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Ph.D. - PUBLIC HEALTH

A THEORY-BASED HAND HYGIENE EDUCATIONAL INTERVENTION FOR ENHANCING PROPER HANDWASHING BEHAVIOUR AMONG SCHOOL CHILDREN IN THE EJISU-JUABEN MUNICIPALITY OF GHANA

BY

EMMANUEL APPIAH-BREMPONG (BSc., MSc.)

JULY, 2018

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(MSc. Public Health-Health Promotion)

A THESIS SUBMITTED TO THE DEPARTMENT OF HEALTH PROMOTION & EDUCATION, SCHOOL OF PUBLIC HEALTH, COLLEGE OF HEALTH SCIENCES IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY IN PUBLIC HEALTH

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DECLARATION

I hereby declare that this submission is my own work towards the Ph.D. and that, to the best of my knowledge, it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

This work is dedicated to the Lord Jesus Christ, the source of my wisdom for academic advancements. I also dedicate this work to my wife and children for the sacrifices that they made throughout my PhD journey. Finally, I dedicate this piece of work to my parents for their support.

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LIST OF ABBREVIATIONS

BCTs	Behaviour Change Theories
BI	Behavioural Intention
CDC	Center for Disease Control and Prevention
CFR	Case Fatality Rate
CHRPE	Committee on Human Research, Publication and Ethics
CI	Centrality Index
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CONSORT	Consolidated Standards of Reporting Trials
cRCT	Cluster-Randomised Controlled Trial
EBSCO	Elton Bryson Stephens Company
EJMA	Ejisu-Juaben Municipal Assembly
ERIC	Education Resources Information Center
GES	Ghana Education Service
HBM	Health Belief Model
HICPAC	Healthcare Infection Control Practices Advisory Committee
HP	Health Promotion
HWWS	Handwashing with Soap
ICC	Intra-Cluster Correlation Coefficient
IGF	Internally Generated Fund
JHS	Junior High School
MEDLINE	Medical Literature Analysis and Retrieval System Online
MMDAs	Metropolitan, Municipal and District Assemblies

MWST	Municipal Water and Sanitation Team
NGO	Non-Governmental Organisation
PTA	Parents and Teachers Association
PubMed	Public/Publisher MEDLINE
SCT	Social Cognitive Theory
SD	Standard Deviation
SHEP	School Health Education Programme
SMC	School Management Committee
STATA	Statistics and Data
TPB	Theory of Planned Behaviour
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit
WASH	Water, Sanitation and Hygiene
WC	Water Closet
WHO	World Health Organisation
WinS	WASH in School

ABSTRACT

Background

Handwashing with soap (HWWS) has been described as the single most cost-effective approach to reducing infectious disease burden in both the developed and developing worlds. With respect to the promotion of HWWS in schools, hand hygiene education appears to be the most common behaviour change strategy, especially in the developing world. Ironically, there is a paucity of robust evidence in Africa on the effectiveness of a theory-based hand hygiene educational intervention targeting the cognitive, affective, and psychomotor learning domains.

Principal Objective

To determine the effect of a theory-based hand hygiene educational intervention (*HandsCare*) on handwashing behaviour; describe the distribution of functional hand hygiene facilities and examine the psychosocial predictors of reported handwashing behaviour (HWB) in the Ejisu-Juaben Municipality.

Methods

The study began with an observation of hand hygiene facilities in 37 basic schools. Analysis methods for data on facilities included the Scalogram model. The thrust of the study was a cluster-randomised controlled trial consisting of four clusters. Schools constituted the clusters and were randomly allocated to an intervention arm or a control arm. At baseline, 328 and 389 pupils were allocated to the intervention and control arms respectively. Outcomes were behavioural intention and practice of HWWS and these were measured at two-weeks follow-up. Data on handwashing behaviour were gathered using a structured observation, and analysed using the Student's *t*-test. Data on psychosocial predictors of reported HWB were gathered using a structured questionnaire, and analysed using linear regression models. All statistical analyses were done using *Stata/SE 14*.

Results

A hand hygiene facility deficiency was observed across a range of schools. Only 16% of schools had functional handwashing stations. The observed rate of HWWS after toilet use was 2%, while that of HWWS before meals was 1%. At follow-up, the intervention led to a detection of a significant difference between the study arms with regard to intention to wash hands with soap [after toilet use (p=0.032, d=0.5); and before meals (p=0.020, d=0.2)]. Similarly, a significant difference was detected between the study arms with regard to the practice of HWWS [after toilet use (p=0.005; d=2.6); before meals (p=0.012; d=0.5)]. Handwashing skill (p=0.008; β=0.037; 95% CI 0.01-0.07), attitude to handwashing (p=0.046; β=0.120; 95% CI 0.00-0.24), subjective norms (p=0.011; β=0.055; 95% CI 0.01-0.10), and perceived susceptibility (p=0.001; β=0.101; 95% CI 0.04-0.16) were identified as predictors of intention to wash hands with soap and/or the practice of HWWS. With regard to the intention-behaviour relationship, the result indicates that intention to wash hands with soap does predict handwashing behaviour [(p=0.003, β=0.247; 95% CI 0.08-0.41) and (p<0.001, β=0.346; 95% CI 0.19-0.50) for HWWS after toilet use and HWWS before meals respectively].

Conclusion

A school-based hand hygiene educational intervention underpinned by psychosocial theories which targets the cognitive, affective and psychomotor learning domains has a medium to a very large effect size, with respect to the practice of HWWS; and a low to a medium effect size with respect to behavioural intention. Handwashing skill as a predictor of HWWS implies the need to prioritise skill-based hand hygiene education in schools. Addressing the problem of hand hygiene facility deficiency and the low rates of HWWS requires a collaborative effort involving the government, educational authorities, development partners and civil society organisations.

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CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Infectious diseases continue to pose a threat to public health both in the developing and developed worlds (Monistrol *et al*., 2012; Wang *et al*., 2016). The threat appears to be more daunting in the developing world where there are relatively weak health systems with implications for disease prevention, surveillance and control. In recent years, many African countries have come under intense pressure from epidemics of infectious diseases leading to high rates of mortality, morbidity and disability. For example, diarrhoeal diseases have been listed as one of four leading causes of early death in all sub-Saharan African countries (Wang *et al.*, 2016). By the end of the first quarter of 2016, the Ebola virus disease had claimed over 11,000 lives in West Africa (WHO, 2016). In Ghana, between June 2014 and August 2015, all ten administrative regions reported cases of cholera (totaling 28,975) which led to 243 deaths (CFR=0.8%) (WHO, 2015).

Infectious diseases claim millions of children's lives globally. It is estimated that by the year 2030, approximately 24 million children could lose their lives as a result of diarrhoea, if global efforts are not intensified (UNICEF, 2016). The contribution of diarrhoea and pneumonia to child mortality is greater than the contribution of all other child illnesses combined (UNICEF, 2016). The available evidence suggest that about 60% of diarrhoeal mortality worldwide is attributable to poor water, sanitation and hygiene (Prüss-Ustün *et al*., 2014). Thus, diarrhoea, like many other infectious diseases is preventable through adherence to safe water, sanitation and hygiene practices (UNICEF, 2016). It is for reasons such as the above that the Sustainable Development Goal six (6) calls on nations to achieve access to adequate sanitation and hygiene for all by the year 2030.

The school is a strategic setting for child-centred hygiene interventions as it provides a conducive environment which facilitates life-long healthful learning (Adams *et al*., 2009; Snel & Shordt, 2005). Owing to the fact that the school environment is characterised by a high level of person-to-person contact, the risk of the spread of infectious agents is heightened. Schools with better hygienic conditions tend to facilitate safer hygienic practices and consequently have fewer occurrence of communicable diseases (Grimes *et al*., 2016). Thus, promoting school-based hygiene interventions is an essential step towards reducing the infectious disease burden among children, their household and the community at large.

One of the most crucial hygiene behaviours to promote among school children is handwashing with soap (HWWS), under running water and at critical times. Handwashing with soap has been described as the single most cost-effective approach to reducing the infectious disease burden in both the developed and developing worlds (Curtis *et al*., 2011). In a systematic review and meta-analysis of handwashing practices in diverse settings, HWWS reduced the risk of diarrhoea infection by 40% (Freeman *et al*., 2014). In another systematic review which specifically targeted the school setting, handwashing promotion accounted for a reduction of diarrhoea episodes by over 30% (Ejemot-Nwadiaro *et al*., 2015).

To ensure the practice of safe hand hygiene behaviours in schools, the provision of adequate physical facilities is essential (UNICEF, 2008; Adams *et al*., 2009). For example, a functional handwashing station creates an enabling environment which makes the adoption of proper handwashing behaviour possible. Nonetheless, the mere provision of physical facilities is not enough to ensure the sustainable practice of proper handwashing behaviour (UNICEF, 2008). The complementary role of a behaviour change communication becomes crucial to the attainment of the aforementioned.

With respect to a strategy for promoting HWWS in schools, hand hygiene education appears to be the most common behaviour change strategy, especially in the developing world. Conventionally, hygiene education has focused on developing the cognitive learning domain (knowledge), with little or no emphasis on developing positive attitudes (affective) and skills (psychomotor) necessary for triggering behaviour change. Conventional hygiene education has been reported as yielding less success in enhancing compliance to hygienic practices (UNICEF, 2008).

Nonetheless, there is a paucity of robust evidence (especially in Africa) on the effectiveness of a theory-based hand hygiene educational intervention targeting all three learning domains (*i.e.* cognitive, affective, and psychomotor), for the enhancement of behavioural intention and safe handwashing practices. In view of this, the present study sought to generate evidence on the effectiveness of a theory-based hand hygiene educational intervention named '*HandsCare*' for enhancing safe handwashing behaviours among school children in a Ghanaian municipality.

1.2 Problem Statement

The underlying problem warranting this research has been structured under the following: Low rates of HWWS worldwide and in Ghana, less attention given to hygiene in schools, dearth of research on hygiene behaviour change in Africa, and the paucity of robust evidence establishing the effectiveness of a theory-driven hand hygiene education in African schools.

1.2.1 Low Rates of HWWS Worldwide and in Ghana

Globally, rates of HWWS are low. In a study conducted in eleven (11) countries, an average of 17% of caretakers of children washed their hands with soap after using the toilet (Curtis *et al.*, 2009). In a systematic review and meta-analysis, HWWS after using the toilet was estimated to be

19% (Freeman *et al.*, 2014). In a nationwide research conducted by Scott *et al*. (2007), the rate of HWWS among Ghanaian mothers was reported to be as low as 4%.

In a school setting, in the Greater Accra Metropolis, Steiner-Asiedu *et al.* (2011) observed the handwashing practices of basic school children (traditionally aged 12 to 14 years) and reported that only 5% of school children (using a sample of 295) were observed washing their hands with soap before eating; and no pupil was observed to wash his/her hands with soap after using the toilet. The authors subsequently reported inadequate handwashing facilities in the participating schools. In another observational study among students of a public university in Ghana, only 16% of students (using a sample of 806) were observed to practice HWWS under running water (Mariwah *et al.*, 2012). Conversely, in a study by Monney *et al*. (2014) conducted in some basic schools in Ghana, self-reported rate of handwashing was estimated to be 73%. The relatively high rate of handwashing (73%) could be attributed to the over-estimation which often characterises self-reported data (Grimason *et al*., 2014; Curtis *et al*., 2009).

1.2.2 Less Attention Given to Hygiene in Schools

In spite of the generally low rate of HWWS in Ghanaian schools, interventions in the area of water, sanitation and hygiene (WASH) give little attention to the school setting, despite the fact that school-based hygiene interventions are essential for fostering life-long learning (Adams *et al*., 2009; Snel and Shordt, 2005). More so, the few interventions which have targeted schools have often neglected behaviour change which has been described as a "software", by overemphasising infrastructure provision often referred to as the "hardware" (Cross and Coombes, 2014). Ironically, behaviour change has been described as more important than the mere provision of physical infrastructure, in efforts aimed at the sustainability of WASH interventions (UNICEF, 2008).

In a global study involving 54 countries, sanitation in schools was identified as the most comprehensively monitored WASH in School (WinS) component, whereas hygiene was identified as the least (UNICEF, 2015). Thus, due to data scarcity on hygiene, information on handwashing facilities in schools is rarely reported. The concepts of 'sanitation' and 'hygiene' have been elucidated in the literature review section of this thesis report.

1.2.3 Dearth of Research on Hygiene Behaviour Change in Africa

In spite of the huge importance ascribed to behaviour change interventions in WASH, there remains a dearth of high-quality methodological studies on hygiene behaviour change in Africa. At a continental conference organized to engage African politicians and WASH experts to assess the sanitation and hygiene situation in Africa, conference participants bemoaned the lack of high quality studies examining among others, hygiene behaviour change in Africa (Cross & Coombes, 2014).

With respect to robust evidence on the predictors of proper handwashing behaviour in Ghanaian schools, only one study was identified that investigated this (Steiner-Asiedu *et al*., 2011). Nevertheless, limited information is provided by the authors to identify the individual-level predictors of school children's handwashing behaviour, even though some environmental-level predictors were presented (*e.g*. the existence of handwashing facilities).

1.2.4 Dearth of Robust Evidence on the Effectiveness of a Theory-Based Hand Hygiene Education in African Schools

One of the earliest interventions for school hygiene behaviour change is *traditional* hygiene education. *Traditional* hygiene education tends to be underpinned by a didactic approach and

therefore affects only the cognitive domain of learning. Many experts agree that this approach yields less success in changing hygiene behaviour (UNICEF, 2008). Nevertheless, it is common to find school hygiene interventions seeking to influence behaviour change across Africa resorting to *traditional* hand hygiene education. An alternative, which is a theory-based hand hygiene education has been suggested by some authors (Trunnell & White, 2005a; Mortell *et al*., 2013). A theory-based intervention has advantages such as the avoidance of trial and error in intervention design and evaluation (Melnyk & Morrison-Beedy, 2012); enhancement of construct validity and intervention fidelity (Stein *et al*., 2007); and the enhancement of generalization of intervention effect (Elder, 2001). Ironically, there is a dearth of studies examining the effectiveness of a theory-driven hand hygiene educational intervention in schools, especially using an experimental approach.

Rosen *et al*. (2006) have elaborated extensively on the utility of an experimental design when assessing the effectiveness of health promotion interventions, of which hand hygiene education is no exception. Such an approach is helpful in ensuring that intervention effect is not attributable to extraneous variables, which cannot be adequately controlled for by non-experimental, pre-experimental and in many cases quasi-experimental studies (Cottrell & McKenzie, 2011; Rosen *et al*., 2006).

In a scoping search conducted by the author using databases and search engines including EBSCO host (MEDLINE, CINAHL, Academic search complete, PsycINFO, PsycARTICLE, PsycLIT), PubMed, ERIC, Cochrane Library, Google Scholar and Hinari (*search strategy is attached as appendix 1*), no study was identified in Ghana to have assessed the effectiveness of a theory-driven hand hygiene educational intervention targeting the three domains of learning (cognitive, affective,

and psychomotor), for enhancing HWWS in schools using an experimental design. A related study was conducted in Kenya (Graves *et al*., 2012), which employed a poster design competition among school children, and evaluated its effect on handwashing practice. Nonetheless, the intervention of Graves *et al.* (2012) did not incorporate the psychomotor learning domain.

1.3 Significance of Study to National Development

Owing to the dearth of robust evidence on the predictors of HWWS in Ghanaian schools, school health promotion practitioners would likely be faced with the difficulty of designing evidence-based interventions for schools. Interventions will likely assume a certain generality which often lacks a reflection of the contextual variations which exist in schools, and which influence handwashing behaviour at both the individual and environmental levels. This study sought to enhance an understanding of these contextual variables. Such knowledge would enhance the activities of the School Health Education Programme (SHEP) of the Ministry of Education-Ghana, in its design of hand hygiene behaviour change interventions, especially within the Ejisu-Juaben Municipality. Furthermore, the Coalition of Non-Governmental Organisations (NGOs) in Health can gather vital knowledge from the output of this research to inform their school hygiene intervention design and delivery (*e.g.* knowledge of psychosocial predictors of HWWS).

More so, health promotion practitioners in Africa continue to rely on hand hygiene education for behaviour change, even though there is a dearth of robust evidence establishing its effectiveness in schools. In the absence of robust evidence, practitioners could be faced with the difficulty of justifying their interventions especially to prospective funders. The importance of evidence-based practice cannot be overemphasized as it enhances efficiency and effectiveness, thereby establishing the legitimacy of interventions (Bunton and Macdonald, 2002). In the midst of a

global economic crisis, the efficient and effective use of resources for health promotion interventions deserves optimum attention. The evidence generated by this study is useful with respect to informing the decision to continue committing scarce resources to hand hygiene educational interventions in schools.

Another output of this study is a matrix showing the distribution of functional hand hygiene facilities across a range of junior high schools. This matrix would serve as a guiding document for handwashing facility planning and intervention in schools within the geographic scope of the study.

1.4 Theoretical Framework

1.4.1 Behaviour Change Theories/Models

A framework was developed to enhance the conceptualization of handwashing behaviour change in a school setting. The framework was developed by drawing from relevant psychosocial theories and models. The models/theories include; the Health Belief Model (HBM) developed by Rosenstock *et al.* (1988), the Social Cognitive Theory (SCT) developed by Bandura (1986), and the Theory of Planned Behaviour (TPB) developed by Ajzen (1988).

1.4.2 Rationale for Choice of Models/Theories

The TPB was adopted due to its particular relevance in explaining *volitional* behaviours through its construct *behavioural intention* (Ajzen, 1988). Behavioural intention has been described as the closest predictor of behaviour. According to the TPB, other constructs which may predict behavioural intention are *subjective norms, attitudes* and *perceived behavioural control* (*ibid*). Handwashing behaviour is volitional in nature and requires an individual to exercise his/her 'will

power' prior to the performance of the behaviour. Some researchers have relied on constructs of the TPB to explain a range of hygiene behaviours, including hand hygiene (White *et al*., 2015a; Eshetu, 2013).

