transmit the information to students. In Rwanda, little is known about the effectiveness of handwashing education program in school children; thus in this study, the training was given to school children themselves allowing them to directly observe the proper handwashing technique and be able to do a return demonstration.

### **The significance of the study**

The curriculum and health education sessions focused on raising children's awareness and knowledge of the importance of handwashing and proper handwashing, but few studies focused on the skills and practice of proper handwashing technique. Many studies used the simple handwashing technique with wet the hands, put on the soap, rub the hands together, rinse and dry (Harrison, 2012; Mahmud, Spigt, Bezabih, Pavon, Dinant & Velasco, 2015). The purpose of this study is to evaluate the effectiveness of theoretical and practical health education session on knowledge and practice of the proper handwashing technique of school children; thus after this study, the children should know how to wash their hands and practice

the proper handwashing technique which will contribute to the reduction of feco-oral transmissible infections.

### **Research question**

Is one hand washing health education session effective to raise the knowledge and practice of proper handwashing technique of school children in Rwanda?

### **Objectives**

#### **General objective**

The main objective of this study is to evaluate the effectiveness of the proper handwashing technique on raising knowledge and skills of school children in the effective handwashing technique.

#### **Specific objectives**

The specific objectives of this study are:

To identify handwashing knowledge and skills of school children before the intervention i.e. 30 minute theoretical health education session and skills demonstration of proper handwashing technique.

To identify handwashing knowledge and skills of school children after the intervention i.e. 30 minute theoretical health education session and skills demonstration of proper handwashing technique.

To determine if there is a difference between the pretest and posttest scores of children after receiving theoretical health education session and practical health education session and compare the knowledge and skills of proper handwashing technique of school children in urban and rural Public school.

### **Methods**

#### **Study area**

The study area was composed of two public schools (one urban: Gacurabwenge primary school, and another one located in rural area: Kibali primary school) located in Byumba sector, Gicumbi district of the Northern Province in Rwanda.

#### **Study design**

The design of this study was a quantitative quasi-experimental pretest-posttest design. The pretest-posttest study design is appropriate to evaluate the effectiveness of an intervention by comparing the baseline results before the intervention (pretest) with the results after the intervention (post test). It shows that the outcomes resulted from the intervention and not the previous knowledge of the participants. There was no control group.

#### **Study population**

The target population was the primary school children studying in grade 4 and 5 attending two public schools (one urban school and one rural school) in Byumba sector of Northern Province, Rwanda.

#### **Sample size and sampling**

The sample will be composed of 108 primary school children. A hundred and eight pairs are sufficient in pretest-posttest study which uses paired t-test in analysis with  $\alpha$  of 0.05, power  $(1-\beta)$  of 0.9, estimated paired mean difference to be detected: 0.5 and expected standard deviation of 1.5 (<http://biomath.info/power/prt.htm>). The sample was obtained using a stratified systematic sampling with two strata: grade 4 and grade 5. Twenty seven children were included in each stratum in each school using a systematic sampling where number 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53 on each classroom students list with signed consent forms and assent forms was included in the

sample. If one or another child do not want to participate or was not available, then a child with a following odd number on the list was included and participated in the study.

### **Inclusion and exclusion criteria**

Primary school children studying in grade four and five who are at least nine years old were included in the study; the children in these grades have the capabilities to follow the WHO steps of handwashing. Excluded were students in grade one, two, three, six, seven, eight, nine and above. Children whose age is less than nine years were also excluded from the study.

### **Data collection tools and procedures**

The WHO detailed steps of handwashing composed of 10 steps (from step 0 to step 9) were used to test children's prior skills of handwashing technique and also were used after the intervention to evaluate the outcome of health education session.

Data were collected in two public primary schools (one urban school: Gacurabwenge and one rural school: Kibali). Data were collected in two separate days, one day for urban school, and one day for rural school. It was started by data collection of previous knowledge and skills of handwashing of children (pretest): 20 closed-ended questions with yes or no answers were used as a pre-test and post test where each correct answer values a score of one and the wrong answer values a score of zero. The pretest practical part was consisting of the observation of how children wash their hands, and the allocation of a score of two for each correct step of handwashing using WHO detailed steps of handwashing and score of zero for incorrect or missed step. The same questions and observation were used in posttest. The maximum total score was 20 in theoretical questions and 20 in practical part. The score for Knowledge and skills was ranged as Excellent: 80 -100%, Very Good: 70- 79%, Good: 60-69%, Fair: 50-59% and Poor: 0 - 49%.

Intervention: A health education session was consisting of theoretical part and insisted on the importance of handwashing and the consequences of not washing hands properly, the important moments of handwashing, materials used to ensure proper handwashing and the parts of the hands to focus on during handwashing and lastly the duration of the entire technique of handwashing. The theoretical education took 30 minutes which is effective in delivering handwashing instructions (Celik & Pancoe, 2012).

The WHO steps of handwashing (from step 0 to step 9) was used to teach the skills of handwashing and was the one to assess the learned skills after health education with 2 marks for each step. The following are the steps of handwashing according to WHO (2008):

- wet hands with water,
- apply enough soap to cover all hand surfaces,
- rub hands palm to palm,
- right palm over left dorsum with interlaced fingers and vice versa,
- palm to palm with fingers interlaced,
- backs of fingers to opposing palms with fingers interlocked,
- rotational rubbing of left thumb clasped in right palm and vice versa,
- rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa,
- rinse hands with water then,
- dry the hands with proper towel.

All materials were in Kinyarwanda, the vernacular language for Rwandans. The author and two assistants who are both registered midwives collected data. The assistants were trained to the same standard in handwashing as the author, and familiar with the pretest and post test data collection.

## Data analysis

The pretest and post test scores for each child were entered in the computer and children's scores were analyzed using paired t-test (for normally distributed data) and Wilcoxon rank test (for data which are not normally distributed). SPSS software version 16.0 will help in data analysis. The mean score was computed and theoretical and skills score were categorized as excellent (80-100%=16-20), very good (70-79%=14-15.9), good (60-69.9%=12-13.9), fair (50-59%=10-11.9) and poor (0-49%=0-9.9). The p value of 0.05 will be considered as statistically significant.