Also, the SCT was resorted to because it explains the interplay which exist between individual-level, and environmental-level variables, and the resultant influence of this interplay on behaviour. Bandura (1986) has termed this triad of interplay *reciprocal determinism.* A key variable of the SCT which is termed *behavioural capacity* has guided the development of predictor variables for this study. The rationale for its selection is that many studies that have been conducted in varied health domains identified the construct as a predictor variable (Liao *et al*., 2011; Li *et al*., 2011; Okun *et al*., 2002). According to Bandura (1986), *behavioural capacity* encapsulates the knowledge and skills which an individual has acquired with respect to a given health behaviour.

The rationale for adopting the HBM stems from the potential utility of the model's key constructs namely *perceived susceptibility*, and *perceived severity*, for explaining hygiene behaviour. Rosenstock *et al.* (1988) have described *perceived susceptibility* as an individual's evaluation of his/her vulnerability to a given health condition. Perceived severity on the other hand evaluates the degree of the consequences of not adopting a healthful behaviour. Solhi *et al*. (2010) have reported the applicability of the HBM in enhancing the adoption of preventive oral health behaviours among adolescent girls.

1.4.3 A Theory-Based Framework for Designing Hand Hygiene Educational Interventions in Schools

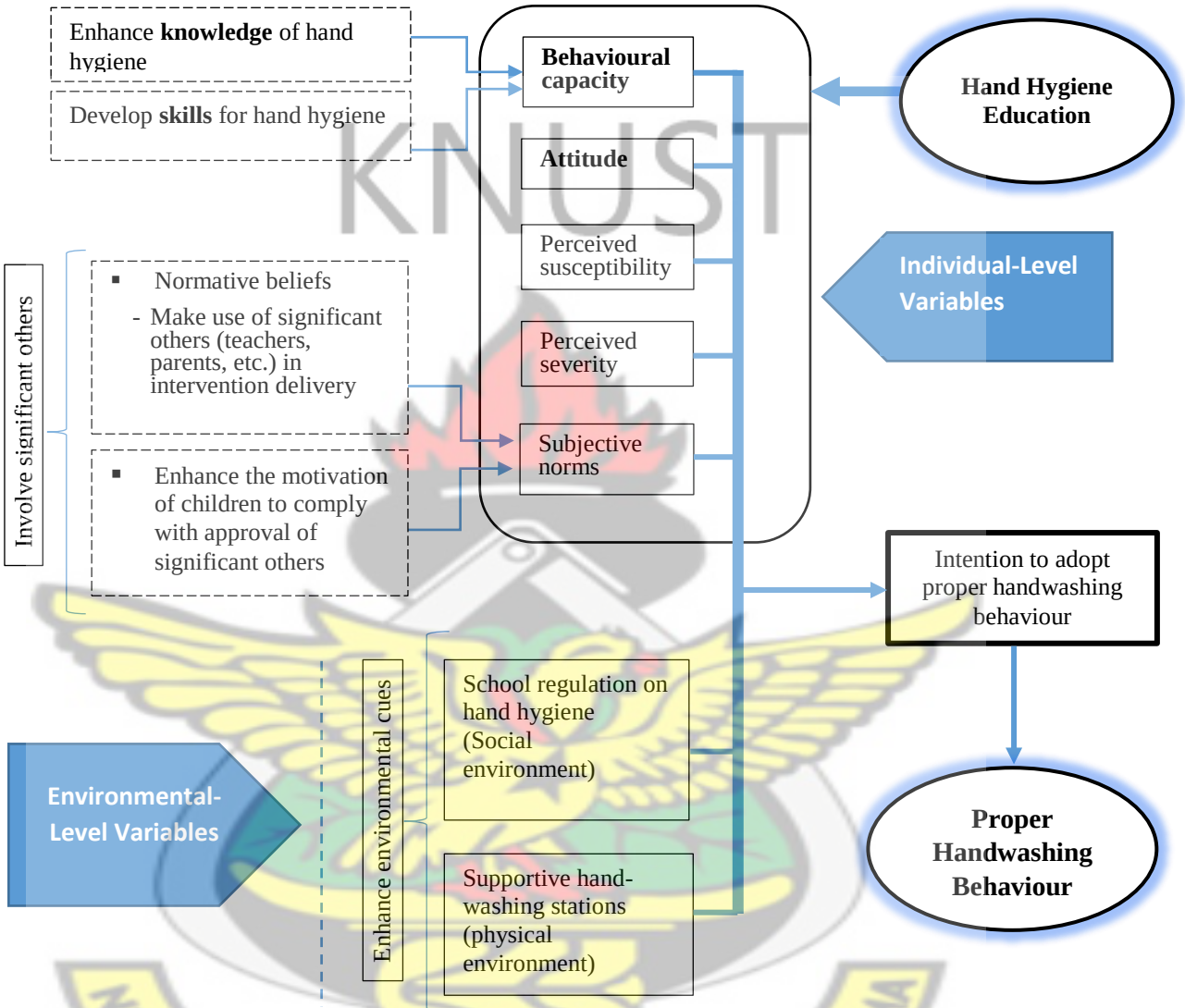

Figure 1. 1 A Framework for Designing Hand Hygiene Educational Intervention in Schools
Source: Adapted from Appiah-Brempong *et al*. (2018)

The framework makes use of pertinent constructs from the aforementioned theories/models. The Social Cognitive Theory (SCT) posits that the combined effect of knowledge and skill can trigger the adoption of a behaviour (Bandura, 1986). Rosenstock *et al.* have described *perceived susceptibility* as an individual's evaluation of his/her vulnerability to a given health condition

(Rosenstock *et al*., 1988). In line with this description, an individual will likely consider whether failure to wash hands with soap could result in him/her contracting diarrhoea. In the event that the individual concludes that he/she is prone to diarrhoea, then a further evaluation emerges which assesses the seriousness or otherwise of the consequences of diarrhoea, which when considered by the individual to be devastating to his/her aspirations could trigger an intention to adopt a healthful behaviour. This has been termed as *perceived severity* (Rosenstock *et al*., 1988).

Another individual-level variable which has been suggested to influence behavioural intention is *Subjective norms.* Bennet & Murphy posited that subjective norms are determined by *normative beliefs* and the *motivation to comply* (Bennet & Murphy, 1997). Normative beliefs have been described as the belief which an individual has about the approval or otherwise of a given behaviour by people considered to be *significant others* (Huesmann & Guerra, 1997). In a school setting, *significant others* could be teachers and respectable peers. Many studies have underscored the crucial role of teachers in influencing the handwashing behaviour of school children, even though few have assessed teachers' handwashing behaviour (Setyautami *et al*., 2012). In the homes, *significant others* could be parents or older relatives. Apart from the school, children spend the rest of the day in the home. This brings to light the potential influence of parents or guardians on a child's handwashing behaviour.

Within the context of handwashing with soap for example, the existence of an enabling physical environment is essential for encouraging the practice. Functional facilities providing running water, and soap are crucial to the adoption and maintenance of proper handwashing behaviour. The importance of functional handwashing facilities for enhancing children's handwashing behavior has been strongly established (Adams *et al.*, 2009; UNICEF, 2008). Also, the social environment plays a critical role in the adoption and maintenance of hand hygiene behaviour. A

key variable pertaining to the school environment is school regulation or prohibition pertaining to hand hygiene. This holds potential for influencing students' handwashing behaviour.

Behavioural intention according to the Theory of Planned Behaviour is the closest determinant of behaviour (Lavin & Groarke, 2005; Ajzen, 1988). It often presents itself as a moderator variable through which a behaviour is adopted or rejected.

With respect to dependent variables, it is common to find health promotion studies that resort to 'behaviour' as a dependent variable (*E.gs*. Moussa *et al.*, 2015; Eshetu, 2013; Setyautami *et al*., 2012; Graves *et al*., 2012; Biran *et al.*, 2009; Curtis *et al.*, 2001), even though some resort to a health condition or disease as a dependent variable. For the purpose of this study, behavioural intention, and practice of HWWS are the intermediate and dependent variables respectively.

1.5 Research Questions

The following questions guided this research.

- What is the distribution of functional hand hygiene facilities among basic schools?
- Is a theory-driven hand hygiene educational intervention effective in enhancing behavioural intention, and adherence to the practice of HWWS?
- What are the psychosocial predictors of a handwashing behaviour?

1.6 Objectives of Study

The principal objective of the study was to determine the effect of a theory-driven hand hygiene educational intervention (*HandsCare*) on handwashing behaviour, describe the distribution of functional hand hygiene facilities, and examine the psychosocial predictors of reported handwashing behaviour in the Ejisu-Juaben Municipality. Specifically, the study sought to:

1) Describe the distribution of functional hand hygiene facilities among basic schools.
2) Determine the effect of a hand hygiene educational intervention on intention to wash hands with soap
3) Determine the effect of a hand hygiene educational intervention on the practice of HWWS
4) Examine the psychosocial predictors of reported handwashing behaviour

1.7 Profile of Study Area

1.7.1 Location and Size

The Ejisu – Juaben Municipality has an estimated population of 164,259. It is located within Latitudes 1º 15'N and 1º 45'N and Longitude 6º 15'W and 7º 00 W. It occupies a land area of 637.2 km^2. The Municipality lies in the central part of the Ashanti Region sharing boundaries with six municipalities in the region: Sekyere East and Afigya Kwabre to the North-East and North-West respectively; Bosomtwi and Asante Akim South to the South; Asante Akim North to the East and Kumasi Metropolitan Assembly to the West. Figure 1.2 shows the location of the Municipality in both regional and national contexts.

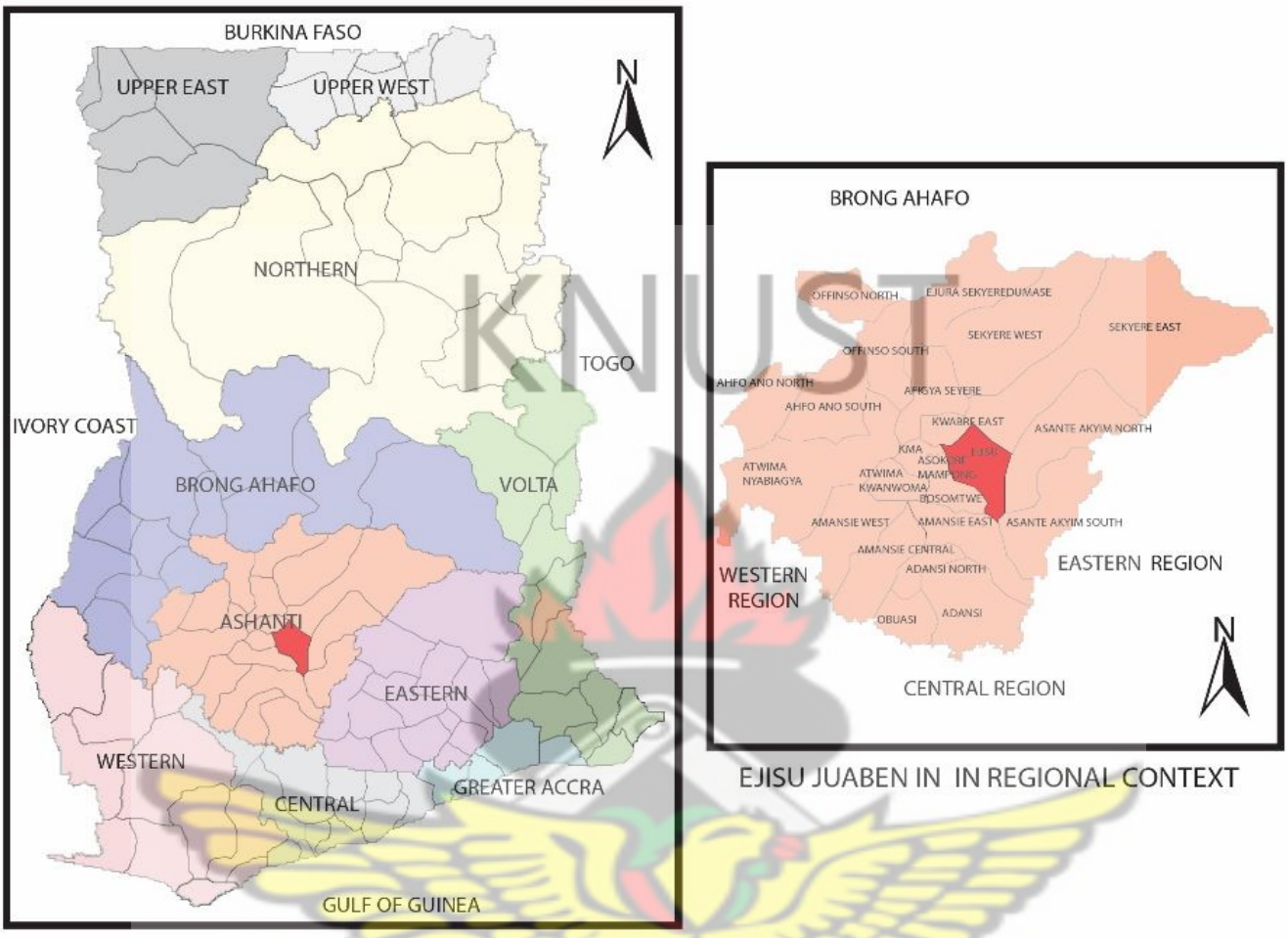

Figure 1. 2: Ejisu-Juaben Municipality in the Regional and National Context (Not Drawn to Scale)

Source: Town and Country Planning Department - EJMA (2013)

1.7.2 Top Five Causes of Hospital Admissions

Information obtained from the Ejisu-Juaben Municipal Health Directorate (2015) indicates that in 2013, diarrhoea was identified as the third leading cause of hospital admissions contributing to a total of 456 admissions. This figure increased in 2014 to 681. A further increase was recorded in 2015, when diarrhoea become the second leading cause of hospital admissions, contributing to a total of 798 admissions (Table 1.1). Even though disaggregated data which spells out the proportion of diarrhoea-attributable admissions occurring among children was unavailable, there

is ample evidence to suggest that over 90% of diarrhoea cases occur among children (UNICEF-GHANA, 2015; WHO, 2001).

Table 1.1: Top Five Causes of Hospital Admissions

	2013		2014		2015	
RANK	**DISEASE**	**CASES**	**DISEASE**	**CASES**	**DISEASE**	**CASES**
1	Malaria	3012	Malaria	3452	Malaria	2818
2	Septicaemia	667	Septicaemia	767	Diarrhoea Diseases	**798**
3	Diarrhoea Diseases	**456**	Diarrhoea Diseases	**681**	Septicaemia	657
4	Anaemia	297	Anaemia	664	Hypertension	201
5	Hypertension	128	URTI	220	Anaemia	472

Source: Ejisu-Juaben Municipal Health Directorate (2015)

1.7.3 Water and Sanitation

The Municipal potable water coverage in 2010 stood at 56% as compared to the regional coverage of 73%. The main sources of potable water in the municipality are hand-dug wells and boreholes. There are also three (3) small water systems located at Kwaso, Juaben and Onwe. Also, the Municipality has about 316 boreholes, 57 hand-dug wells fitted with hand pumps in the Municipal Assembly area. It is worth noting that, Ejisu the Municipal capital has no piped water system. Poor management and maintenance of water systems have resulted in frequent breakdown of facilities resulting in the use of unsafe sources of water, which are potential sources of water-related diseases. Though there is paucity of information on community toilet facilities, the Municipal Assembly has described the existing number of toilet facilities in the municipality as "woefully inadequate" (MWST, 2013).

1.8 Organisation of Thesis Report

The thesis report is organised into six chapters. The first chapter presents background information on the entire research and gives a rationale for the conduct of the research. Subsequently, the objectives of the research are presented as well as the geographic scope of the study.

Chapter two discusses the body of literature related to hand hygiene from a global to a local perspective. The chapter assesses the contents and methodologies of pertinent studies, identifies gaps in the body of literature related to school hand hygiene, and specifies the contribution of this study to bridging the identified gaps.

Chapter three describes the methodology, and specifies the methods underpinning each specific objective of the study. The fourth chapter presents the results of the study which is organised into three parts. Part One presents the results specific to the first objective of the study. Part Two presents the results specific to objectives two and three, while Part Three presents results responding to specific objective four.

The discussion of results is presented under Chapter Five. The discussions chapter is organised into three parts. Part One presents a discussion on the results specific to the first objective of the research. Part Two presents a discussion on results of the second and third specific objectives, while Part Three discusses the results on specific objective four.

The last chapter of the report presents the conclusions and recommendations of the research.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews the body of literature on hand hygiene from the global to the local levels. The chapter assesses the contents and methodologies of pertinent studies, identifies gaps in the body of literature and specifies the contribution of this study to bridging the identified gaps. The core themes constituting the Chapter include; hand hygiene facilities in schools, effect of hand hygiene educational interventions on behavioural intentions, and practice of HWWS. The final theme relates to the predictors of handwashing behaviour at the individual and environmental levels. The Chapter concludes with a summary of key issues emanating from the body of literature, with particular emphasis on the need for a school-based intervention research on a theory-based hand hygiene education.

2.1 Utility of Literature Review

A good understanding of the literature in a given field is crucial and warrants the pursuit of research in that field. It is undoubted that a defective literature review has the tendency to derail a research process, as a literature review is essential in framing any given research (Boote & Beile, 2005; Randolph, 2009). With guidance from Randolph (2009), the following were the rationale for conducting the literature review of this study:

- To enhance author's knowledge of the historical developments within the field of hygiene
- To enhance author's understanding of the theories and concepts within the field of hygiene behaviour change, and the application of these theories and concepts
- To enable the author to be acquainted with acceptable vocabulary and variables within the field of hand hygiene

- To enhance an understanding of methods used by previous researchers in studying hand hygiene

2.2 Approach to Literature Search

Scouting for literature in the field of Health Promotion is often complicated (Jackson & Waters, 2005; Peersman & Oakley, 2001). This complication is largely attributable to the multi-disciplinary nature of Health Promotion, which relies on contributions from many disciplines including Epidemiology, Education, Psychology, Sociology, Economics, Social Policy, Politics of Integration, among others (Bunton & Macdonald, 2002; Beahler *et al*., 2000). The implication of this multidisciplinary background is that Health Promotion literature is scattered across many databases and library catalogues.

Databases and search engines which were consulted during the literature search included EBSCO Host (MEDLINE, CINAHL, Academic Search Complete, PsycINFO, PsycARTICLE, PsycLIT), PubMed, ERIC, Cochrane Library, Google Scholar and Hinari. A search strategy was developed to guide the literature search of this study. The search strategy was developed with guidance from a tool developed by the Humboldt State University (2008) (strategy is attached as *Appendix 1*). The identified literature was summarized using narrative synthesis.

2.3 Water, Sanitation and Hygiene in Schools (WinS)

2.3.1 Complementarity of Water, Sanitation and Hygiene

The complementarity of water, sanitation and hygiene (WASH) is universally recognized, and hence many interventions integrate the three fields. The World Health Organisation describes the term 'Sanitation' as the "provision of facilities and services for the safe disposal of human urine and faeces" (WHO, 2018). The existence of quality water and sanitation facilities makes the

practice of safe hygiene possible. For example, in a context where running water is not available, promoting HWWS becomes practically difficult if not impossible. Also, the existence of a good sanitary facility such as an improved toilet with sinks providing running water can enhance the promotion of safe hygiene behaviours (Adams *et al*., 2009). Nonetheless, it is important to state that the mere provision of water and sanitation facilities, without complementing these with appropriate hygiene behaviour change interventions have shown to be ineffective in ensuring the sustainability of proper hygienic practices (Cross & Coombes, 2014; UNICEF, 2008).

2.3.2 WASH in Schools (WinS), and Why it is Promoted

WinS is a component of the Child Friendly School framework which is driven largely by UNICEF with support from its partner institutions. WinS *is "concerned with water, sanitation and washing facilities in schools along with hygiene education"* (UNICEF, 2011:6). For a school to be described as having adequate WASH facilities, it is expected that the school has a functional and reliable water system which meets all the water needs of the school, especially for handwashing and drinking purposes (*ibid*). In addition, the school is expected to have several facilities for handwashing close to toilets so as to encourage HWWS after using the toilets (UNICEF, 2011). Facilities are expected to meet the needs of all school children, but special attention should be given to the needs of small children, girls of menstruation age as well as children with disability (*ibid*).

WinS is known to have a significantly positive impact on children's health and educational outcomes (UNICEF, 2011). There is a plethora of evidence suggesting that WinS reduces diarrhoeal episodes among children, reduces diarrhoea related absenteeism, increases school enrolment and enhances academic performance of school children (WHO, 2014; UNICEF, 2011).

In addition, WinS is known to foster life-long learning. Thus, if one can get children to grow up with knowledge and skills for maintaining safe hygiene, they will likely pass it on to their children (UNICEF, 2010; Adams *et al*., 2009).

According to UNICEF (2008), children are more receptive and tend to adopt new behaviours easier than adults. Also, children are known to be good change agents in their families and the community at large, when given the necessary guidance and support (Vivas *et al*., 2011). Again, children tend to me more susceptible to infectious diseases and, in the event that a child contracts a hygiene related infection, he or she will likely transmit the infectious agent to family members and ultimately to the community at large (Adams *et al*., 2009). In spite of the above motivations for promoting WinS, few studies have investigated handwashing behaviour outside the clinical setting (Scott *et al*., 2007).

2.4 Overview of Hygiene

2.4.1 Meaning and Evolution

The evolution and meaning of the term *hygiene* remain contested. The term has been linked to an ancient Greek goddess called *Hygeia*, who was regarded as the giver of health and required all people looking for health to live in accordance with a balanced physical regimen, and also in accordance with her precepts (Wilkie, 2004). In line with this proposition, an individual who wanted to be healthy needed to live a life which balanced his/her internal resources with the external environment. The crucial role of the environment was explicitly emphasised by those who held unto this conception of hygiene. Curtis (2007) has however argued that hygiene evolved almost with the evolution of animal life and has therefore been in existence for about four (4)

billion years. Hygiene has been described as being partly instinctive in humans and its driving force is the innate or intrinsic sense of a need to avoid disgust (*ibid*).

As a field of practice, some have postulated that the birth of *hygiene* dates back to 460-377 BC, when it was known to be a branch of medicine which focused on *positive health* rather than the treatment of disease (Accord, 2011). The notion of positive health distinguished hygienic practices from therapeutic practices which were understood to be concerned with the treatment of diseases. Wilkie (2004) argues that hygiene as a field of practice has its roots in antiquity, tied to the classical and other civilisations which existed before the middle ages.

In recent years, the term hygiene has been viewed differently by authors. Jumaa views hygiene as referring to "*cleanliness and especially to any practice which leads to the absence or reduction of harmful infectious agents*" (Jumaa, 2005:4). Hygiene has been defined broadly as "*the science of preventive medicine and the preservation of health*" (Nicolle, 2007:767). This definition apparently poses a challenge in that it is broad enough to include issues such as physical activity and even healthy eating. The World Health Organisation conceptualises the term hygiene as the *"conditions and practices that help to maintain health and prevent the spread of diseases"* (WHO, 2013:40).

Curtis (2007) has cautioned that one should expect the term to be defined by people based on their background training or experience. For example, a historian would view hygiene as simply health, a microbiologist would view it as relating to the avoidance of germs and diseases, while a mother at home with a child would describe it as relating to cleanliness and tidiness. Notwithstanding the varied perspectives, there appears to be giant strides by stakeholders to demystify the term *hygiene*.

2.4.2 Fields in Hygiene

A growing number of fields exist within the domain of hygiene. A review of the literature brings to light fields such as; facial hygiene, respiratory hygiene, menstrual hygiene, oral hygiene, domestic hygiene, environmental hygiene, industrial hygiene, mental hygiene, vocal hygiene, and of course hand hygiene (Carling *et al.,* 2010; Nicolle, 2007; Plog & Quinlan, 2002). The underlying motivation for practitioners working in the varied fields of hygiene is the prevention of disease and maintenance of health (WHO, 2016; Nicolle, 2007).

2.4.3 Significance of Hygiene to Public Health - Globally and Locally

Globally, threats posed by infectious diseases such as the severe acute respiratory syndrome (SARS), avian influenza and more recently Ebola suggest to the public health community that hand hygiene still deserves attention at the global level. At both the continental and national levels, infectious diseases such as cholera continue to claim thousands of lives, especially in Africa where relatively little investments are made by governments towards the creation of an enabling environment which enhances the pursuit of hygiene (Cross & Coombes, 2014). For example, in Africa, while cholera killed 1,583 people in 2014, the Ebola virus disease killed a woeful number exceeding 11,000 people as at the end of the first quarter of 2016 (WHO, 2016). In Ghana, WHO (2015) recorded a total of 28,975 cases of cholera (CFR=0.8%) resulting in 243 deaths, between June 2014 and August 2015.

The situation described above does not in any way suggest that the developed world is exempted from the spread of pathogens of faecal origin and the consequences of it. In a study conducted by Judah *et al*. (2010), 28% of commuters in five cities in the UK had bacteria of faecal origin on their hands. Another study conducted in South England showed that only 31% of men at a service

station washed their hands with soap after using the toilet (Judah *et al*., 2009). The implications of unsafe hand hygiene practices to the spread of infectious diseases globally and locally is axiomatic, and certainly requires a public health attention.

Though hygiene promotion has received relatively less attention from donors and governments, especially when compared to other health issues such as HIV and malaria, the evidence is clear that hygiene related diseases are still threatening to public health. For example, diarrhoea and respiratory illness account for about 5 million deaths in children every year, and are therefore mentioned as the top two killers of children worldwide (Curtis *et al*., 2011). In an era where the public health movement is under pressure to combat neonatal, infant and child mortality, especially in the developing world, the utility of hygiene cannot be glossed over.

From all indications, there is a natural fit between hygiene and public health. Hygiene, which has been described as the "*conditions and practices that help to maintain health and prevent the spread of diseases"*(WHO, 2013), contributes to the attainment of the goal of public health which is the prevention of disease, promotion of health, and the prolonging of life (Winslow, 1920).

2.5 Hand Hygiene

2.5.1 Historical Perspectives

Historically, handwashing was done only as a cultural or religious act that was required to fulfil a ritual demand (Jumaa, 2005). However, for other people, handwashing was necessary if one wanted to beautify his or her hands (*ibid*). Somewhere in the 14th century, there was an epidemic which plagued the world that was referred to as the Black Death (Straub, 1992). During the period of these epidemics, it was observed that the Jewish people had a lower mortality rate as compared

to other nations (*ibid*). It was postulated that the Jewish ritual of handwashing could explain the lower mortality recorded among its people (Straub, 1992).

Handwashing as a structured intervention to prevent the spread of infections began only a few decades ago. In the early 1960s, the Center for Disease Control (CDC) published guidelines instructing healthcare professionals to practice HWWS for 1 to 2 minutes before and after patient contact (Jumaa, 2005; Coppage, 1961). This perspective is however challenged by some authors who have suggested that hand hygiene practice and research in the clinical setting dates back to the 1840s, when it was discovered by Ignacz Semmelweis that puerperal fever could be prevented by adhering to hand hygiene disinfection; which eventually led to his introduction of handwashing standards in obstetric clinics (Kelcíkova *et al*., 2011; Stone, 2001). HWWS is now being promoted in the world over and in diverse settings.

2.5.2 Definition of Hand Hygiene

A review of the body of literature suggests a few attempts made by authors at defining the term *hand hygiene*, though the term *hygiene* has received varied conceptualisations. According to the US Center for Disease Control and prevention, hand hygiene "*includes handwashing (washing hands with non-antimicrobial soap), antiseptic handwash (washing hands with water and soap or another detergent containing an antiseptic agent), antiseptic hand rub (rubbing hands with an antiseptic hand rub) and surgical hand antisepsis (preoperative antiseptic handwash or hand rub performed by surgical personnel)*" (CDC, 2002:1-48).

As comprehensive as the above definition may appear, it can be criticized in the following ways:

- The use of local cleansing agents as alternatives to soap is not conspicuous in the definition
- The purpose of engaging in the act of handwashing or hand rubbing is not captured

- The definition appears to focus on hand hygiene as pertaining to the hospital setting

For the purpose of this study, which is school-based, hand hygiene refers to *an activity involving the use of soap or other effective local agents in which running water is provided, or the use of a hand-rub containing the right proportion of alcohol, which cleanses the hands of micro-organisms of disease causing potential*. From the discussion so far, it can be recognised that handwashing with soap or a local cleansing agent is subsumed under hand hygiene.

2.5.3 Approaches to Hand Hygiene

Different approaches exist for hand hygiene. These approaches are often tied to the setting within which hand hygiene occurs. For example, in a school or community setting, the most common approach for hand hygiene is observed to be handwashing with soap or ash in the absence of soap. Also, the use of hand sanitizers or rubs tends to be less common in community than in clinical settings.

2.5.3.1 The Use of Hand Sanitizers

Earlier guidelines for handwashing placed more emphasis on the use of water and soap, than the use of a waterless hand sanitizer in the clinical settings (HICPAC, 1995). Recent guidelines for clinical settings however appear to place emphasis on hand sanitizers, especially in instances where the hand is not visibly dirty (WHO, 2009). A typical hand sanitizer consists of ethanol, isopropanol, and n-propanol. The antimicrobial activity of the aforementioned alcohols is tied to their ability to denature proteins (Jumaa, 2005). An alcohol concentration of 60-95% is considered to be the most effective (CDC, 2002; Jumaa, 2005). When applied to the skin, alcohols are known to have the most rapid bactericidal effect when compared to other disinfectants (*ibid*). A quantity

of 3mL of hand sanitizer, lasting for 20-30 seconds on the hands has been recommended (Hand Hygiene Australia, 2016; Widmer, 2000).

2.5.3.2 A Critique of the Use of Hand Sanitizers

The use of hand sanitizers is not without criticisms. Hand sanitizers have been criticized for not being able to rid the hands of debris and some oils which may serve as hiding places for some micro-organisms on the hands (Filion *et al.*, 2011). Others have also raised concerns about the possible hand irritations and skin damages which may result from the use of hand sanitizers (Larson *et al*., 2006). In the school setting however, the School Health Education Programme (SHEP) of the Ministry of Education in Ghana encourages handwashing with soap instead of the use of hand sanitizers, for reasons including affordability for children, safe handling, and the inability of the product to rid the hands of dirt.

2.5.3.3 Handwashing with and without Soap

How to Wash Hands with Soap

Handwashing with soap has been described as simple yet a complex practice (Jumaa, 2005). It is common to find many guidelines (*E.g.* WHO, 2009; CDC, 2015; Hand Hygiene Australia, 2016) outline the steps to proper handwashing to include the following:

- Turn on clean running water
- Get hands wet
- Apply soap to hands to cover all hand surfaces
- Rub palms together, with fingers interlaced (in-between fingers)
- Rub one palm over the back of another hand and vice versa, with fingers interlaced
- Rub thumb with your other palm, and vice versa
- Wash the tip of your fingers and clean under finger nails (especially when hands are visibly dirty)
- Wash both wrists with palm

- Rinse hands and wrists thoroughly with running water
- Dry hands with a single use towel or air dry

Duration of Handwashing with Soap

Regarding the duration for handwashing, WHO estimates a duration of 40-60 seconds for the entire handwashing procedure, beginning with the wetting of hands to the drying of hands (WHO, 2009). The Center for Disease Control and Prevention has recommended a minimum duration of 20 seconds for the rubbing together of hands (CDC, 2015). The same duration has been suggested by Hand Hygiene Australia (2016). It is however worth mentioning that the duration for handwashing with soap has implications for the compliance to handwashing practice. A study conducted by Kelcíkova *et al.* (2011) showed that reasons for non-compliance to handwashing guidelines included the time required for handwashing with soap.

Handwashing with and without Soap – Relative Effectiveness

There is a growing body of evidence to suggest that handwashing with water alone is less effective for cleaning the hands of pathogens. In an experimental study by Burton *et al.* (2011), the presence of bacteria of faecal origin were found on the hands of 23% of sample participants after they had washed their hands with water alone. On the other hand, handwashing with soap reduced the presence of such bacteria to 8% with respect to the same study sample. A statistically significant difference was observed between the figures generated by the two handwashing arms ($p < 0.001$). Similarly, a study done by Luby *et al.* (2011) in Bangladesh concluded that though handwashing with water alone could reduce the bacteria load on the hands, handwashing with soap led to a greater reduction of bacteria on the hands (OR=0.45; 95% CI=0.26–0.77).

In spite of the above evidence, handwashing with water alone continues to persist. In a global study conducted in eleven countries, while 17% of participants washed their hands with soap, 45%

washed their hands with water only (Curtis *et al*., 2009). The non-usage of soap for handwashing, especially in homes has been linked to problems pertaining to knowledge and attitudes as opposed to the inability of households to acquire soap. For example, Scott *et al*. (2007) identified that though only 2.3% of Ghanaian mothers used soap for handwashing, soap was observed to be available in 96% of homes studied. The study further identified that households rather preferred to use soap for bathing and washing of cloths and dishes, as opposed to washing of hands. In the absence of soap, ash has been recommended for handwashing, especially in rural communities (Baker *et al*., 2014).

2.5.3.4 A Critique of Handwashing with Soap

There are some criticisms in literature related to handwashing with soap, mostly grouped around two issues; the use of antiseptic soap as against plain soap, and the potential risks of HWWS. Soap may come in the form of bars, liquid or leaflets. The main constituents of soap are fat and oils, with either sodium hydroxide or potassium hydroxide (Wolf *et al*., 2001). Earlier studies reported that the use of plain soap for handwashing was ineffective in ridding the hands of pathogens (Ehrenkranz & Alfonso, 1991). Converse to this position, a study conducted in the US which distributed antiseptic soap and plain soap to two sampled populations found no statistically significant difference between the study outcomes (Larson *et al*., 2004). Similarly, in a randomised controlled trial conducted in Pakistan, the incidence of infectious disease did not differ significantly between households that were given an antibacterial soap, and those given plain soap (Luby *et al*., 2005). Additional studies would be required to strengthen the evidence on this phenomenon.

Some concerns have been expressed about HWWS from different but related perspectives. Larson (1999) has reported that HWWS could lead to damaged skin, which may be more heavily colonised

by micro-organisms with pathogenic potential. According to Nicolle (2007), the use of soap for handwashing may result in skin irritation for some people. Another criticism against HWWS has been referred to as the "*hygiene hypothesis*," which suggests that the increased rates of asthma and other related diseases in children in developed countries are linked to a low exposure to microbiologic antigens at an early age. There are those who have argued that "too much cleanliness" can cause the immune system to develop along a pathway which renders children more susceptible to allergic conditions (Nicolle, 2007). There are also concerns that prolonged use of antibacterial cleansing agents such as Triclosan could lead to antibacterial resistance in the community (Aiello & Larson, 2003). By comparing the benefits of HWWS (*see section 2.5.4*) with the potential risk of HWWS, it is apparent that discouraging the promotion of HWWS would invariably accelerate the loss of human lives attributable to an increased spread of infectious diseases.

2.5.3.4 Significance of Hand Drying

Though little attention is given to hand drying in many handwashing interventions, it has been described as an essential aspect of any effective handwashing activity (Jumaa, 2005). According to Michaels *et al*. (2004), a wet hand can facilitate the spread of micro-organisms more than a dry hand. In addition, some studies have linked skin excoriation with damp hands following handwashing (Fawzi *et al.*, 2009; Larson *et al.*, 1998). Hands can be dried using a cloth towel, paper towel, or air dried. The use of a shared cloth-towel is not recommended as evidence has shown that this can be a reservoir for micro-organisms, thereby facilitating the spread of infections (Gerhardts *et al*., 2015; Ansari, 1991).