## Timeframe

Data collection was done in October, 2016 in two different days (one day for urban school, and one day for rural school) from 10: 00 A.M to 12: 30 PM.

## Ethical consideration

The study was approved by the Institutional Review Board (No 257/CMHS IRB/2016) of the College of Medicine and Health Sciences, University of Rwanda before data collection and the consent form and the assent forms were signed by the parents and children respectfully who voluntarily participated in the study. The school authority i.e. Head teacher in charge of school directorate also gave the written permission to conduct the study

## Limitations of the study

The study was conducted in two primary schools in one sector of Northern Province of Rwanda, so its effectiveness could not be generalized in children from other communities or to children aged less than 9 years.

## Results

### Descriptive Statistics

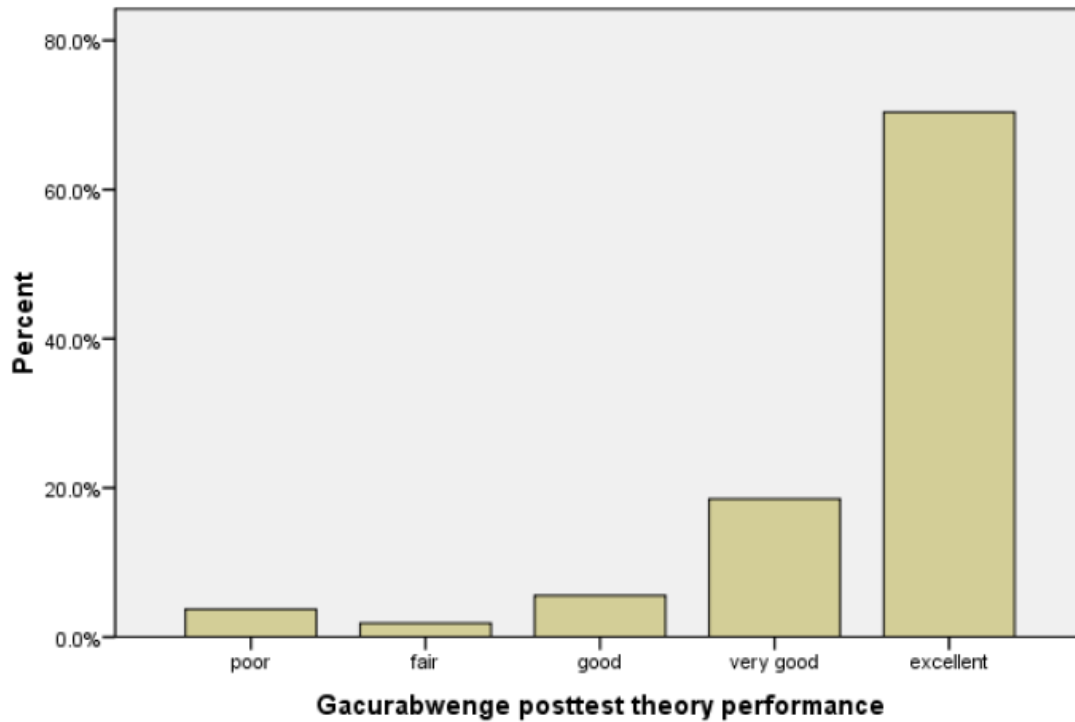
	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Gacurabwenge theory pretest	54	15.93	3.403	2	20	14.75	17.00	18.00
Kibali theory pretest	54	13.85	2.993	1	18	12.00	15.00	16.00
Gacurabwenge skills pretest	54	12.33	2.952	6	18	10.00	12.00	14.00
Kibali skills pretest	54	11.30	2.724	4	16	10.00	12.00	14.00
Gacurabwenge theory posttest	54	16.24	2.977	3	20	15.00	17.00	18.00
Kibali theory posttest	54	15.37	2.790	0	19	14.75	15.00	17.00
Gacurabwenge skills posttest	54	18.07	1.902	12	20	16.00	18.00	20.00
Kibali skills posttest	54	18.00	1.099	16	20	18.00	18.00	18.00

The median score during the theoretical pretest was 17 (IQR: 14.75-18) in urban school; while in rural school the median score was 15 (IQR: 12-16). The post test median score in

urban school remain 17 (IQR: 15-18); whereas in rural school, the median score of theoretical knowledge after the intervention was 15 (14.75-17) over 20 maximum score.

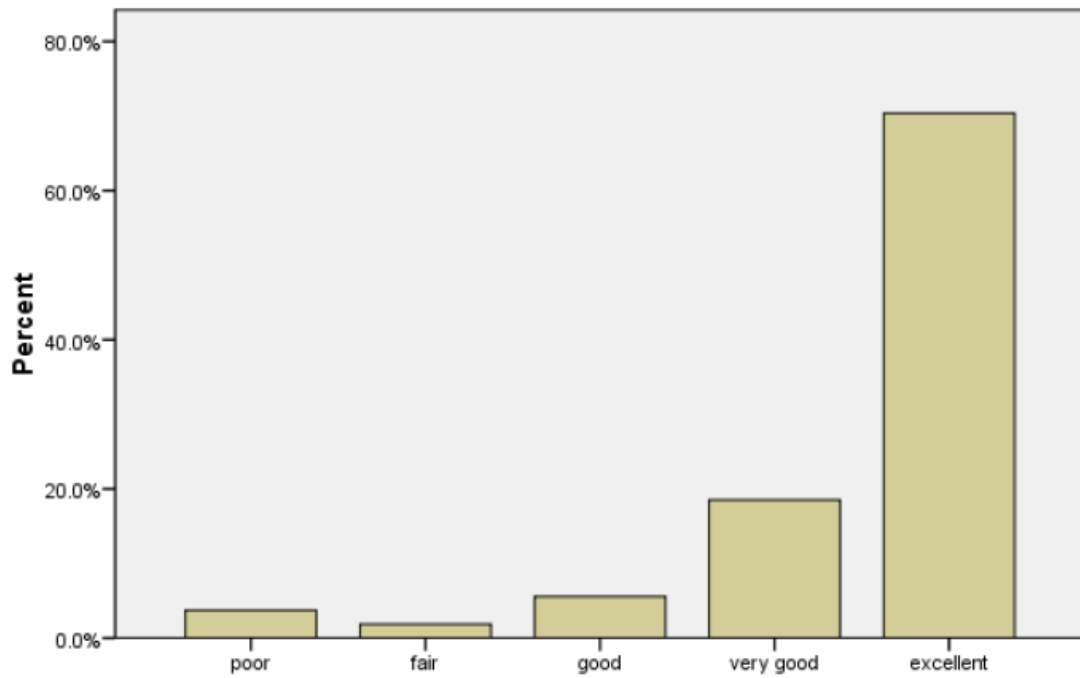
There is a significant increase in mean score of hand washing skills after demonstration from  $12.33 \pm 2.95$  to  $18.07 \pm 1.90$  in urban school and from  $11.30 \pm 2.72$  to  $18.00 \pm 1.09$  in rural school.