2.5.4 Effectiveness of HWWS for reducing the Risk of Some Infectious Diseases

There is a plethora of evidence establishing HWWS as effective for reducing the risk of infectious diseases. Globally, Curtis (2003) estimated that HWWS could save one million lives per annum. In a systematic review of RCTs, HWWS was able to reduce diarrhoea risk by 43-47% (Curtis & Cairncross, 2003). Similarly, Freeman *et al.* (2014) in a systematic review and meta-analysis of handwashing practices worldwide reported that HWWS reduced the risk of diarrhoea by 40%. In a more recent systematic review of studies conducted in both the developed and developing world, handwashing promotion with the use of soap was reported to reduce diarrhoea episodes by 30% (Ejemot-Nwadiaro *et al*., 2015).

Handwashing has also been reported to reduce respiratory tract infections by 16% (Rabie & Curtis, 2006). In a cluster-randomised controlled trial, handwashing with soap reduced acute lower respiratory tract infections by 50% (Luby *et al*., 2005). Furthermore, handwashing has been reported to reduce the incidence of trachoma (Emerson *et al*., 2000), and parasitic worm infestation (Fung & Cairncross, 2009). Also, handwashing was described as a protective strategy against the Severe Acute Respiratory Syndrome (SARS) (Fung & Cairncross, 2006).

2.5.5 Hand Hygiene Facilities in Schools

The crucial role of a functional handwashing facility for influencing children's handwashing behaviour is widely known (UNICEF, 2008; Adams *et al*., 2009). A functional handwashing station in a school makes it possible for children to adopt the practice of HWWS. In spite of this importance, national monitoring systems for WASH which is intended to report on the availability and state of handwashing facilities in schools is generally weak in developing countries. Few developing countries have reliable data on hygiene facilities in schools, of which Ghana is no

exception. According to UNICEF, only about half of its programme countries is able to report on WASH facilities in schools (UNICEF, 2011). UNICEF expresses worry over the dearth of reliable data on the quantity and functionality of WASH facilities in schools, as such data is required for good programme design and management. The few studies reporting on the availability of handwashing facilities in African schools appear to paint a gloomy picture of the situation. For example, a study conducted in Senegal reported that only 10% of participating schools had soap available for children's handwashing (Sidibe & Curtis, 2007).

A review of the body of literature suggest a dearth of information on handwashing facilities in Ghanaian schools; a situation which justifies the present study's bid to assess the existing handwashing facilities in a representative sample of basic schools. Though Steiner-Asiedu *et al.* (2011) reported on the poor state of handwashing facilities existing in basic schools in the Tema Metropolis of Ghana, the findings of the authors could be considered preliminary as the study relied on a small convenience sample of eight schools.

2.5.6 Predictors of Handwashing Behaviour

Though it is not uncommon to find studies reporting the factors influencing handwashing behaviour in settings such as the hospital and community, few studies have targeted the school setting. According to the social cognitive theory, the factors influencing behaviour can be both at the individual and the environmental levels (Bandura, 1986).

2.5.6.1 Individual Level Factors

Individual level factors may be cognitive, motivational or habitual (Curtis *et al.*, 2009). They may also be affective or relate to the psychomotor. In a global study involving child caretakers in eleven countries, factors identified to influence handwashing included disgust, nurture, comfort and

affiliation (Curtis *et al.*, 2009). A qualitative methodology underpinned the study, which employed anthropological techniques as well as techniques in consumer science. In a prospective study involving nurses in a hospital setting, individual level predictors of hand hygiene behaviour were identified to include subjective norm, perceived behavioral control, subjective knowledge and risk perceptions (White *et al*., 2015b). In a qualitative study involving primary school children in England, some participants indicated that their handwashing behaviour was influenced by a lack of time (Chittleborough *et al*., 2012). In a study involving 188 nursing students undergoing training in a clinical setting, factors explaining the non-compliance with hand hygiene standards included hand hygiene causing irritation and dry skin, the limitation of time, and the lack of adequate information on the benefits of hand hygiene (Kelcíkova *et al*., 2011). In a Ghanaian teaching hospital, the perception of risk was identified as a factor influencing compliance to hand hygiene guidelines among medical officers and nurses (Yawson & Hesse, 2013). In a study conducted by Steiner-Asiedu *et al.* (2011) in Ghana, limited information is provided to unpick the individual-level predictors of school children's handwashing behaviour. The available literature suggests a dearth of studies which have investigated the influence of individual level variables on HWWS among school children, especially in Ghana.

2.5.6.2 Environmental Level Factors

According to Curtis *et al.* (2009), environmental level factors which can potentially influence handwashing behaviour primarily relates to the physical and social environment. Chittleborough *et al*. (2012) reports adult modelling, accessibility of handwashing facilities, unattractive handwashing facilities, and social norm as factors influencing the handwashing behaviour of primary school children in South-West England. In a prospective study involving nurses in a hospital setting, the lack of a positive role model was identified as a factor influencing regular

handwashing practice (Kelcíkova *et al.*, 2011). In a school based study conducted within the Tema Metropolis of Ghana, inaccessible handwashing facilities was reported as influencing the handwashing behaviour of basic school children (Steiner-Asiedu *et al*., 2011). In another school-based study conducted in Indonesia which involved 274 students, the availability of a handwashing facility was observed to have a statistically significant association with handwashing practice (Setyautami *et al*., 2012). Though some studies have reported on the crucial role of the environment in influencing handwashing behaviour in schools, a review of such studies shows a focus on the physical environment with few studies delving into issues pertaining to the social environment.

2.5.6 Measuring Handwashing Behaviour and Related Variables in Schools - Approaches

Studies which assess hand hygiene variables make use of self-reported data, observational data or both. Self-reported data is derived from responses given by participants which reflect their knowledge, attitudes or practices. Observational data on the other hand tend to rely on the researcher's judgement of a participant's attitude or behaviour relating to the phenomenon under study. Common instruments used by researchers for gathering self-reported data include a questionnaire, interview guide and a focus group discussion guide (Chittleborough *et al*., 2012; Li *et al*., 2011; De Wandel *et al*., 2010; Cairncross *et al*., 2005). On the other hand, observational checklists have often been resorted to by many researchers gathering observational data (Moussa *et al*., 2015; Monistrol *et al*., 2012; Kelcíkova *et al*., 2011; Schmidt *et al*., 2009; Asare *et al*., 2009).

2.5.6.1 Self-Reported Data

Self-reported data has been described as useful for answering questions relating to knowledge, beliefs, or attitudes regarding HWWS, and the factors which influence handwashing behaviour (Ram, 2010). In the area of hand hygiene, several studies have used self-reported data for answering questions on knowledge of the transmission routes of pathogens of faecal origin, socio-cultural beliefs associated with hand hygiene, factors influencing a decision to handwash with soap, among others (Pang *et al*., 2015; Monney *et al*., 2014; Eshetu, 2013; Setyautami *et al*., 2012; Vivas *et al*., 2011). Self-reported data has been criticised for its inability to accurately determine handwashing practice. Some authors have posited that relying on self-reported data to answer questions on a socially sensitive phenomenon such as hygiene can lead to obtaining socially desirable responses, thereby inflating handwashing rates among a given study population (Grimason *et al*., 2014; Curtis *et al*., 2009).

2.5.6.2 Observational Data

As an alternative to self-reported data for measuring practices or behaviour relating to hand hygiene, some authors have recommended a structured observation using an observational checklist (Curtis *et al*., 2009). A structured observation involves observing the daily way of life of a study population (usually from a distance) for a considerable amount of time with the intention of obtaining first-hand insight into their practices relating to a given phenomenon. Within the domain of hand hygiene, some studies have used a structured observation lasting for a period of three (3) hours or more (Pickering *et al*., 2014; Xuan *et al*., 2013; Luby *et al*., 2011). Like self-reported data, observational data is not without criticisms. Structured observation is criticized for its tendency to introduce a *reactive bias* or the *Hawthorne effect*, which can also lead to the inflation of estimates regarding the practice of handwashing with soap (Grimason *et al*., 2014;

Curtis *et al*., 2003). From an ethical perspective, a structured observation may be intrusive and sometimes deceptive as participants are deprived a full disclosure of the actual intention of researchers observing daily activities in homes, work and the learning environments. In spite of the above limitations of a structured observation, many hand hygiene experts agree that the use of a structured observation generates more valid data on handwashing practices than a self-reported approach.

2.5.7 Assessing Handwashing Behaviour – Theoretical Issues

Behaviour change theories (BCTs) continue to demonstrate usefulness in assessing health behaviour within the field of Public Health. According to Glanz & Bishop (2010), BCTs are useful for suggesting ways by which a behaviour might change or be maintained. Trifiletti *et al.* (2005) consider BCTs as useful for the planning, implementation and evaluation of Public Health interventions. The application of a theory in the design of a Public Health research is useful for enhancing the external validity of the study's findings (Elder, 2001). Studies have applied BCTs in varied domains of health including oral health (Solhi *et al.*, 2010), injury prevention (Gielen & Sleet, 2003), blood donation behaviour (Holdershaw *et al*., 2011), and understanding healthy eating habits (Deshpande *et al*., 2009).

BCTs commonly identified in Health Education include the Protection Motivation Theory (Rogers, 1975), the Health Belief Model (HBM) (Rosenstock *et al.*, 1988), and the Theory of Planned Behaviour (TPB) (Ajzen, 1988). The TPB proved to be useful for exploring hand hygiene beliefs among Australian nurses (White *et al*., 2015). Likewise, the HBM was useful for identifying the determinants of oral hygiene practices among children in the US (Walker & Jackson, 2015). In spite of the successes of the aforementioned theories, some authors have

criticized the theories for their overemphasis on personal factors which influence behaviour, with little focus on the wider environmental factors, which oftentimes are beyond the control of the individual (Munro *et al*., 2007). The Social Cognitive Theory (SCT) developed by Bandura (1986) contributes to addressing the limitations of individual level theories by introducing a construct termed "reciprocal determinism". According to this construct, there exists an interplay between personal factors and factors operating at the environmental level (including the social environment) in determining the behaviour of an individual. The SCT has been applied to research investigating the factors which influence personal hygiene practices against influenzas in Hong Kong (Liao *et al*., 2011).

2.5.8 Effect of Hand Hygiene Education on Behavioural Intention, Practice of HWWS or related Endpoints

Studies which have contributed to generating evidence to determine the effect of hand hygiene education evaluated endpoints including knowledge, attitudes/beliefs, behaviour/practice, absenteeism, and incidence of infectious diseases or its symptoms. There is a paucity of studies focusing on 'behavioural intention' as an endpoint, though behavioural intention has been described as the closest determinant of behaviour (Ajzen, 1988). This study gives substantial focus to "behavioural intention" as an endpoint. Table 2.1 presents a summary of the characteristics of studies which have investigated the effectiveness of hand hygiene education in diverse settings.

2.5.8.1 Effectiveness of Hand Hygiene Education - The Available Evidence

Robust studies assessing the effectiveness of a theory-driven hand hygiene education for enhancing HWWS or other endpoints in a school setting remain scanty. In a teaching hospital located in Virginia, Bischoff *et al.* (2000) reported the effectiveness of a hand hygiene educational

programme in increasing compliance to hand hygiene standards from a baseline figure of 51% to 83%. From a study by Guinan *et al.* (2002), a comprehensive handwashing programme which included a one-hour hygiene education was able to reduce absenteeism in five elementary schools in Pennsylvania. In another study by Snow *et al*. (2008), a teacher cue to action and a hand hygiene educational intervention were delivered in a public elementary school in Utah. Authors reported that the intervention was effective in terms of improving the application of hand hygiene products. Sandora *et al*. (2005) reported that a multi-faceted intervention including a hand hygiene education was effective in reducing the transmission of gastro-intestinal illnesses in the homes of three neighbourhoods in Massachusetts.

Schweon *et al*. (2013) conducted a study involving some long-term care facilities in Pennsylvania and reported that a comprehensive hand hygiene programme involving hand hygiene education was effective in reducing lower respiratory tract infections, as well as skin and soft tissue infections. Similarly, in a tertiary care hospital in Spain, Monistrol *et al.* (2012) reported that a hand hygiene educational programme was able to improve compliance to the use of alcohol-based hand rub from 54.3% to 75.8%. In rural India, Biran *et al.* (2009) in a cluster randomised trial involving 30 households reported that soap promotion and traditional hygiene education led to significant changes in knowledge, but failed to achieve a statistically significant difference in the observed handwashing practice of study participants.

In Africa, Haggerty *et al.* (1994) in a community based study in the then rural Zaire concluded that hygiene education may be effective in reducing the incidence and duration of diarrhoeal episodes. The authors however did not provide sufficient information to determine whether or not issues of hand hygiene were included in the hygiene education. Also, a study conducted by Lansdown *et al*. (2002) in Tanzanian primary schools reported that an enhanced health education on personal

hygiene led to an increase in knowledge of participants post intervention. Similarly, the authors did not provide sufficient information to ascertain whether or not the health education component of the intervention included issues on hand hygiene education. In Egypt, Moussa *et al.*, reported that the handwashing practice of elementary school children was improved following a health educational programme (Moussa *et al.*, 2015). Again, authors did not report the intervention as being a hand hygiene education. Also, the study was underpinned by a quasi-experimental design involving two government schools. A quasi-experimental design is prone to a severe compromise of internal validity, as extraneous variables could interfere with the study results (Rosen *et al.*, 2006). Lang (2012) in a qualitative study conducted among elementary school children in Ghana reported that hand hygiene knowledge and practice improved following a hand hygiene programme.

Graves *et al*. (2012) conducted a study in Kenya, that implemented a handwashing educational intervention employing a poster design competition among school children and evaluated its effect on handwashing practice. Though this intervention sought to assess handwashing practice as a dependent variable, the intervention delivered failed to consider the skill-development dimension of hand hygiene education, an essential learning domain which makes the practice of HWWS possible. Authors reported that the intervention failed to achieve a significant difference between the intervention and control arms, regarding the frequency of handwashing.

It can be observed that the studies described present varied intervention effects of a hand hygiene education. In a systematic review and meta-analysis which assessed the effectiveness of hand hygiene interventions, authors described the effect of hand hygiene interventions on the incidence of infections in school settings as equivocal, and conclude with a call for more robust RCTs (Willmott *et al.*, 2015).

Table 2.1: Characteristics of Studies Assessing the Effectiveness of Hygiene Interventions

Study (Location of Study)	Type of Intervention	Methodological Approach	Study Design	Setting of Intervention	Method of Analysis	Total Participants	Key Endpoints/ Dependent Variables Assessed	Use of *Int. and Control Group(s)	*Int. Reportedly Effective
Bischoff *et al.* (2000) (Virginia)	Education/Feedback intervention program	Quantitative	Prospective observational study	Hospital	Fisher's exact test, x^2 statistic and t test for equal variances using Epi Info Version 6.0	Not reported	• Hand washing practice/rates	No	No
Guinan *et al.* (2002) (Pennsylvania)	Education and use of a hand sanitizer	Quantitative	Not reported	Elementary schools	Binomial distribution with parameters of n = 27 and P = .05	290	Absenteeism	Yes	Yes
Sandora *et al.* (2005) (United States)	Increasing Alcohol-based sanitizer use & Hand hygiene Education	Quantitative	Cluster randomized control trial	Home	Fisher's exact test, Wilcoxon rank sum test, Poisson distribution model, Generalized estimating equations	292	• Knowledge on hand hygiene • Practice of hand hygiene • Illness occurrence (RTI and GI illness)	Yes	Yes
Schweon *et al.* (2013) (Pennsylvania)	Increasing availability of hand sanitizers & education	Quantitative	Not reported	Long-term care facility	Not reported	Not reported	• Infection rates. • Hand hygiene compliance rates	Not reported	Yes
Monistrol *et al.* (2012) (Terrassa, Spain)	Educational and motivational campaign	Quantitative	'Before and after' interventional study	Tertiary care Hospital	Chi-square, Fisher's exact test, Student's t-test and the Mann–Whitney U-test.	968	Hand hygiene compliance. Hand rub usage. Incidence density of hospital acquired infections.	No	Yes
Snow *et al.* (2008) (Utah-US)	Teacher cue to action & Hand hygiene education	Quantitative	Not reported	Public elementary school	A 2-sample test of proportion using STATA 8.0	492	Application of hand hygiene products	Yes	Yes

Biran *et al.* (2009) **(Rural Indian)**	Germ awareness campaign	Quantitative	Cluster randomized control trial.	Households	Binomial regression model, ANOVA model, Multinomial logistic and ordered logistic regression using STATA 9.	300	• Knowledge of germs • Practice of HWWS	Yes	No
Haggerty *et al.* (1994) **(Rural Zaire)**	Hygiene education	Quantitative	Randomized control trial	Homes	Standard normal deviate (SND) tests or analyses of variance, Chi squared tests.	2082	• Incidence and duration of Diarrhoea episodes	Yes	Yes
Lansdown *et al*. (2002) **(Tanzania)**	Enhanced health education	Mixed	Not reported	Schools	Not reported	Not reported	• Health -seeking behaviours. • Knowledge of disease causation and prevention	Yes	Yes
Moussa *et al.* (2015) **(Port Said, Egypt)**	Health educational program	Quantitative	Quasi-experiment	Primary Schools	Mean and standard deviation using IBM SPSS 20.0. Qualitative data were described using number of and percentage.	450	• Knowledge about HW • HW Practices	No	Yes
Graves *et al*. (2012) **(Rural western Kenya)**	Provision of *HW infrastructure & HW education using a poster contest	Quantitative	Cluster-randomized trial	Primary Schools	Bivariate analyses, Two sample paired t-test, Wilcoxon rank-sum non-parametric test using STATA /IC 10.1	Not reported	• HW practice	Yes	No
Eshetu (2013) **(Ethiopia)**	Integrative model and media priming	Mixed	Before and After	Primary School	Wilcoxon's Matched Pairs Sign Rank Test, using SPSS	44	• Intention to handwash with soap • Practice of HWWS	No	Equivocal
Lang (2012) **(Ghana)**	Hand hygiene intervention	Qualitative	Not reported	Elementary schools	Not reported	1739	• Hand hygiene Knowledge • Hand hygiene practice	No	Yes

Source: Author's Compilation, 2016

*Int. – Intervention; *POs – Primary Outcomes; *HW-Handwashing;

2.5.8.2 Methodological Issues

Designing a methodology for research on hand hygiene can be described as complex and challenging (Jumaa, 2005). The underlying reason is that hand hygiene behaviour emanates from a complex interaction among many factors, from the individual level to the environmental level. According to Rosen *et al*. (2006), quasi-experimental designs which have been used by many health promotion researchers for accommodating the complexities surrounding the evaluation of Health Promotion interventions are prone to a severe compromise of internal validity.