**Knowledge of handwashing in urban school after intervention**



This graph shows the baseline theoretical knowledge of school children studying in one urban school towards hand washing: 70.4% had excellent knowledge, 11.1% had very good knowledge, 9.3% had good knowledge, 3.7% had fair knowledge and 5.6% with poor knowledge.

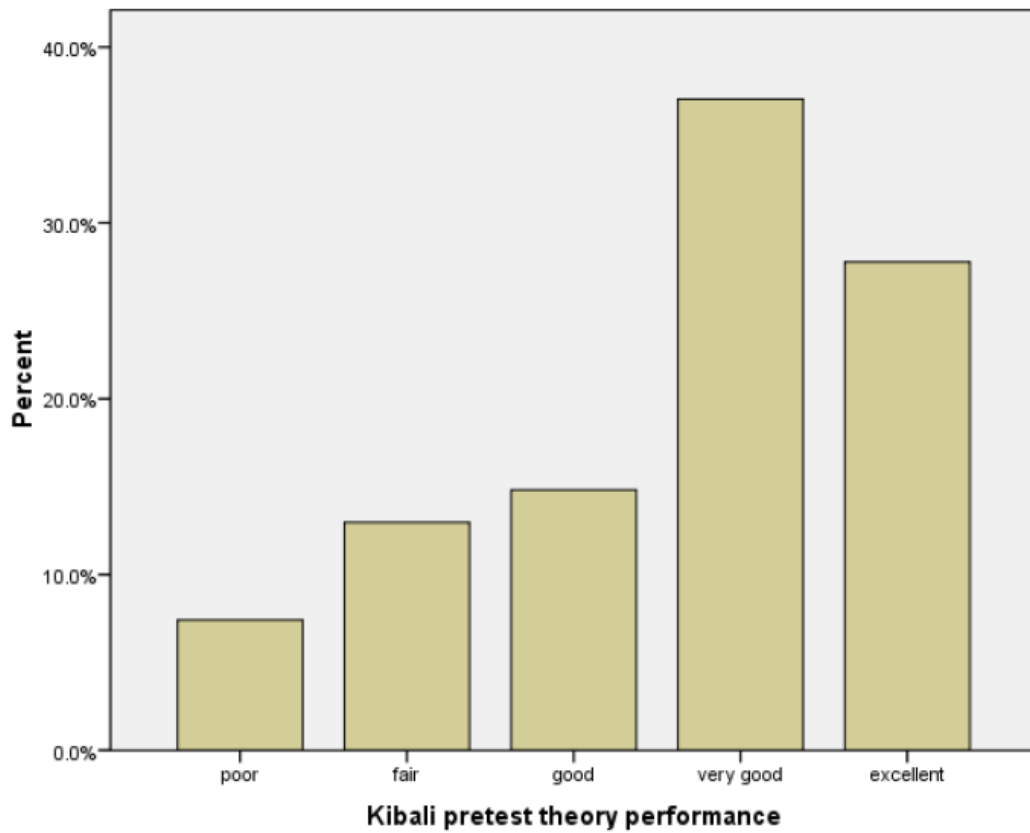
### Knowledge of handwashing in urban school after intervention



#### Gacurabwenge posttest theory performance

This graph shows the theoretical knowledge of school children studying in one urban school towards hand washing after receiving 30 minutes health education on handwashing: 70.4% had excellent knowledge, 18.5% had very good knowledge, 5.6% had good knowledge, 1.9% had fair knowledge and 3.7% with poor knowledge.

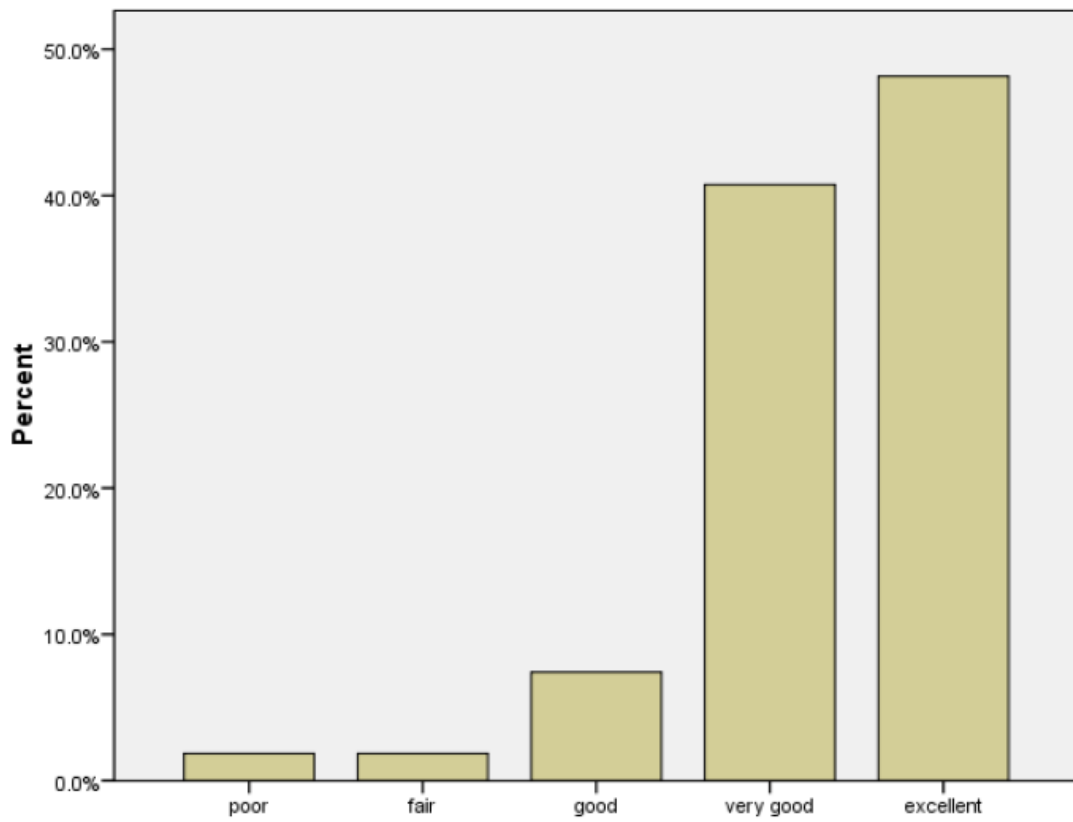
**Knowledge of hand washing in rural school before intervention**



This bar chart shows the knowledge of school children in rural school before 30 minutes theoretical health education on hand washing: 27.8% of school children had excellent knowledge before intervention (at baseline), 37.0% had very good knowledge before intervention, 14.8% had good knowledge. 13.0% and 7.4% had fair and poor knowledge respectively.



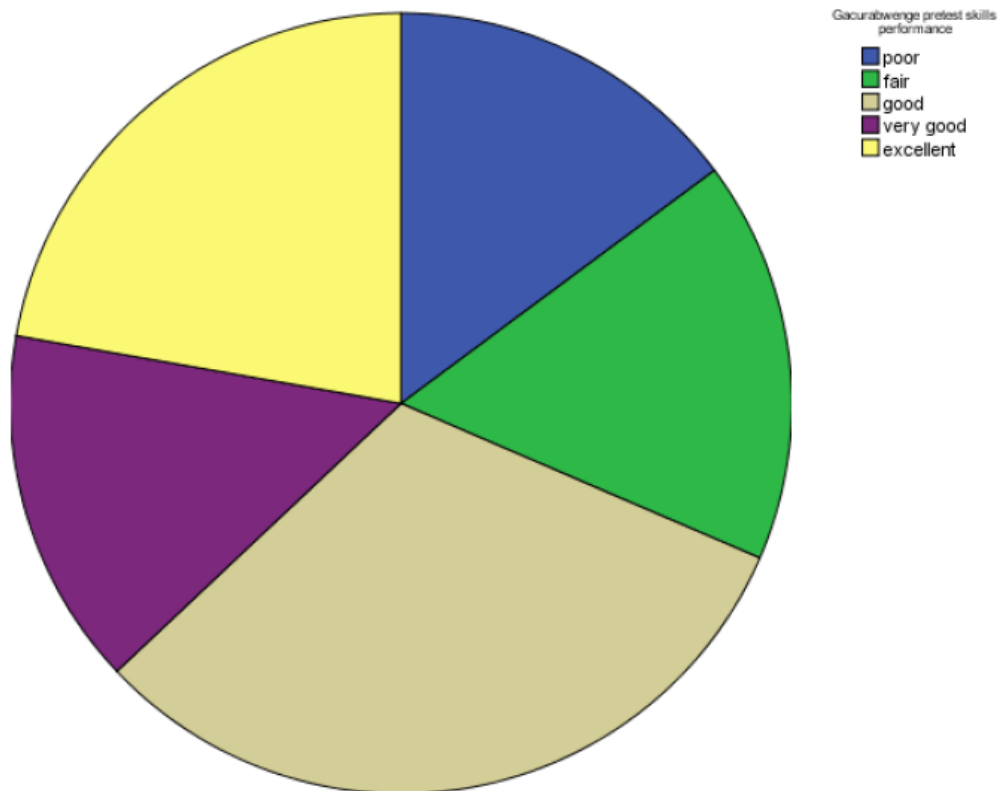
**Knowledge of hand washing in rural school after intervention**



**Kibali posttest theory performance**

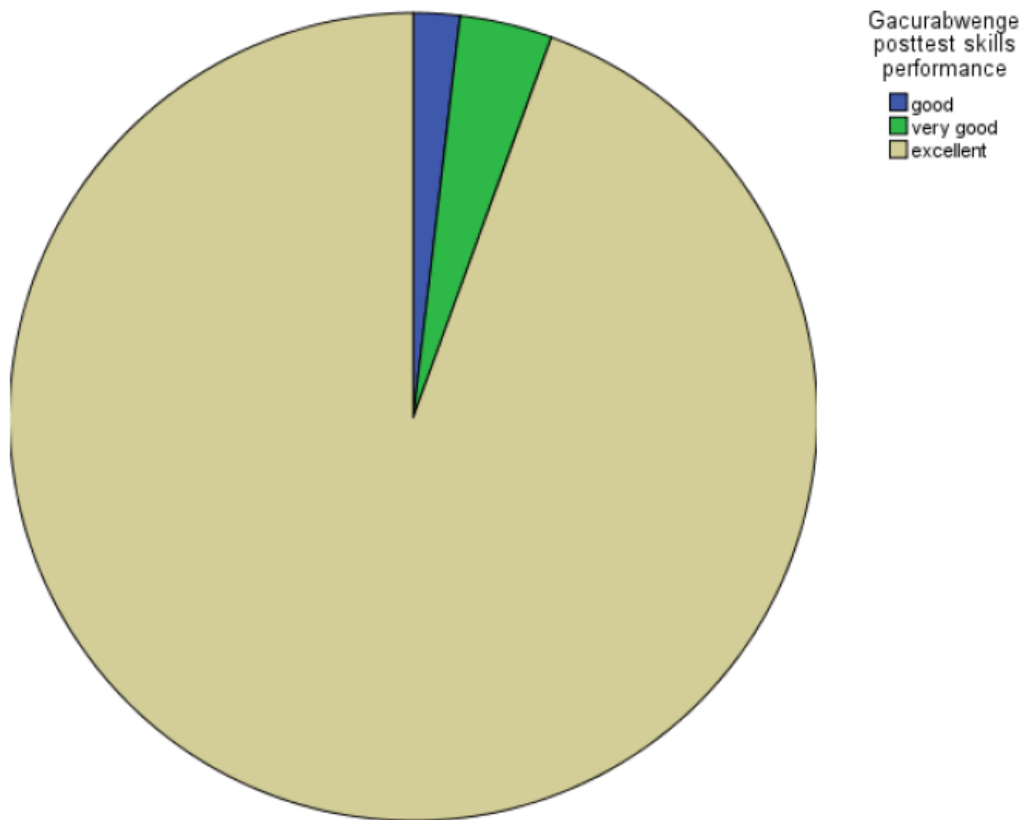
This bar chart shows the knowledge of school children in rural school after 30 minutes theoretical health education on hand washing: 48.1% of school children had excellent knowledge after intervention, 40.7% had very good knowledge after intervention, 7.4% had good knowledge, while 1.9% had fair knowledge and 1.9% had poor knowledge.