RCTs which have been viewed as the 'gold standard' for medical research (Rosen *et al*., 2006) have been questioned within the Health Promotion community for the use of the individual as a unit for randomisation. Some have argued that the primary focus of Health Promotion is the group or community, and so the randomisation of individuals to an intervention or control group defies the philosophy of Health Promotion (Green & Tones, 1999). In contributing to addressing this challenge, the Cluster-Randomised Controlled Trial (cRCT) has evolved. Unlike a conventional RCT, a cRCT randomises at the level of a group, and not at an individual level (Rosen *et al*., 2006).

A cRCT can be used to study the effect of Health Promotion interventions on endpoints including attitudes, intentions, behaviour, morbidity or mortality (Rosen *et al*., 2006). It is however worth stating that very few Health Promotion studies will adopt morbidity and mortality as endpoints for reasons which have been described elsewhere (see Green & Tones, 1999). Though RCTs remain a key source of information for public health decision making, very few RCTs have been conducted in developing countries. Within the domain of hand hygiene, Jumaa (2005) in a study reviewing the body of literature on hand hygiene concluded by emphasising the need for more robust designs for hand hygiene research. Similarly, Curtis *et al.* (2011) expressed concern about

the very few RCTs published in the area of hand hygiene in developing countries (Curtis *et al.*, 2011).

In a systematic review and meta-analysis of RCTs, Willmott *et al.* (2015) included studies which sought to determine the effect of hand hygiene interventions on illness absence in school settings that were generally not well executed and reported. This finding appears to be in consonance with earlier calls from Jumaa (2005) and Curtis *et al.* (2011) for more RCTs in order to establish a robust evidence base of effectiveness of hygiene promotion interventions, especially in developing countries. This present study attempts to respond to the calls (Jumaa, 2005; Curtis *et al.*, 2011; Willmott *et al.*, 2015), by adopting a cRCT to determine the effect of a theory-based hand hygiene educational intervention on behavioural intention and handwashing practice in schools.

2.5.8.2.1 Designing and Analysing Cluster-Randomised Controlled Trials

When compared to RCTs, designing and analysing cRCTs is more complex. A decision to randomise at the cluster-level introduces new challenges relating to clustering, which must be controlled for at both the design and analysis stages of the research (Hayes & Moulton, 2009). At the design stage, a sample size should be estimated by taking into consideration an intra-cluster correlation coefficient (ICC) which is obtained either through a formative research or from the body of literature. An ICC is a measure of homogeneity within a cluster with respect to a key study variable. An ICC can also be considered as an estimate of a between-cluster variability (Eldridge & Kerry, 2012). With an ICC, a design effect or inflation factor for a given sample size can be estimated.

Two notable approaches exist for analysing data in a cRCT. These are; cluster-level analysis, and individual-level analysis. A cluster-level analysis is a two-stage approach which makes use of

aggregate cluster-level summaries to determine the statistical difference between two sets of clusters constituting the intervention and control arms, with respect to an outcome measure of interest (Campbell & Walters, 2014; Hayes & Moulton, 2009). On the other hand, an individual-level analysis makes use of individual respondent data to develop a regression model with robust standard errors; or may employ random-effects models using individual level data (Campbell & Walters, 2014). When compared to an individual level analysis, an aggregate cluster-level analysis is more robust when an analysis involves a small number of clusters (Eldridge & Kerry, 2012; Hayes & Moulton, 2009). A cluster-level analysis is recommended especially when the number of clusters per arm is fewer than fifteen (Hayes & Moulton, 2009). On the basis of the aforementioned discussion, the study adopted a cluster-level analysis for determining the intervention effect at follow-up.

2.6 Summary of Key Issues Emanating from Literature

The literature review showed that few attempts have been made in conceptualizing the term hand hygiene. On the basis of this, the present study has suggested a definition of hand hygiene, which is deemed to be relevant for the conceptualisation of hand hygiene in varied settings.

Secondly, a review of the body of literature brings to the fore the paucity of data on hand hygiene facilities in schools, especially in the developing world. This study contributes to generating data on hand hygiene facilities in schools. Furthermore, the available literature suggests a dearth of studies which have investigated the individual-level predictors of HWWS in schools, especially in Ghana. This study contributes by generating evidence on the psychosocial predictors of HWWS.

Also, with regard to approaches for measuring handwashing practices, it is widely accepted in the body of literature that self-reported data are useful when answering research questions relating to

variables such as knowledge, beliefs, and attitudes. Regarding measuring the practice of HWWS, a well-designed structured observation is preferred. In addition, the review of literature shows a paucity of studies measuring 'behavioural intention' as an endpoint, though behavioural intention has been described as the closest determinant of behaviour. This study measures 'behavioural intention to wash hands with soap' as an endpoint.

From the body of literature, it is evident that robust studies assessing the effectiveness of a theory-driven hand hygiene education for enhancing behavioural intention and the practice of HWWS in a school setting remain scanty. This present study sought to contribute towards building the evidence-base in the aforementioned domain.

CHAPTER THREE

METHODOLOGY

The section describes the broad methodology, and specifies the methods underpinning each specific objective of the study. The epistemological debate surrounding the nature of evidence in Health Promotion is discussed, leading to a justification of the choice of a quantitative methodological approach. Thus, the section is organised mainly according to the four (4) specific objectives of the study, and describes key concepts including; study approach and design, sampling, data collection methods and tools. In addition, data handling, analysis and presentation are described. The section concludes with a description of ethical considerations guiding the study.

3.1 Evidence in Public Health-Health Promotion

Generating evidence in Health Promotion (HP) continues to engender epistemological debates, influenced mainly by the *positivist* and *interpretivist* paradigms. For example, Green & Tones (1999) have argued against the strict adherence to quantitative approaches for generating evidence in HP. In converse to their perspective, Rosen *et al*. (2006) have elaborated extensively on the utility of a quantitative approach for judging the effectiveness of HP initiatives. The perspective of WHO however is that there is no single approach for generating evidence in HP (WHO, 1998). Considering the fact that this study primarily seeks to measure the effect of an intervention on a health behaviour, it becomes expedient to approach the study from a positivist paradigm and in a manner that controls for all possible confounders to the intervention effect. In the light of this, a quantitative approach was employed for the study.

3.2 Describing the Distribution of Functional Hand Hygiene Facilities in Schools - Methods

This aspect of the study sought to develop a profile of the existing functional hand hygiene facilities in a representative sample of schools. The rationale for this activity is two-fold. First and foremost, the assessment offers an opportunity to contribute towards developing a reference material which could guide the handwashing facility planning within the Ejisu-Juaben Municipality. Secondly, the information generated was useful in the compilation of a list of schools that were potentially eligible to participate in the experimental component of this research (*see inclusion criteria under section 3.3.3*).

3.2.1 Approach and Design

The existing hand hygiene facilities were assessed quantitatively using a cross-sectional design. The choice of a design was informed by the underlying purpose of the assessment, which was to present a snapshot of functional facilities at a given point in time.

3.2.2 Sample Population, and Sample Size

The study targeted 80 public junior high schools (with pupils expected to be aged from 12 to 14 years) in the Ejisu-Juaben Municipality. Schools were organised within 10 educational 'circuits' (considered as strata, for the purpose of this study). The organisation of the schools is based on geographical location. The list of schools was obtained from the Municipal Education Directorate of the study area. A representative sample of 37 schools was derived from the 80 schools using two complementary formulas. Formula 1 was developed by Yamane (1967), while formula 2 was developed by the Pennsylvania State University (2016). Formula 2 complements formula 1 when estimating a sample size using a small finite sample population (usually less than 100)(Pennsylvania State University, 2016). Formulas are presented below:

$$n_1 = \frac{N}{1 + N(E)^2} \quad \ldots\ldots\ldots\ldots Formula\ 1$$

Where, n_1 is the initial sample size; *N* is the sample population of schools and *E* is the margin of error at a 95% confidence level (0.05).

Subsequently, a correction factor was computed (for a small finite population)

$$n_2 = \frac{n_1}{1 + \frac{n_1 - 1}{N}} \quad \ldots\ldots\ldots\ldots Formula\ 2$$

Where, n_2 is the final sample size; n_1 is the initial sample size, *N* is the sample population.

Substituting the variables into formula 1

$$n_1 = \frac{80}{1 + 80(0.05)^2} \quad \ldots\ldots\ldots\ldots Formula\ 1$$

$$n_1 = \frac{80}{1 + 80(0.05)^2} = 66.7$$

Correcting the initial sample size (n_1) using formula 2

$$n_2 = \frac{66.7}{1 + \frac{66.7 - 1}{80}} \quad \ldots\ldots\ldots\ldots Formula\ 2$$

$$n_2 = \frac{66.7}{1.82} = 36.6$$

3.2.3 Sampling Technique

In a bid to ensure that each school in all 10 educational circuits had an equal chance of being a part of the study, and in a manner that enhances the external validity of study results, a Stratified Random Sampling technique was employed. In line with this technique, educational circuits constituted the strata, while schools constituted the sample units. As part of the process of conducting a Stratified Random Sampling, a *proportionate stratification* approach was employed (Bowling, 2009).

In line with the proportionate stratification approach, the estimated sample sizes of each educational circuit were drawn using a simple random technique. With this technique, schools within each stratum were assigned arbitrary numbers, which were captured on folded pieces of paper and shuffled in a transparent container. Afterwards, schools were drawn from the container until the estimated sample size figures were attained. A formula obtained from StratTrek (2016) presented below was used to calculate the sample sizes required from each of the 10 educational circuits. Table 3.1 presents the estimated number of schools required from each educational circuit.

$$n_h = \frac{N_h}{N} \; x \; n$$

Where n_h is the sample size for stratum h, N_h is the population size for stratum h, N is total population size, and n is total sample size.

Table 3.1: Estimated Number of Schools Drawn from Educational Circuits

ID	EDUCATIONAL CIRCUIT	NO. OF SCHOOLS IN CIRCUIT	NO. OF SCHOOLS PROPORTIONAL TO SIZE
A	Achinakrom	6	3
B	Bomfa	8	4
C	Ejisu	11	5
D	Fumesua	5	2
E	Kubease	8	4
F	Kwaso	9	4
G	New Koforidua	6	3
H	Ofoase	5	2
I	Juaben	14	6
J	Tikrom	8	4
	TOTAL	**80**	**37**

Source: Author's Construct Based on Information from EJM Education Directorate, 2015

3.2.4 Data Collection - Method and Tool

Data on facility assessment was gathered within the period of March 2016 and July 2016. A checklist adapted from UNICEF and Moore *et al.* aided the assessment towards obtaining first hand data on existing facilities in schools (UNICEF, 2011; Moore *et al*., 2003). A decision on the facilities to observe was guided by a WASH-in-schools monitoring package developed by UNICEF (UNICEF, 2011). The observation tool was pretested in a junior high school located in a municipality which is contiguous to the geographic scope of this study (student enrolment, *n*=256), and was subsequently fine-tuned. For instance, after the pretest of the instrument, it became necessary to include an item that enabled the observation of a functional toilet facility within schools. This was essential due to the complementarity of the concepts of hygiene and sanitation. Where required, clarifications on facilities were sought from the head teacher or an authorized representative of the school. The checklist makes use of dichotomous questions and assesses the school environment based on predetermined parameters. These parameters included; accessibility and source of water points, existence of functional handwashing stations, functionality of toilet facility, and accessibility to the toilet facility. The checklist is attached as *appendix 2b*.

3.2.5 Data Analysis and Presentation

Descriptive statistical analysis was used in describing the existing functional facilities in schools. A Scalogram Model was used to profile the distribution of functional facilities among participating schools. The first two columns of the Scalogram Matrix present a list of participating schools with their respective student enrolment figures. The second row presents the facilities assessed in the study. Corresponding to the facilities are codes indicating whether or not a particular facility existed in a particular school. At the base of the matrix are the corresponding weights of each of

the facilities calculated by dividing the assumed centrality by the total number of facilities. The last two columns present the total number of facilities in each school as well as the centrality indices.

The Student's *t*-test, Fisher's exact test, and a two-sample proportion test were used to explore for possible relationships between key variables, and differences in proportions of variables. Data were analyzed using STATA *version 14.0* (*STATA Corp., College Station, Texas*).

3.3 Estimating the Effect of a Hand Hygiene Educational Intervention on Behavioural Intention, and HWWS - Methods

3.3.1 Approach and Design: A Cluster-Randomised Controlled Trial (cRCT)

The design adopted was a two-arm Cluster-Randomised Controlled Trial (cRCT), with an allocation ratio of 1:1. A cRCT is an experimental design in which intact social units (or clusters of other units) are randomly allocated to intervention and control arms (Thabane, 2004). For the purpose of this study, a school was considered as a cluster, with its units being the individual pupils (Rotondi, 2009). Randomization was therefore done at the school level. CRCTs have gained popularity within Health Promotion potentially due to their ability to address the practical difficulties involved in randomising individual units in circumstances where there exist intact social groups.

In line with the cRCT, a pre and post intervention assessment was conducted at the two study arms. Following post intervention assessment was a comparison of the two study arms to determine whether a statistically significant difference existed for key study variables. This was essential in determining whether the intervention was successful in enhancing the key variables.

For the purpose of this study, a statistically significant difference was judged using $p<0.05$ (at a confidence level of 95%). In the event that the scores of variables for the intervention arm was statistically significantly higher than that of the control arm, then the intervention was judged to be successful in enhancing the variable under consideration (Gitlin & Czaja, 2016).

3.3.2 Hypotheses of cRCT

Emanating from specific objectives two and three of this research (*see section 1.6*), the following hypotheses were tested.

Category 1:

- H_o: There will be no significant difference in mean intention to wash hands with soap, between the two study arms at follow-up
- H_a: There will be a significant difference in mean intention to wash hands with soap, between the two study arms at follow-up

Category 2:

- H_o: There will be no significant difference in the proportions of pupils washing their hands with soap, between the two study arms at follow-up
- H_a: There will be a significant difference in the proportions of pupils washing their hands with soap, between the two study arms at follow-up

3.3.2 Study Participants

The primary participants of the trial were Junior High School (JHS) children in the Ejisu-Juaben Municipality. Secondary participants included JHS teachers. A flow chart which provides details of the progression of participants through the phases of the cRCT is presented under *section 4.2.1*.

3.3.3 Inclusion and Exclusion Criteria for the cRCT

Schools that participated in the trial met the following inclusion criteria:

- had a JHS section with grades 1, 2 and 3
- had a functional water facility located within the school compound
- had a functional toilet facility located within the school compound

On the other hand, a school was excluded if:

- School management did not agree to their participation in the study
- an intervention judged to be similar to this study was being implemented in the school or has been implemented within the past year

Inclusion/exclusion criteria for pupils has been described under *Section 3.3.7*.

3.3.4 The Intervention: Description, Rationale and Delivery

Traditionally, and for many years, many behaviour change interventions in the area of hygiene have resorted to hygiene education. Conventional hygiene educational interventions have focused on passing information to people to build knowledge on issues pertinent to safe hygiene. Though knowledge acquisition is vital for behaviour change, knowledge relates to only one of the three domains of learning, namely the *cognitive domain*. Considering a skill-based behaviour such as handwashing with soap (HWWS), it might be essential that beyond influencing the cognitive domain, the other domains of learning namely the *affective domain* and the *psychomotor* are targeted also by interventionists. Affective domain relates to the attitudes or feelings about the subject of learning, while psychomotor relates to the skills required to perform a behaviour under consideration (Bloom, 1956).

Conventional hygiene education has been viewed by many experts in the field of WASH as yielding less success, in terms of enabling people to adhere to hygienic practices (UNICEF, 2008). Reasons accounting for this limited success have been cited to include the following; an intense drive to increase knowledge with little drive to changing behaviour, the use of a top-down approach, and failure to recognize the peculiarity of contextual variables that influence behaviour (*ibid*). In a bid to contribute to addressing the limitations of traditional hand hygiene education, a theory-based hand hygiene educational intervention which is focused on influencing the three domains of learning (*i.e.* cognitive, affective and psychomotor), and is underpinned by a participatory approach was developed for this study. The intervention is named '*HandsCare*' to reflect the need to care for the hands by practicing handwashing with soap, under running water, and at critical times.

3.3.5 Theoretical Basis of Intervention and Underlying Principles

The content and delivery of the intervention was based on Bloom's Taxonomy of Learning Theory (Bloom, 1956), and psychosocial theories including the Theory of Planned Behaviour, Social Cognitive Theory, and the Health Belief Model. The aforementioned theories have demonstrated usefulness in understanding relationships between variables in a range of volitional health behaviours including HWWS (Eshetu, 2013; White *et al.*, 2015a; Dreibelbis *et al.*, 2013; Dyson *et al.*, 2010).

Key among the Health Promotion principles which underpinned the delivery of *HandsCare* was participation. Beneficiary participation is key to achieving sustainability of interventions, and leads to the empowerment of beneficiaries (Green & Tones, 2010). Some strategies used to ensure teacher and student participation are discussed under *section 3.3.8*.