**Hand washing skills of school children before demonstration in urban school**



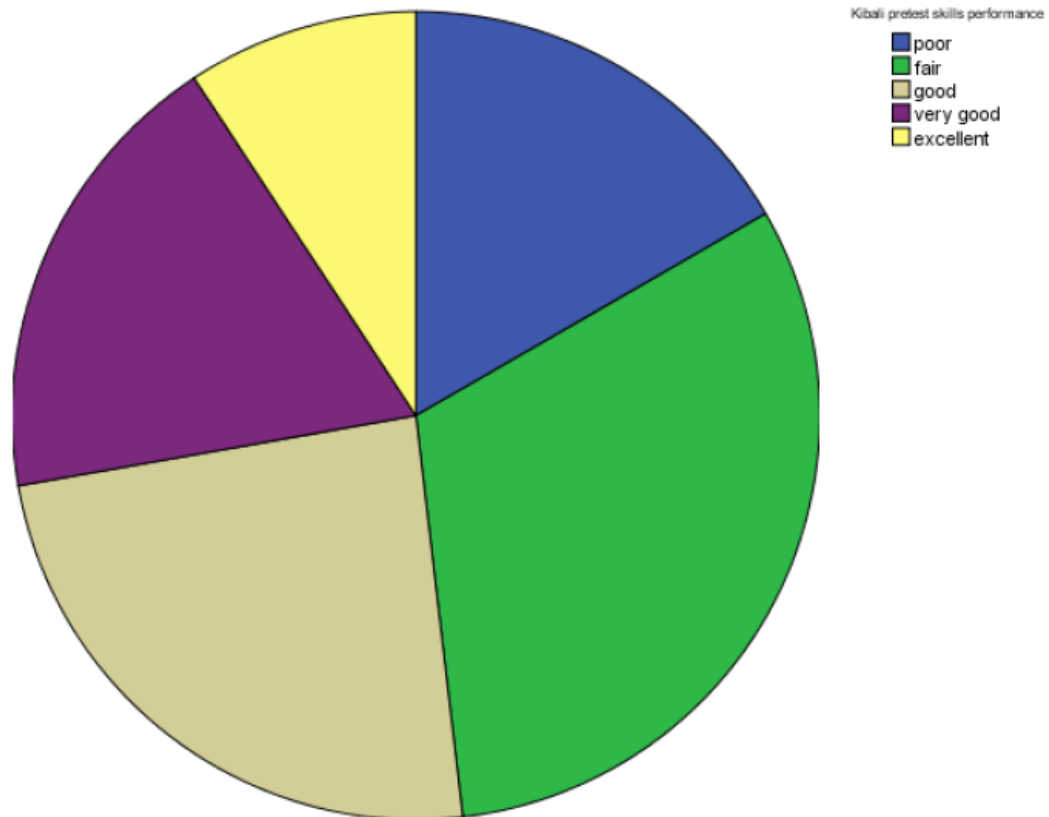
Before demonstration of proper technique of hand washing, 22.22% of school children in urban school had excellent handwashing skills, 14.81% had very good handwashing skills, 31.48% had good handwashing skills, 16.67% had fair handwashing skills and 14.81% had poor handwashing skills.

**Hand washing skills of school children after demonstration in urban school**



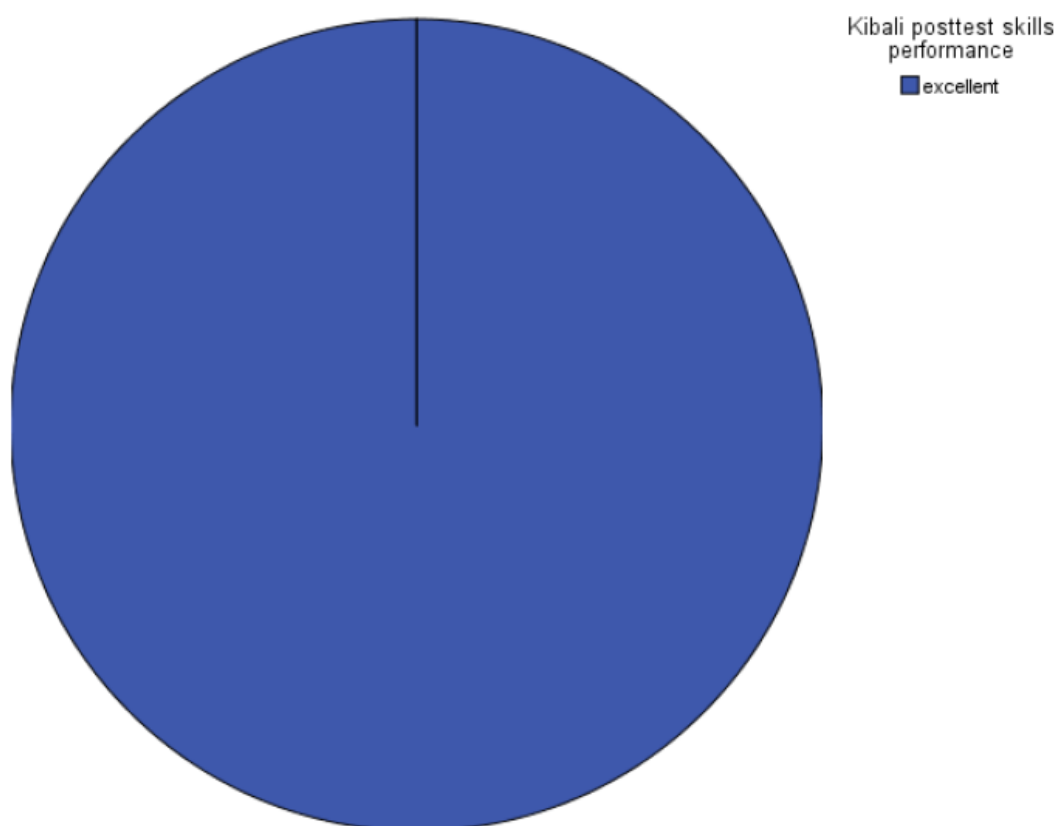
A high percentage of school children in urban school demonstrated the correct technique of handwashing after demonstration of the technique: 94.4% had excellent handwashing skills, 3.70% had very good handwashing skills, 1.86% had good handwashing skills after demonstration. No one demonstrated fair and poor handwashing skills after demonstration of the proper technique of handwashing.

**Hand washing skills of school children before demonstration in rural school**



Before demonstration of proper technique of hand washing in rural school, 9.26% of school children had excellent handwashing skills, 18.52% had very good handwashing skills, 24.07% had good handwashing skills, 31.48% had fair handwashing skills and 16.67% had poor handwashing skills.

**Hand washing skills of school children after demonstration in rural school**



All (100%) school children in rural school had excellent handwashing skills after demonstration and had significantly improved their handwashing technique compared with their skills before demonstration where only 9.26% had excellent knowledge.

**Difference between theory pretest and posttest in urban and rural school**

Test Statistics <sup>b</sup>		
	Gacurabwenge theory posttest - Gacurabwenge theory pretest	Kibali theory posttest - Kibali theory pretest
Z	-2.719 <sup>a</sup>	-4.545 <sup>a</sup>
Asymp. Sig. (2-tailed)	.007	.000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

There is a statistically significant difference between pretest theoretical score and posttest score in both urban school ( $p=0.007$ ) and rural school ( $p < 0.001$ ), and the post test scores are higher than the pretest scores.

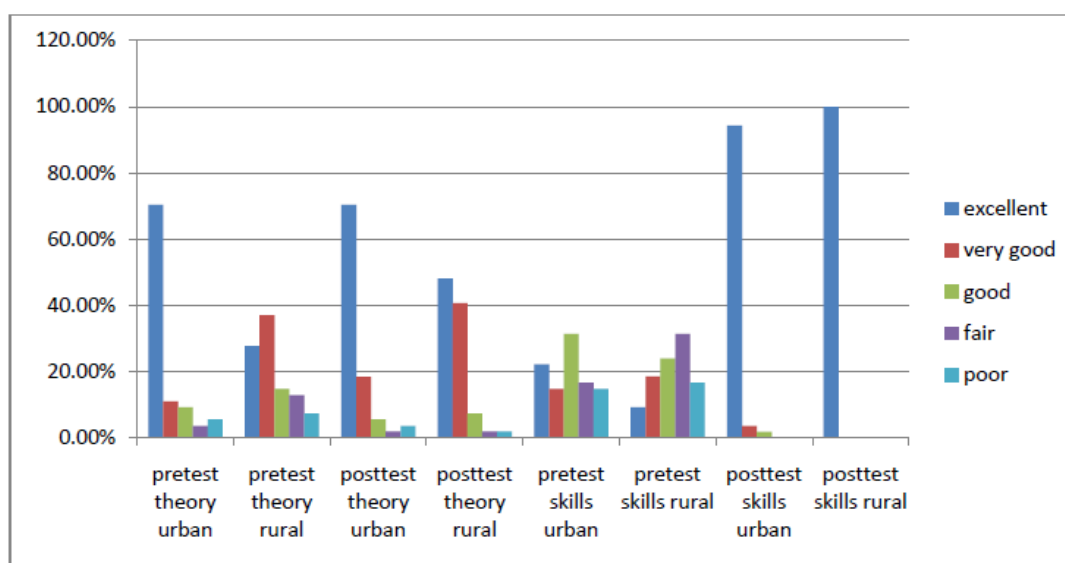
## Difference between handwashing skills pretest and post test in urban and rural school

### Paired Samples Test

		Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	Lower	Upper			
Pair 1	Gacurabwenge skills pretest - Gacurabwenge skills posttest	-5.741	2.748	.374	-6.491	-4.991	15.349	53	.000
Pair 2	Kibali skills pretest - Kibali skills posttest	-6.704	2.668	.363	-7.432	-5.975	18.464	53	.000

There is a statistically significant difference between pretest skills score and posttest score in both urban school ( $p < 0.001$ ) and rural school ( $p < 0.001$ ), and the post test scores are higher than the pretest scores.

### Comparison of pretest/posttest knowledge and skills in urban and rural school



This graph shows that 70.4% versus 27.8% excellent handwashing knowledge in urban and rural school during theory pretest, 70.4% versus 48.1% excellent handwashing knowledge in urban and rural school during theory post test. The same for handwashing skills the excellent pretest score was 24% in urban and 9.6% in rural school. This shows the difference in handwashing knowledge and skills in school children in urban and rural school. The excellent post test handwashing skills in both urban school and rural school were quite similar with high percentage in rural school (94.4% in urban and 100% in rural school).