3.3.6 Outcome Objectives of Intervention

The aim of the intervention was to increase knowledge, influence attitudes and develop skills for HWWS. In line with this aim, the outcome objectives were the following:

a. Existing socio-cultural beliefs about diarrhoea identified
b. Knowledge about the transmission and prevention of diarrhoea pathogens increased
c. Knowledge about the consequences of diarrhoea to health and educational aspirations enhanced
d. Positive attitudes to HWWS enhanced
e. Participants' skills for practicing proper HWWS improved

3.3.7 Beneficiaries of Intervention

Beneficiaries of *HandsCare* were school children expected to fall within the ages 12 to 14 years (junior high level), who were based in the intervention arm of the study, and who met the inclusion criteria below:

- Children who assented to participate in the study
- Children whose parents/guardians consented to their participation in the study

3.3.8 Training of Teachers and Intervention Delivery

HandsCare was delivered by teachers, selected from intervention schools and trained prior to the intervention delivery. The training primarily focused on how to use the protocol guiding the intervention delivery (*protocol attached as appendix 7*). Training sessions were characterised by learning techniques such as discussions, illustrations/ demonstrations, and role plays. All training sessions were facilitated by the principal investigator, who has an advanced training in Health Promotion, and teaches Health Promotion at the post-graduate level. The training had a duration

of two (2) days, with a period of five (5) hours per daily session. The eligibility criteria used for recruiting teachers for the training is presented below:

- A minimum experience of three years teaching at the junior high level
- Consent to participate in the implementation of *HandsCare*
- Willingness to act as a role model to pupils in issues relating to hygiene

The intervention which lasted approximately two (2) hours on a given day was delivered in English with the aid of posters on handwashing. It required three (3) working days to deliver the intervention in each intervention school. All sessions of the educational intervention were delivered within a period of one month. The following approaches were used for teaching and learning sessions:

- Topical discussions
- Practical sessions
- Reflections

To aid the delivery of the intervention, a user-friendly manual was developed and used by participating teachers. The manual is organised into three (3) modules and subsequently into sessions, with concise modular and sectional objectives, which are in consonance with the key objectives of this research (Educational Manual is attached as *appendix 7*).

Topical Discussions

Preceding modular discussions was a session which explored the lay perceptions and socio-cultural beliefs associated with diarrhoea transmission and prevention. This enabled teachers to establish discrepancies between students' socio-cultural beliefs and evidence-based perspectives on diarrhoea and handwashing. The following were ten (10) key questions which were addressed at the discussion sessions.

- What do people in my community say about diarrhoea transmission?
- Are germs really on my hands?
- How do hands get germs on them?
- Do germs really cause diarrhoea?
- Is it a big deal if I have diarrhoea?
- Why is handwashing with soap important?
- When is handwashing with soap important?
- Do people really not wash their hands?
- Why should I wash my hands?
- How do I wash my hands?

The questions were developed by drawing from existing literature on hand hygiene education targeting children, which included recommendations by the Tacoma/Pierce County Health Department (2007) and Minnesota Department of Health (2003).

Skill-Based (Practical) Sessions

The skill-based session sought to enhance the psychomotor domain of learning. Demonstrations of handwashing with soap (HWWS) under running water was led by participating teachers. Subsequently, school children took turns to practice HWWS, after which other pupils were asked to point out what was done well and what was not done so well. A pupil was not limited to any length of time for the demonstration of handwashing skills. In the event that a pupil missed out on a crucial step for proper handwashing, there was an opportunity for him/her to begin the process. Thus, the practical session offered an opportunity for sharing lessons, and developing skills on proper handwashing practice.

Reflection Sessions

Each day's activities ended with a reflection session. During this session, pupils had the opportunity to seek clarifications on modular discussions and share their experiences with

diarrhoea and handwashing with soap. In a bid to ensure a participatory approach to learning, participants took key roles in the reflection activities, which in the end helped to deepen their understanding of the topical issues discussed.

3.3.9 Intervention Fidelity

The fidelity of the intervention delivery was assessed using data obtained from a direct observation. This strategy has been described as being more reliable when compared to other strategies which rely on self-reported data (Breitenstein *et al*., 2010; Mellard, 2010). An observer checklist based on pre-determined parameters (*See appendix 2d*) was used to assess the intervention delivery. Checklist was developed with guidance from Mellard (2010). Field observers checked YES or NO to indicate whether a particular measurement item was observed to be followed by teachers in the intervention delivery process. There were 10 measurement items on the checklist with each carrying a score of 1 if that item was observed and 0 if it was not observed. Thus, an observer scored 10 points if all measurement items were observed and 0 if none was observed. Mean scores were then computed for all the educational sessions occurring in each school in order to derive a single score for a school. Mean scores were subsequently converted into percentages, and these denoted the total fidelity score for a given school.

For the purpose of this study, a threshold of 70% was used to determine whether intervention fidelity occurred in a given school. Thus, a school with a fidelity score of 70% or more was considered to have conformed to the intervention delivery protocol. The assessment yielded an 84% score for intervention school A (Onwe Methodist JHS) and 70% score for intervention school B (Hwereso MA JHS).

3.3.10 Characteristics of Study Variables

Health behaviour is multi-faceted and the environment which influences it is complex (Nutbeam *et al.,* 2010). In the light of this, the use of multiple theory becomes essential in the design of health behaviour interventions. The variables for this study were developed by drawing from theories/models namely the; Social Cognitive Theory (SCT), Health Belief Model (HBM), and Theory of Planned Behaviour (TPB). Characteristics of study variables are presented in Table 3.2.

Table 3.2: The Characteristics of Variables

SN	Key Variables	Variable Type
	Independent Variables	
1	Perceived susceptibility [HBM]	Continuous
2	Perceived seriousness [HBM]	Continuous
3	Attitude to HWWS [TPB]	Continuous
4	Subjective norms [TPB] ▪ Normative beliefs ▪ Motivation to comply	Continuous
5	Knowledge of HWWS [Behavioural capacity-SCT]	Continuous
6	Skill to perform HWWS [Behavioural capacity- SCT]	Continuous
8	Existence of supportive handwashing facilities [SCT]	Binary
9	Existence of a school regulation on HWWS	Binary
	Intermediate Variable	
11	Behavioural intention [TPB]	Continuous
	Dependent Variable	
12	Practice of HWWS after toilet use	Binary
13	Practice of HWWS before meals	

Source: Author's Construct, 2016

From Table 3.2, the primary outcomes which the intervention sought to enhance were:

1. Practice of HWWS after - toilet use
2. Practice of HWWS before - meals

The intermediate outcomes were:

1. Intention to wash hands with soap - after toilet use
2. Intention to wash hands with soap - before meals

Key explanatory variables assessed pre and post intervention included knowledge of hand hygiene, attitude to HWWS, and skills for practicing HWWS. All variables were measured quantitatively. The study adopted a two-weeks post intervention assessment, which is similar to related studies such as Kamm *et al.* (2014), and Feikin *et al*. (2010).

3.3.11 Sample Size Estimation for cRCT

Four schools were estimated to detect at least a 60% reduction in the proportion of pupils who do not practice proper handwashing at follow-up. Statistical power was set at 80% while significance level was set at 5%. The average cluster size was estimated to be 153 students and the intra-cluster correlation coefficient (ICC) was assumed to be 0.03 based on published studies (Hutchison 2009; Pickering *et al*. 2013). The assumed ICC was subsequently used for estimating the design effect (DE) which was required in a bid to adjust for clustering at the design stage. A formula developed by Thabane (2004), presented below was adopted in the estimation of sample size.

$$k = \frac{(z\alpha_{/2} + z_{\beta})^2 \left[\pi_1(1+\pi_1) + \pi_2(1-\pi_2)\right] \times IF}{m(\pi_1 - \pi_2)^2}$$

Where, k is the estimated number of clusters per arm;
$z\alpha_{/2}$ is the z-score at a 95% confidence level = 1.96;
z_{β} is the statistical power = 80%, with a corresponding z-score of 0.84 ($z_{0.80}$= 0.84)
π_1 is first proportion (proportion of target participants who do not handwash with soap) = 0.95;
π_2 is second proportion (expected proportion of participants who do not handwash with soap) = 0.35;
m is the average cluster size = 153;
ρ is the intra-cluster correlation co-efficient (ICC) = 0.03
IF is the inflation factor (or design effect) given as $1+(m-1)\rho$, which is computed to be 5.56

$$k = \frac{(1.96 + 0.84)^2\,[0.95(1 + 0.95) + 0.45(1 - 0.45)] \times 5.56}{153\,(0.95 - 0.45)^2}$$

$$k = \frac{7.84\,[1.8525 + 0.2475] \times 5.56}{153\,(0.5)^2} = 2.39$$

Thus, a minimum number of four (**4)** schools were required for the study (*i.e.* 2 clusters per arm). In adherence to the ethical principle of *equity*, which ought to govern the selection of participants in educational trials, a decision was made to recruit all children who were in school at the time of the baseline study, who assented to participate and whose parents had given a consent to their participation. A total of 328 students were recruited from the intervention arm, while a total of 389 were recruited from the control arm.

3.3.12 Randomisation

Out of a total of 37 schools assessed for potential eligibility, four (4) schools met the study's inclusion criteria (*see section 3.3.3 for inclusion criteria*) and were therefore randomised into the two arms of the study. The essence of generating a random allocation sequence was to eliminate allocation bias, thereby strengthening the internal validity of study results (Schulz & Grimes, 2002). Using a *random number table*, with guidance from a handbook developed by the Air University (2002) and Woodruff *et al.* (2009), a five (5) step procedure was followed in allocating the four (4) schools into either an intervention arm, or a control arm. The steps are outlined below:

Steps

1. Each of the 4 schools were assigned an arbitrary number as follows: Onwe Methodist (*1*), Ejisu M/A Model (*2*), Hwereso M/A (*3*) and Nobewam Presby (*4*).
2. From a table of random numbers, an arbitrary number was chosen as a starting point (*i.e.* 9744**2**), and a decision was made to read numbers in a downward flow, beginning with a number which comes after the starting point

3. Only numbers ranging from 1 to 4 were considered in course of the reading (in line with the total number of schools)
4. An arbitrary decision was made to assign the first 2 random numbers generated by the number table to the intervention arm, while the subsequent 2 random numbers went to the control arm
5. With a focus on last digits of random numbers (97442), the first four numbers generated were **1, 3, 2, 4** which corresponded to the following schools; Onwe Methodist (*1*), Hwereso M/A (*3*), Ejisu M/A Model (*2*), and Nobewam Presby (*4*).

3.3.12.1 Allocation to Intervention and Control Arms

Based on step 5 above, clusters constituting the intervention arm of the study were; Onwe Methodist (*1*), and Hwereso M/A (*3*). Regarding the control arm, the clusters were; Ejisu M/A Model (*2*) and Nobewam Presby (*4*). Though the two study arms showed similarity by WASH infrastructure (*eg.* existence of functional water and toilet facilities), a further assessment was made to establish demographic, and psychosocial similarity at baseline. Allocation of study arms, and the primary outcome being measured were concealed to school children, their teachers and the schools' management. This was a measure to control for the Hawthorne effect (*i.e.* reactive bias) and subsequently strengthen internal validity (Cottrell & McKenzie, 2011).

3.3.12.2 Selection of Grades/Classes

In a bid to recruit pupils who were well developed cognitively and could rationalise their handwashing behaviour, the Piaget's Theory of Cognitive Development was used. This theory postulates that cognitive growth in children progresses through four (4) stages which are the *sensorimotor*, *preoperational*, *concrete operational* and *formal operational*. It is within the formal operational stage that a child is fully developed cognitively and can fully handle abstract ideas and

engage in deductive reasoning (Piaget, 1963). According to Piaget, a child aged above 11 years fits within the formal operational stage of cognitive development. Considering the structure of the Ghana Education Service (GES), the expected age of a child in JHS 1 (or grade 7) is 12 years. When interpreted along the tenets of the above theory, it can be inferred that children in JHS 1 (grade 7), JHS 2 (grade 8) and JHS 3 (grade 9) have developed well enough cognitively to be able to rationalise their handwashing behaviour. Also, they can make sound judgements when assessed using an abstract scale of measurement (*e.g.* a Discrete analogue scale). In the light of the above, the study targeted children in JHS 1, JHS 2 and JHS 3 as individual level participants.

3.3.13 Data Collection

3.3.13.1 Description of Measurement Techniques

Two key techniques were adopted for measuring study variables – self-report by participants, and a structured observation. Self-reported data was obtained through the responses given by participants which reflect their knowledge, attitudes, subjective norms and behavioural intentions.

The knowledge variable was measured using a set of 10 statements on hand hygiene for which participants were to answer whether a statement was "TRUE" or "FALSE". Each participant was scored out of a total of 10 points. Attitude was measured using three Likert scale questions, consisting of 5-points each. Means were computed from the responses and taken as the overall attitude score for each participant. Similarly, behavioural intention was measured using two Likert scale questions consisting of 5-points. The means of these responses were also computed and used as the total intention score for each participant. Likewise, subjective norms (normative beliefs, motivation to comply) were measured using a 5-point Likert scale consisting of three items for each of the sub-variables (normative belief, and motivation). The skill variable was assessed by

directly observing participants demonstrate the steps for proper HWWS at a handwashing station. A total of 10 marks was allocated for each participant. The assessment was done using a guideline based on recommended handwashing steps published by WHO (2009), CDC (2015) and Hand Hygiene Australia (2016). Questionnaire is attached as *appendix 2a*.

Regarding the primary outcome variables (HWWS after toilet use, and before meals), a structured observation was used. It involved observing the behaviour of the study participants (from a distance) for a considerable amount of time with the intention of obtaining a first-hand insight into their practices relating to handwashing. The use of a structured observation offered an opportunity to gather objective behavioural data in a manner that avoids the biases attributable to socially acceptable responses. A structured observation was conducted in all participating schools, occurring at two points in time (*i.e*. at baseline and post intervention). For assessing handwashing behaviour, these observations were conducted from two spots in each school with the view to observing the behaviour at the two key moments (after toilet use, and before meals). In consonance with best practices, a daily structured observation lasted for a period of 7-hours continuously.

3.3.13.2 Description of Tools/Instruments

Structured observations were done with the aid of a tool adapted from Pickering *et al*. (2014). This tool was used for observing handwashing practices of students in Kenya. The key parameters for assessment included whether or not hands were washed, whether or not soap was used, the duration of handwashing, whether or not handwashing was done according to recommended guidelines, and how hands were dried (*structured observation checklist is attached as appendix 2c*).

Self-reported data was generated with the aid of a questionnaire adapted from Pang *et al*. (2015), Ram (2010), Eshetu (2013) and UNICEF (2013). The questionnaire makes use of dichotomous questions, as well as questions on a 5-point Likert scale. Example of responses on items ranged

from 1 (disagree strongly) to 5 (agree strongly). Sub-variables were tested for internal reliability using the Cronbach alpha score set at $\alpha \geq 0.7$ (Nunnally, 1978; Nunnally & Bernstein, 1994). For example, Alpha scores generated were α=0.80 for behavioural intention, and α=0.75 for attitude, and α=0.74 for subjective norms. Both questionnaires and observation checklists were administered by the lead researcher with assistance from trained field enumerators (*see section 3.6 for details of their training*).

3.3.13.3 Measures for Strengthening Internal Validity

In a bid to strengthen internal validity in an experimental study, it is expedient to adopt strategies to reduce the effect of confounding and other threats to internal validity to the barest minimum. Potential threats to internal validity were identified to include history effect, maturation effect, testing effect, selection bias, attrition effect, spill-over or diffusion effect, implementation effect, effect of the home environment, clustering effect, and effect of unreliable data gathering instruments. Table 3.3 presents the proposed measures adopted to address the above.

Table 3.3: Measures for Addressing Threats to Internal Validity

Potential Threat	**Working Definition**	**Control Measures**
History effect	An event occurring between pre and post intervention other than the intervention variables that could affect the outcome variable	• The use of an equivalent control group that did not receive '*HandsCare*' • Tracking of occurrences between pre and post in both arms of the study
Maturation effect	Changes which occur in participants because of passage of time	• The use of a short intervention duration (of one month) controls for this effect • The use of a relatively short post intervention assessment timeline (of two weeks)
Testing effect	Baseline assessment affecting post intervention responses	The use of a control arm which receives pretest naturally controls for this
Selection bias	Uneven characteristics of participants in intervention and control arms at baseline	Intervention and control groups were pretested on relevant variables (especially demographics and psychosocial) to ensure an even distribution of characteristics

Potential Threat	Working Definition	Control Measures
Attrition effect	Dropping out of participants or a cluster in the course of the study	• In a bid to have a large number of students enrolled, the study recruited all students in all three grades who assented to participate, and whose parents/guardian gave consent to their participation • The potential inconveniences of the study were fully explained to school management until a firm assurance had been received from them indicating their commitment to completing the study
Spill-over or diffusion effect	Intervention delivered to intervention group is diffused to control group	• There was concealment of allocation. The two study arms were blinded to their status as intervention arm or control arm. • Also, schools were blinded to the outcome variables being measured by the research team.
Implementation effect	Differences in persons delivering an intervention	• Teachers and research assistants who participated in the intervention delivery were given the same training • Intervention delivery process was monitored by the principal investigator to document potential differences
Effect of home environment	Family influences which could account for handwashing behaviour in school	Baseline assessment gathered data on relevant social variables related to the home environment which were tested for statistical difference between both study arms
Effect of other socio-demographics	Variables such age, gender, religion, parent's education, family approvals which could confound handwashing behaviour	At baseline, variables were tested statistically to determine whether they had a magnitude of confounding of 10% or more. Such variable would have been adjusted for in determining the intervention effect
Clustering effect	Interdependence occurring among individual units in a cluster or between clusters	• At the design stage of the study, the minimum number of clusters for the study was adjusted using the design effect estimated with an ICC of 0.03 • At the analysis stage, outputs of statistical tests were adjusted for clustering using either cluster-level summaries or the robust standard error.
Effect relating to validity/ reliability of data tools	Inconsistencies in sub-variables being measured, and inaccuracies in responses	All data collection instruments were pretested in a selected school within the Kwabre East municipality, which is contiguous to the geographic scope of this study

Source: Author's Construct (2016) based on extracts from Cottrell & McKenzie (2011)

3.3.14 Data Analysis

A cluster-level analysis using an independent samples *t*-test was used for determining the effect of *HandsCare* post-intervention, on the basis of the hypotheses developed for this study. This approach is more robust in an analysis involving a few number of clusters (Eldridge & Kerry, 2012; Hayes & Moulton, 2009). Also, an independent samples *t*-test is robust even when some parametric test assumptions are violated (Hayes & Moulton, 2009; European Medicines Agency, 2003). Furthermore, the *t*-test can be used for any cluster-level summary measure [*e.g.* means, proportions (in the case of binary outcomes)] (Eldridge & Kerry, 2012).