### Discussion

This study found that in urban school, during pretest theory 70.4% had excellent knowledge, 11.1% had very good knowledge, 9.3% had good knowledge, 3.7% had fair knowledge and 5.6% with poor knowledge. The post test theory in the same school was 70.4%, 18.5%, 5.6%, 1.9% and 3.7% for excellent knowledge, very good, good, fair and poor

knowledge respectively. The difference between theory pretest and posttest in urban school was statistically significant ( $p=0.007$ )

The results of pretest theory in rural school were different from those found in urban school with only 27.8% with excellent knowledge, 37% with very good knowledge, 14.8% with good knowledge, 13% with fair knowledge and 7.4% with poor knowledge. The post test theory for the same school was 48.1%, 40.7%, 7.4%, 1.9% and 1.9% for excellent, very good, good, fair and poor knowledge respectively. The difference between theory pretest and posttest in rural school was statistically significant ( $p<0.001$ )

There was a significant increase in handwashing skills from pretest to post test in both urban and rural school. In urban school the pretest revealed 22.22% of school children with excellent handwashing skills, 14.81% with very good handwashing skills, 31.48% with good handwashing skills, 16.67% with fair handwashing skills and 14.81% with poor handwashing skills. In post test in the same school, after demonstration of proper technique of handwashing, almost all (94.4%) school children in urban school demonstrated excellent skills of handwashing. The difference between pretest and post test skills was statistically significant ( $p<0.001$ ). In rural school, the same difference has been found from pretest to post test handwashing skills; in pretest, 9.26% of school children had excellent handwashing skills, 18.52%, 24.07%, 31.48% and 16.67% had very good handwashing skills, good handwashing skills, fair handwashing skills and poor handwashing skills respectively, in posttest in the same school, all school children (100%) had excellent handwashing skills and the difference between pretest and post test skills was statistically significant ( $p<0.001$ ). This improvement in handwashing has been also found in one study done in India (Rubanprem Kumar, Aruna, & Sasikala, 2014)

School children in urban public school had baseline knowledge in handwashing theory; more than two third (70.4%) of school children at Gacurabwenge primary school had excellent knowledge before theoretical health education and the same percentage had excellent knowledge in posttest (after health education), whereas only 27.8% of school children in rural public school had excellent knowledge before health education. This is possibly due to lack of sources of information like media (radio, television...) and other means of communication in rural communities.

The percentage of school children who had excellent theory score has been similar in pretest and post test in urban school and has been increased from pretest to post test in rural school (20% increase) and there was a tremendous increase in excellent skills score from pretest to post test in both urban (72% increase) and rural school (90.7% increase), this is similar to the findings in Georgia, USA showing the ability of handwashing education on raising the knowledge of school children towards handwashing technique (Harrison, 2012). These findings showed that school children can follow the 10 steps of handwashing of the World health organization and be able to emphasize on critical areas of the hands where microbes may be hidden namely between fingers, in fingernails, therefore school children should be demonstrated how to wash their hands in details in order to eliminate the microbes, not just a routine of putting water and soap. The steps that are usually used by healthcare personnel (WHO, 2008) due to its effectiveness in eliminating germs on their hands can also be followed by a 9 years old child and be adopted as a better way of washing hands. This is confirmed by the post test skills performance in rural school where all the school children (100%) had excellent score (80-100%) after handwashing technique demonstration following a baseline of only 9.3% of excellent handwashing skills score.

## **Conclusion and recommendations**

Handwashing health education was effective to increase the knowledge and skills of school children regarding proper technique of handwashing in urban and rural public primary school and there is a need to teach other school children the detailed technique of handwashing with emphasis on those studying in rural area as their baseline handwashing knowledge and skills need more improvement compared to urban school children.