3.3.14.1 Steps to the Analysis

The first step of the analysis involved computing aggregate cluster-level summaries for all individual level variables – a measure which controls for data clustering (Campbell & Walters, 2014; Hayes & Moulton, 2009). The second step involved determining the statistical difference between the two-sets of clusters (intervention and control) post-intervention, with respect to the variable being measured. The third step was to adjust for variations in cluster sizes. All analyses were done using S*tata/SE* 14 (Stata Corp., College Station, Texas).

In computing for cluster-level means and proportions, *Stata's collapse* command was used. Afterwards, an independent samples *t*-test was used to determine an initial statistical difference between the two study arms. The results of the *t*-test were further weighted to adjust for variations in cluster sizes, using the *regress* command in *Stata*. Statistical significance was set at alpha score $p<0.05$ (95% confidence interval), while effect sizes were classified using the Cohen's Classification Table (Cohen, 1992). This table categorises effect sizes into small, medium, large and very large. The aforementioned analysis procedure was guided by guidelines published by the

University of York (2006). With respect to pre and post analysis of difference, a dependent samples *t*-test was used. This analysis adjusted for clustering using the robust standard errors.

3.4 Predictors of Reported Handwashing Behaviour - Methods

3.4.1 Approach and Design

A quantitative approach using a cross-sectional design characterised this component of the research; thus, data was generated at only one point in time. The choice of a quantitative approach was deemed necessary considering that there remains a paucity of quantitative studies assessing the predictors of handwashing behaviour in Ghana.

3.4.2 Sample Population and Size

The sample population comprised JHS pupils in four selected schools within the study area. These were schools which were involved in the experimental component (both intervention and control schools) of this research (*i.e.* the cRCT) and were selected based on the study's inclusion/exclusion criteria. In all, a total of 717 pupils were involved in the study by means of a *census* (Cottrell & McKenzie, 2011). Thus, all pupils in the four selected schools had an opportunity to provide responses to the survey questions.

3.4.3 Data Collection –Tools

Self-reported data on handwashing practices were collected using a structured questionnaire (Further description of the data tools were presented earlier under *section 3.3.13.2*). Handwashing practice was assessed at two critical times - after using the toilet, and before eating. These critical times have been viewed as particularly crucial for a school setting (UNICEF/IRC, 1998).

3.4.4 Data Analysis

Multiple regression analysis was used to explore the predictors of HWWS (statistical significance level was set at $p<0.05$). All regression models were adjusted for clustering (using robust standard errors), considering the fact that data was obtained from a cluster of schools.

3.5 Data Management Techniques

The ensuing sub-sections describes the techniques used for managing the entire data generated by the study. The section has been structured along the following headings; data entry and cleaning, data storage techniques, and training of field enumerators.

3.5.1 Data Entry and Cleaning

Data was entered using *SPSS v. 22* (SPSS Inc., Chicago IL), and exported to *Stata v. 14.0* (Stata Corp., College Station, Texas). Entry errors were verified using Stata's *codebook* command. Identified mismatches were corrected manually. *Stata v. 14.0* addressed missing values automatically by eliminating its effect on outputs of statistical tests . Data cleaning was completed within three (3) calendar months.

3.5.2 Data Storage Techniques

Prior to data entry, all consent forms were manually separated from questionnaires containing the corresponding data. The forms were kept safely in a location different from that used for keeping the questionnaires. Data entered were stored on a personal computer specifically designated for the research and backed up on two different external hard drives kept at two different locations. Access rights to these devices were given to only members of the research team. The goal of this

protocol was to ensure adherence to the ethical principle of confidentiality or privacy as was assured participants of the research.

3.6 Training of Field Assistants

In a bid to enhance the validity and reliability of data, field assistants whose primary role was to assist with data collection were trained. A total of eight (8) field assistants were trained to assist with data collection at baseline and post intervention. The training was facilitated by the Principal Investigator (PI), who has acquired advanced training in conducting social research. Key eligibility criteria used for recruiting field assistants were that the person should have a degree in Public Health or a related field. In addition, a field assistant was required to have gained a one-year field experience in conducting social surveys. A total of two (2) working days was allocated for the training. Each daily session lasted for at least 2-hours. The objectives of the training included the following:

- To increase trainees' knowledge of pertinent concepts and issues relating to hand hygiene in schools
- To enhance trainees' skill in handwashing with soap (HWWS)
- To increase trainees understanding of the nature of survey questions and the prescribed style of questioning adopted for the study
- To introduce trainees to best practices in conducting social surveys involving children

3.7 Ethical Considerations

An ethically sound research is one that places the rights and welfare of the participants above the information needs of the researcher (Peat, 2002). Unethical research behaviours have been abhorred with the following words:

"Researchers eager to gain access to some population that might otherwise be difficult to reach may really not see that their plans are unethical. Some overly zealous researchers, while realizing that certain of their practices may be unethical, nonetheless plunge forward, justifying their actions under the excuse that it isn't illegal!" (Berg, 2007:53)

It is necessary for adequate information to be provided to respondents and informed consent/ assent sought to ensure that their participation in the research is by their own volition and not by compulsion or manipulation. This study involved human participants who are categorized as children making ethical considerations even more crucial.

With this understanding, a permission to conduct this research was obtained from the Ejisu-Juaben Municipal Education Directorate, a regulatory body of all Junior High Schools within the study area (*see appendix 3a for approval letter*), and Kwabre East District Education Directorate, where data instruments were pretested *(see appendix 3b for approval letter)*.

Furthermore, the study sought for an assent from eligible students (*assent form is attached as appendix 4*), and also a parental consent from parents or guardians of children who had given an assent already. A detailed information sheet complemented parental consent forms. The information sheet which was tailored to the information needs of parents/guardians provided detailed information on the research and research team (*information sheet for parents/guardians is attached as appendix 5a*). The parental consent form was issued to parents or guardians to enable them take informed decisions as to whether or not their children should participate in the research (*parental consent form is attached as appendix 5b*). Thus, a child could participate in the research only when he/she had assented together with the parent/guardian's consent. On the other hand, teachers participating in the study had to sign an informed consent form (*attached as appendix*

6b), after being issued with an information sheet tailored to their information needs (*information sheet for teachers is attached as appendix 6a*).

In order to ensure that standard research protocols have been adhered to right from the design stage of the research, the research proposal was submitted to the Committee on Human Research (CHRPE), Publications and Ethics of the Kwame Nkrumah University of Science and Technology for review, and subsequently ethical clearance was granted unconditionally (*Reference Number: CHRPE/AP/402/16*).

CHAPTER FOUR

RESULTS

This chapter is organised into three parts. Part one presents the results of the first objective of the study. Part two presents results specific to objectives two and three (due to the complementary nature of the two); while Part three presents the results specific to objective four.

4.1 Part 1: Distribution of Functional Facilities in Schools

4.1.1 Characteristics of Schools, and Distribution of Facilities

Hand hygiene facilities were observed in 37 schools. All participating schools were public, and none was a single-sex school. Table 4.1 presents summary statistics on the proportions of schools with specific facilities.

Table 4. 1: Proportion of Schools with Specific Facilities (n=37)

S/N	Item	Number of Schools	Percentage (%)
A	Functional[+] water point/facility	6	16
B	Functional[+] water reservoir	4	11
C	Soap	25	68
D	Tap bucket (veronica bucket)	13	36
E	Shared/communal *HW receptacle	12	33
F	Receptacle (for waste water)	11	31
G	Paper/tissue towel	0	0
H	Shared cotton towel/napkin	9	24
I	Functional handwashing station	6	16
J	Functional toilet facility	21	56
	Financial Provision for HW Facilities		
K	Financial Provision for facilities	10	27
L	Source of funds		
	○ Capitation grant	1	6
	○ Internally Generated	9	94

Source: Author's Survey, 2017 *HW-Handwashing [+] Facility was usable on the day of observation

Soap was the most common item available in participating schools. Sixty-eight percent (68%) of schools had soap available for use. Out of the number of schools having soap (n=25), 4% had liquid soap, while the remaining schools (96%) had solid soap. Sixteen percent (16%) of schools had functional water facilities within its compound. Most (83%) of these facilities were boreholes and 17% had stand-pipes (tap-water).

Of the 37 participating schools, 6 (16%) had functional handwashing stations. The average number of functional handwashing stations was 2 (SD=0.98). Only 19% of schools had handwashing facilities attached to toilet facilities, while 23% had separate handwashing stations for teachers. Also, 33% of schools had students washing their hands in shared receptacles (bowl), 24% had students using a single cotton towel to dry hands after handwashing, and none of the schools had paper towels displayed for hand drying.

With regard to functional toilet facilities, 56% had this within the school compound. The types of toilet facility observed were the WC (6%), VIP (6%) and the Simple Pit Latrine (88%). The mean number of cubicles within a toilet facility was 4.9 (SD=2.6). All schools had separate sections of the toilet facilities for males and females, and 75% of schools had sections designated for teachers.

A fund for maintaining handwashing stations reportedly existed in 27% of schools. Two main streams of revenue for maintaining WASH facilities in Schools were identified. These were the "Capitation Grant" from central government, and internally generated funds (IGFs). Most schools (94%) depend largely on the IGF for maintaining WASH facilities. Inflows to the IGF were identified to be from the sporadic donations from the Parents and Teachers Association (PTA), as well as the weekly fundraising activities held during religious activities in schools. All schools (n=21) which had financial provisions for WASH described their financial resources as inadequate.

4.1.2 A Profile of Facilities in Schools

The observed handwashing (HW) and related facilities in participating schools are profiled with the aid of a Scalogram matrix presented as Table 4.2. The centrality index (CI), which is a sum of the weights of all facilities which exist in a particular school are presented in last column of the matrix. The school with identifier 0037 had the highest centrality index (CI=84.80) by having nearly all observed facilities within the school. On the other hand, schools with identifiers 0002, 0009, 0012, 0013, 0016, and 0019 had the lowest CI (CI=0.0), depicting that none of the observed facilities existed in these schools.

Table 4.2: A Scalogram Matrix of Functional Facilities in Schools

School Identifier	Student Enrolment M(SD) = 153(81.9)	Existing Functional Facilities								Total no. of facilities	Centrality Indices
		Water Point	Hand-washing Station	Water Reservoir	Tap Bucket	Soap	Receptacle (waste water)	Toilet	Budget-Water Supply		
0037	309	1	1	1	1	1	0	1	1	7	**84.8**
0027	198	1	1	1	1	1	0	1	0	6	**74.8**
0031	84	1	1	0	1	1	1	1	1	7	**68.8**
0023	178	1	1	0	1	1	0	1	1	6	**59.8**
0036	177	0	1	0	1	1	1	1	1	6	**52.1**
0028	201	0	0	1	0	1	1	1	0	4	**42.7**
0003	99	1	0	0	1	1	0	0	1	4	**38.4**
0015	46	1	1	0	0	1	0	0	0	3	**37.4**
0026	144	0	0	0	1	1	1	1	1	5	**35.4**
0029	258	0	0	1	0	1	0	1	0	3	**33.7**
0010	108	0	0	0	1	1	1	1	0	4	**24.7**
0001	119	0	0	0	0	1	1	0	1	3	**23**
0011	142	0	0	0	1	1	1	0	0	3	**20.7**
0025	103	0	0	0	0	1	0	1	1	3	**18.7**
0006	157	0	0	0	0	1	1	1	0	3	**17.7**
0008	98	0	0	0	1	0	0	0	1	2	**17.7**
0030	92	0	0	0	0	1	1	1	0	3	**17.7**
0034	180	0	0	0	0	1	1	1	0	3	**17.7**
0020	112	0	0	0	1	1	0	1	0	3	**16.4**
0032	50	0	0	0	0	1	1	0	0	2	**13**
0035	75	0	0	0	1	0	0	1	0	2	**12.4**
0024	196	0	0	0	1	1	0	0	0	2	**11.7**
0004	100	0	0	0	0	0	0	0	1	1	**10**
0005	205	0	0	0	0	1	0	1	0	2	**8.7**
0017	227	0	0	0	0	1	0	1	0	2	**8.7**
0022	106	0	0	0	0	1	0	1	0	2	**8.7**
0007	296	0	0	0	0	0	0	1	0	1	**4.7**

0018	163	0	0	0	0	0	0	1	0	1	**4.7**
0033	334	0	0	0	0	0	0	1	0	1	**4.7**
0014	48	0	0	0	0	1	0	0	0	1	**4.0**
0021	134	0	0	0	0	1	0	0	0	1	**4.0**
0002	98	0	0	0	0	0	0	0	0	0	**0.0**
0009	72	0	0	0	0	0	0	0	0	0	**0.0**
0012	119	0	0	0	0	0	0	0	0	0	**0.0**
0013	119	0	0	0	0	0	0	0	0	0	**0.0**
0016	394	0	0	0	0	0	0	0	0	0	**0.0**
0019	130	0	0	0	0	0	0	0	0	0	**0.0**
Total number of facilities		6	6	4	13	25	11	21	10		
Assumed centrality		100	100	100	100	100	100	100	100		
Weight		16.7	16.7	25	7.7	4	9.0	4.7	10		

Note: Code "1" means a facility exist, while code "0" means otherwise.
Source: Author's Construct, 2017

4.1.3 Exploring for Differences and Associations between Variables

Statistical differences and associations between key variables were explored using the independent samples *t*-test, two-sample proportion test, and Fisher's exact test; the results are presented in Table 4.3.

Table 4.3: Differences in Proportions and Means

Student Enrolment		
Response Variables	***p*-value ($\alpha < 0.05$)**	**Mean (SD)**
Functional Toilet Facility	0.04	
- Exist		177(76)
- Does not exist		123(82)
Functional HWS*	0.69	
- Exist		165(92)
- Does not exist		150(81)
Functional HWS		
Explanatory Variables	***p*, Fisher's Exact**	**Cramer's V**
Functional Water facility	0.001	0.80
Functional Toilet facility	0.16	-
Financial Provision for WS^{+}	0.03	0.39
Two-Sample Proportion Test		
	***z* (*p*-value)**	**Proportion (95% CI)**
Functional Water facility	-4.87 (0.001)	
- Within School		0.83 (0.54-1.13)
- Outside School		0.03 (-0.03 - 0.10)
Financial Provision for water supply	-2.38 (0.02)	
- Exist		0.40 (0.10 - 0 .70)
- Does not exist		0.07 (-0.02 - 0.17)

*HWS-Handwashing station $^{+}$WS-Water supply

Results of an independent samples *t*-test shows a statistically significant difference in mean student enrolment between schools which had a functional toilet facility and schools which did not have a functional toilet facility [$t(35) = -2.06$, $p = .04$]: Schools which had a functional toilet facility were observed to have a higher mean enrolment figure [M=177(SD=76)], when compared with schools which did not have this facility [(M=123(SD=82)].

To determine the possible associations between explanatory variables (*i.e.* functional water facility, functional toilet facility, existence of a financial provision for water supply), and a response variable 'functional handwashing station', results of a Fisher's exact test (two-tailed) indicated that there was a statistically significant association between the existence of a 'functional water facility' and the existence of a 'functional handwashing station' ($p < .001$; Fisher's exact). Likewise, there was statistically significant association between the existence of a 'financial provision for water supply' and the existence of a 'functional handwashing station' ($p = .03$; Fisher's exact). On the contrary, there was no significant association between the existence of a 'functional toilet facility' and the existence of a 'functional handwashing station' ($p = .16$; Fisher's exact).

In a bid to further examine the differences in proportions of each of the pairs of categories of explanatory variables (which showed a statistically significant *p*-value), results of a two-sample proportion test (two-tailed) indicated that 83% of schools which had functional water facilities (within its compound) also had functional handwashing stations. With regard to schools which did not have functional water facilities within their compound, only 3% had functional handwashing stations. A test of difference in the proportions of the two sets of schools showed a statistically significant difference ($z = -4.87$, $p<.001$).

In addition, 40% of schools which had financial provisions for water supply also had functional handwashing stations. With regard to schools which did not have financial provisions for water supply, only 7% had functional handwashing stations. There was a statistically significant difference in the proportions of the two sets of schools (z = -2.38, p = .02).

4.2 Part 2: Effect of a Hand Hygiene Educational Intervention (*HandsCare*) on Intention to Wash Hands with Soap, and the Practice of HWWS

4.2.1 Progression of Clusters and Individuals through Phases of cRCT

A total of 37 potentially eligible clusters (*i.e.* schools) were subjected to the study's inclusion criteria which resulted in the exclusion of 33 clusters on the basis of a lack of functional water and toilet facilities within the schools' compound. A functional water facility in a school was crucial for running the practical sessions of *HandsCare* (*i.e.* the educational intervention) which involved pupils taking turns to develop their handwashing skills at a handwashing station. Also, a functional water facility was required for the assessment of students' handwashing skills (pre and post intervention) using a direct observation.

On the other hand, the existence of a toilet facility on a school's compound was crucial as it enhanced the validity of observational data on the practice of HWWS after toilet use. The remaining clusters (4) enrolled unto the study were randomly allocated into an intervention arm and a control arm. Figure 4.1 is a flowchart of the progression of clusters and individuals through the respective phases of the trial.