## References

- [1]. Abraham, C. (2015). Ideas for Exploring Handwashing. Good Health Is In Your Hands! Retrieved April 25, 2016, from <http://www.cdc.gov/handwashing/training-education.html>
- [2]. Assefa, M., & Kumie, A. (2014). Assessment of factors influencing hygiene behaviour among school children in Mereb-Leke District, Northern Ethiopia: a cross-sectional study. *BMC Public Health*, 14, 1000. doi:10.1186/1471-2458-14-1000
- [3]. Biran, A., Schmidt, W., Varadharajan, K. S., Rajaraman, D., Kumar, R., Gopalan, B., ... Curtis, V. (2014). Effect of a behaviour-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial. *The Lancet Global Health*, 2(3), e145–e154. doi:10.1016/S2214-109X(13)70160-8
- [4]. CDC. (2013). Improving child development. Retrieved from <http://www.cdc.gov/healthywater/global/index.html>
- [5]. CDC. (2013). Global water, Sanitation and hygiene. Global diarrhea burden. retrieved from <http://www.cdc.gov/healthywater/global/diarrhea-burden.html>. Retrieved from <http://www.cd.gov/healthywater/global/diarrhea-burden.html>
- [6]. Celik, L. a., & Pancoe, D. L. (2012). Healthy School Environment: Effectiveness of Hand Washing Instruction in an Elementary School Setting. *NASN School Nurse*, 27, 194–196. doi:10.1177/1942602X12444451
- [7]. Center for disease control and prevention (CDC). (2009). Vessel sanitation program. General information on hand hygiene. Retrieved from [www.cdc.gov](http://www.cdc.gov)
- [8]. Global Giving. (2013). strengthen hand washing to 800 children in Rwanda. Retrieved from <https://www.globalgiving.org/projects/clean-hands-to-save-lives/reports/?pageNo=1>
- [9]. Harrison, J. A. (2012). Teaching Children to Wash Their Hands – Wash Your Paws, Georgia Handwashing Education Initiative. *Food protection trends*, 32(3), 116–123.
- [10]. Ilechukwu, G., Ilechukwu, C., Ozumba, A., Ojinnaka, N., Ibe, B., & Onwasigwe, C. (2010). Some behavioural risk factors for intestinal helminthiasis in nursery and primary school children in Enugu, south eastern Nigeria. *Niger J Clin Pract.*, 13(3), 288–293. Retrieved from <http://hinarilogin.research4life.org/uniqueidwww.ncbi.nlm.nih.gov/uniqueid0/pubmed/20857787>
- [11]. Johansen, A., Denbæk, A. M., Bonnesen, C. T., & Due, P. (2015). The Hi Five study: design of a school-based randomized trial to reduce infections and improve hygiene and well-being among 6 – 15 year olds in Denmark. *BMC Public health*, 15, 207. doi:10.1186/s12889-015-1556-1
- [12]. Lee, R. L. T., Leung, C., Tong, W. K., Chen, H., & Lee, P. H. (2015). Comparative efficacy of a simplified handwashing program for improvement in hand hygiene and reduction of school absenteeism among children with intellectual disability. *American Journal of Infection Control*, 43, 907–912. doi:10.1016/j.ajic.2015.03.023
- [13]. Maternal and Child Survival Program. (2015). Water, Sanitation and Hygiene (WASH). Retrieved from <http://www.mcsprogram.org/our-work/water-sanitation-and-hygiene-wash/>
- [14]. Nair, S. S., Hanumantappa, R., Gurushantswamy, S., Siraj, M. A., & Raghunath, P. (2014). Knowledge, Attitude, and Practice of Hand Hygiene among Medical and Nursing Students at a Tertiary Health Care Centre in Raichur, India. *ISRN Preventive Medicine*, 2014. doi:doi.org/10.1155/2014/608927
- [15]. Patel, M. K., Harris, J. R., Juliao, P., Nygren, B., Were, V., Kola, S., ... Quick, R. (2012). Impact of a Hygiene Curriculum and the Installation of Simple Handwashing and Drinking Water Stations in Rural Kenyan Primary Schools on Student Health and Hygiene Practices. *American Journal of Tropical Medicine and Hygiene*, 87(4), 594–601. doi:10.4269/ajtmh.2012.11-0494
- [16]. Ray, S. K., Amarchand, R., Srikanth, J., & Majumdar, K. K. (2011). A Study on Prevalence of Bacteria in the Hands of Children and Their Perception on Hand Washing in Two Schools of Bangalore and Kolkata. *Indian Journal of Public Health*, 55(4). doi:10.4103/0019-557X.92408
- [17]. Rubanprem Kumar, S., Aruna, S., & Sasikala, M. (2014). Effectiveness of hand hygiene teaching on knowledge and compliance of hand washing among the students at a selected school in Mugalivakkam village, Kancheepuram District. *Journal of Nursing and Health Science (IOSR-JNHS)*, 3(4), 56–60. Retrieved from <http://www.iosrjournals.org/iosr-jnhs/papers/vol3-issue4/Version-2/H03425660.pdf>



- [18]. Rwanda Ministry of Health. (2014). Rwanda launches Hygiene Campaign in Schools. Retrieved April 02, 2016, from [http://moh.gov.rw/index.php?id=34&L=1%27&tx\\_ttnews%5Btt\\_news%5D=550&cHash=681f30cedc22611c435f30a67f576e85](http://moh.gov.rw/index.php?id=34&L=1%27&tx_ttnews%5Btt_news%5D=550&cHash=681f30cedc22611c435f30a67f576e85)
- [24]. Saboori, S., Greene, L. E., Moe, C. L., Freeman, M. C., Caruso, B. a., Akoko, D., & Rheingans, R. D. (2013). Impact of regular soap provision to primary schools on hand washing and E. coli hand contamination among pupils in nyanza province, Kenya: A cluster-randomized trial. *American Journal of Tropical Medicine and Hygiene*, 89, 698–708. doi:10.4269/ajtmh.12-0387
- [25]. Tandukar, S., Ansari, S., Adhikari, N., Shrestha, A., Gautam, J., Sharma, B., ... Sherchand, J. B. (2013). Intestinal parasitosis in school children of Lalitpur district of Nepal. *BMC Research Notes*, 6(1), 1. doi:10.1186/1756-0500-6-449
- Harrison, J. A. (2012). Teaching Children to Wash Their Hands – Wash Your Paws, Georgia! Handwashing Education Initiative, 32(3), 116–123.
- [26]. Rubanprem Kumar, S., Aruna, S., & Sasikala, M. (2014). Effectiveness of hand hygiene teaching on knowledge and compliance of hand washing among the students at a selected school in Mugalivakkam village, Kancheepuram District. *Journal of Nursing and Health Science (IOSR-JNHS)*, 3(4), 56–60. Retrieved from <http://www.iosrjournals.org/iosr-jnhs/papers/vol3-issue4/Version-2/H03425660.pdf>
- [27]. Umwangange, L. M. (2016). Knowledge and attitude of hand washing among school children and education on hand washing technique. Rural East Rwanda. *South American Journal of Public Health*, 4(special issue), 1–8. <http://doi.org/10.21522/TIJPH.2013.04.02.Art019>
- [28]. Xuan, L. T. T., & Hoat, L. N. (2013). Handwashing among schoolchildren in an ethnically diverse population in northern rural Vietnam. *Global Health Action*, 6, 1–8. <http://doi.org/10.3402/gha.v6i0.18869>
- [29]. UNICEF. (2012). Simple handwashing crucial to halting diarrhoeal and water-borne diseases, UN stresses. Retrieved from <http://www.un.org/apps/news/story.asp?NewsID=43289#.VtwnnH195dg>
- [30]. Vivas, Alyssa; Gelaye, Bizu; Aboset, Nigusu; Kumie, Abera; Berhane, Yemane.; Williams, M. A. (2011). Knowledge, Attitudes, and Practices (KAP) of Hygiene among School Children in Angolela, Ethiopia. *Journal of Preventive Medicine and Hygiene*, 51(2), 73–79.
- [31]. WHO (2015). Clean care is safer care. Retrieved from [http://www.who.int/gpsc/clean\\_hands\\_protection/en/](http://www.who.int/gpsc/clean_hands_protection/en/)
- [32]. WHO (2008). WHO guidelines on hand hygiene in health care. Retrieved from [www.who.int/gpsc/5may/.../who\\_guidelines-handhygiene](http://www.who.int/gpsc/5may/.../who_guidelines-handhygiene)
- [33]. <http://biomath.info/power/prt.htm>