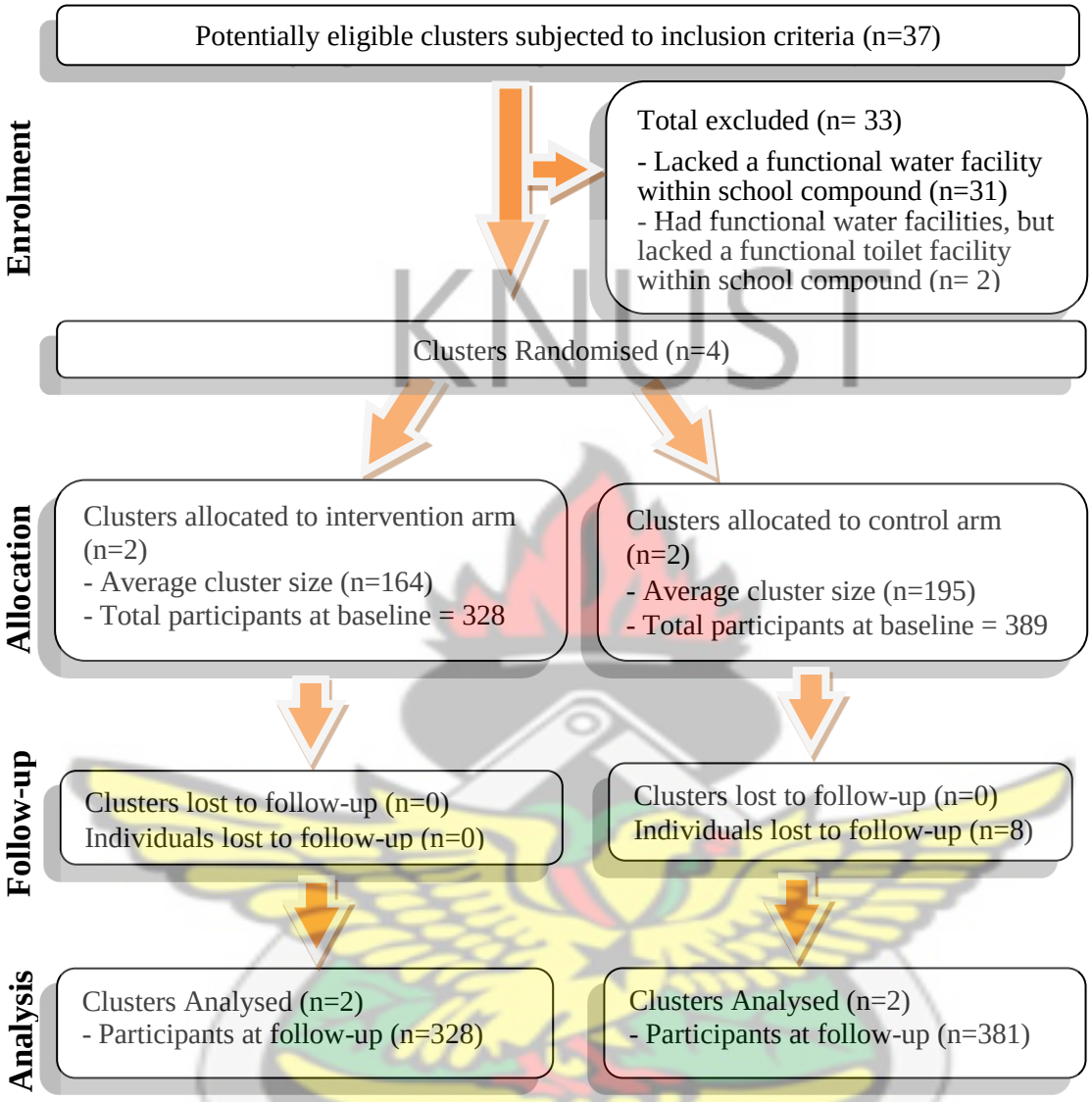

Figure 4. 1: A Flow Chart of Clusters and Individuals: Author's Construct with Guidance from the CONSORT GROUP (2012)

4.2.2 Baseline Characteristics of Study Arms

A baseline comparison of study variables with respect to the intervention and control arms are presented by Table 4.4. The observed rate of HWWS after toilet use was 2%, while that of HWWS before meals was 1%, using the samples from both intervention and control groups.

Table 4.4: Baseline Characteristics of Study Arms

Variables	Arm				*P*-values (2-tailed)	
	Intervention		Control			
	n	Mean(SD)/ %	*n*	Mean(SD)/ %	Crude	Adjusted*
Individual Level						
Age (mean)	327	14.0(1.42)	389	13.7 (1.30)	0.001	0.74
Females (%)	328	48	389	54	0.08	0.07
Religion						
- Christianity (%)	328	87	389	94	0.001	0.01†
- Islam (%)	328	12	389	5	0.001	0.03†
Parent educated to tertiary level (%)	328	27	389	52	0.001	0.04†
Attitude - after toilet use (mean score)	328	14.7 (1.17)	389	14.6 (1.45)	0.23	0.38
Attitude - before meals (mean score)	328	14.5 (0.08)	389	14.5 (0.07)	0.80	0.87
Knowledge (mean score)	328	7.8 (0.53)	389	8.7 (0.32)	0.001	0.17
Skill (mean score)	328	4.8 (1.32)	389	4.8 (1.40)	0.97	0.98
Normative beliefs (mean score)	328	13.6 (1.81)	389	13.7 (1.72)	0.60	0.86
Perceived susceptibility (mean score)	328	18.2(0.25)	389	17.5(0.43)	0.19	0.25
Perceived severity (mean score)	328	9.3(0.16)	389	9.4(0.03)	0.33	0.29
Motivation to comply (mean score)	328	13.4 (1.88)	389	13.4 (1.80)	0.88	0.95
Intention - after toilet use (mean score)	328	8.7 (1.49)	389	8.8 (1.63)	0.19	0.50
Intention - before meals (mean score)	328	8.4 (1.67)	389	8.4 (1.71)	0.75	0.86
Cluster-Level						
Observed HWWS–after toilet use (%)	65	0	34	6	0.05	0.42
Handwashing duration-after toilet use (mean)	65	12 (8.25)	34	10 (5.33)	0.04	0.87
Observed HWWS – before meals (%)	118	1	77	0	0.42	0.48
Duration for handwashing-before meals (mean)	118	5 (0.08)	77	2 (1.4)	0.06	0.28

***** *p*-values were adjusted for clustering, and variance in cluster sizes
† Examined statistically to determine whether or not these were confounders. Results indicate they are not.

At baseline, the intervention and control arms showed similarity in terms of individual level characteristics of participants as well as relevant cluster-level characteristics, except for variables religion and parent's education. To determine whether the variables religion (Islam, Christianity), and Parent's education were possible confounders to the outcome variable of the trial, a regression model was run which combined each of the above variables with 'Behavioural Intention' (proxy variable for primary outcome), and key intervention variables (*i.e. Knowledge*, *Attitude* and *Skill*). Results obtained by estimating the percentage difference between the crude and adjusted measures of effect showed a 0.2% difference for Islam, 0% difference for Christianity and 0.7% difference

for Parent's Tertiary Education. These results indicate that the variables Islam, Christianity, and Parent's Tertiary Education do not confound the intervention outcome (*i.e.* percentage differences between the crude and adjusted coefficients are less than 10%).

4.2.3 Effect of *HandsCare* (Post Intervention Effect)

Differences with respect to the intervention and control arms at two-weeks follow-up are presented by Table 4.5 below.

Table 4.5: Intervention effects at follow-up (based on cluster summaries)

Variables	Arm				
	Intervention	**Control**	***p*-values (2-tailed) *p* <0.05** (Adjusted*)	**Effect Estimate** (Cohen's *d*) †	**95% CI**
Number of clusters (schools)	2	2			
Number of individuals enrolled at baseline	328	389			
Number of individuals assessed at follow-up	328	381			
Primary Outcomes					
Observed HWWS–After toilet use					
- Proportions (SE)	0.88 (.004)	0.08 (.077)	0.005	2.6	1.9-3.3
Observed HWWS – Before meals					
- Proportions (SE)	0.19 (.011)	0.02 (.022)	0.012	0.5	0.2-0.8
Intermediate Outcomes					
Behavioural Intention					
- Intention - after toilet use [Mean (SD)]	9.34 (.093)	8.82 (.154)	0.032	0.5	0.3-0.6
- Intention - before meals [Mean (SD)]	9.08 (.042)	8.82 (.049)	0.020	0.2	0.1-0.3
Ancillary Outcomes					
Duration for handwashing [Mean (SD)] (Seconds)	32 (.813)	11 (.636)	0.002	0.9	0.4-1.4
- Knowledge [Mean (SD)]	8.37 (.026)	9.01 (.209)	0.067[a]	-	-
- Attitude [Mean (SD)]	14.62(.048)	14.29(.086)	0.040	0.21	0.1-0.4
- Skill [Mean (SD)]	9.10(.382)	5.01(.001)	0.004	3.2	2.9-3.4
- P. susceptibility [Mean (SD)]	18.95(.25)	18.35(.58)	0.147	-	-
- P. severity [Mean (SD)]	9.67(.084)	9.44(.046)	0.059	-	-

* Adjusted for clustering and variations in cluster weights
† Small effect = 0.2, medium effect=0.5, large effect=0.8, very large effect=1.3 (Cohen, 1992)
[a] Examined further to determine possible pre and post difference

A statistically significant difference was identified between the intervention and control arms with regard to the practice of HWWS at the two critical times [after toilet use (p=0.005), (80% difference between the two arms); before meals (p=0.012), (17% difference between the two

arms)]. The size of effect was *d*=2.6 with regard to HWWS after toilet use, and *d*=0.5 with regard to HWWS before meals. Furthermore, at follow-up, a statistically significant difference was identified between the intervention and control arms with regard to *intention to wash hands with soap* [after toilet use (*p*=0.032, *d*=0.5); and before meals (*p*=0.020, *d*=0.2)].

In consonance with acceptable practice, the study computed for intra-cluster correlation coefficients (ICCs) using primary data from this research. The ICCs derived the analyses were 0.17 for the variable *practice of HWWS*, 0.04 for *intention to wash hands with soap*, 0.07 for *knowledge on hygiene*, and 0.01 for *attitude to HWWS*.

4.2.4 Intervention Effect - Pre and Posttest Scores

Results of a further analysis to determine the possible differences in pre and posttest scores, with regard to the two study arms is presented in Table 4.6. Regarding the intervention arm, a statistically significant difference was detected for all variables considered for the analysis (*p*<0.001). With regard to the control arm, there was no statistically significant difference between pre and posttest scores with respect to variables considered for the analysis.

Although there was a statistically significant increase in the pre and post 'knowledge' scores for both intervention (*p*<0.001) and control arms (*p*=0.001), the magnitude of difference in the intervention arm was observed to be relatively higher [0.56 (percentage change of 7.2%)] when compared to that of the control arm [0.34 (percentage change of 3.9%)]. Figures 4.2, 4.3, 4.4 and 4.5 are graphical presentations of the results presented in Table 4.6.

Table 4.6: Pre and Posttest Scores of Intervention Effect (Dependent Samples *t*-test)

Variables	Arm							
	Intervention				Control			
	Pretest %/Mean	Posttest %/Mean	Diff. †	*P*-value*	Pretest %/Mean	Posttest %/Mean	Diff. †	*P*-value*
Observed HWWS - after toilet use [Proportions]	0	88	88%	0.001	6	8	2%	0.763
Observed HWWS- before meals [Proportions]	1	19	18%	0.001	0	2	2%	0.320
Intention after toilet use	8.68	9.34	0.66(8%)	0.001	8.83	8.82	-0.01(0.1%)	0.565
Intention before meals	8.38	9.08	0.7(8%)	0.001	8.42	8.82	0.4(5%)	0.132

*$P<0.05$; 2-tailed values adjusted for clustering using robust standard errors
† Percentage differences, and mean differences in pre and post scores

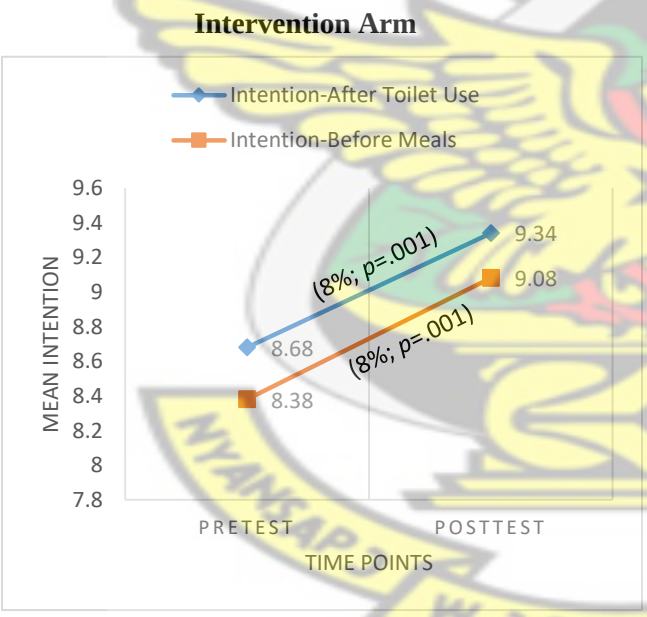

Figure 4.2: Behavioural Intention Pre and Post

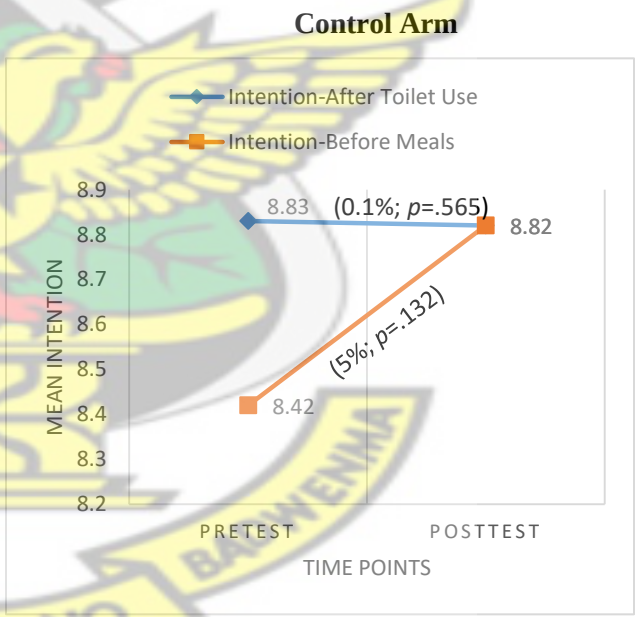

Figure 4.3: Behavioural Intention Pre and Post

Intervention Arm

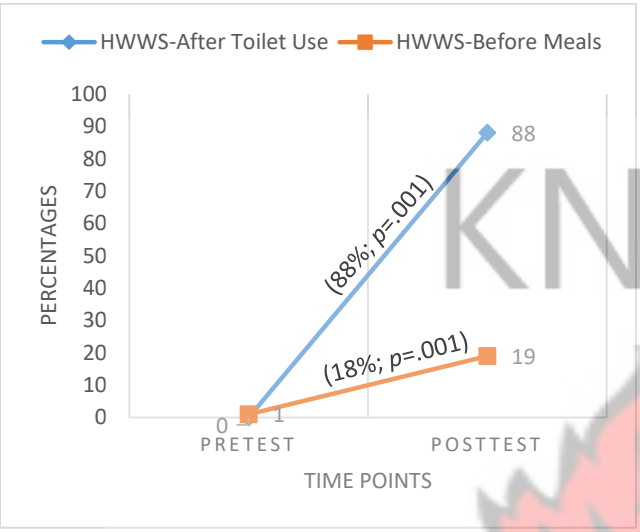

Fig. 4.4: Observed Practice of HWWS Pre and Post

Control Arm

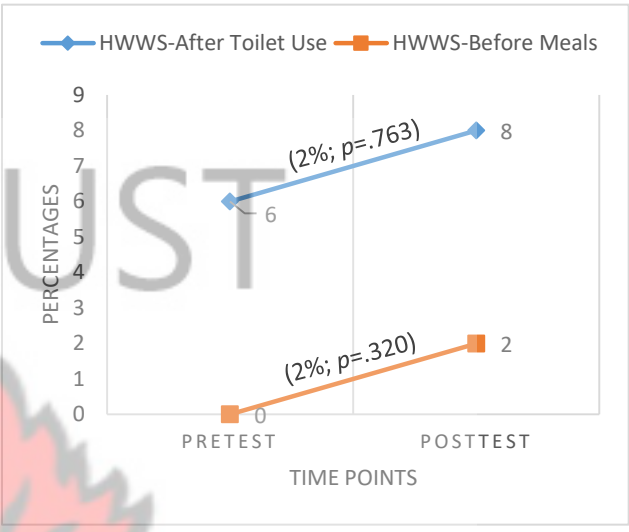

Fig. 4.5: Observed Practice of HWWS Pre and Post

4.3 Part 3: Psychosocial Predictors of Reported Handwashing Behaviour

4.3.1 Socio-Demographic Characteristics of Participants

The mean age of participants was 14 years (SD=1.37). Majority of participants were females (51.3%), and Christianity was the dominant religion (90.8%). The dominant educational level of a participant's father was the tertiary (35.7%), whereas the dominant educational level of a participant's mother was the secondary (32.5%). There was a response rate of 100%. Further details of participants' characteristics are presented in Table 4.7.

Table 4.7: Characteristics of Participants [n=717]

Variables	Absolute	Percentage (%)
Sex		
- Male	349	48.7
- Female	368	51.3
Religion		
- Christianity	651	90.8
- Islam	57	8.0
- Traditional	8	1.1
- Others	1	0.1
Father's Educational Level		
- Tertiary	256	35.7
- Secondary	238	33.1
- Basic/Middle	127	17.7
- Primary	27	3.8
- No formal education	69	9.6
Mother's Educational Level		
- Tertiary	159	22.1
- Secondary	233	32.5
- Basic/Middle	185	25.8
- Primary	52	7.2
- No formal education	88	12.2
Occupation of Household Head		
- Civil/Public service	196	27.3
- Farming	214	29.9
- Clergy	32	4.5
- Self-employed	267	37.2
- Unemployed	8	1.1

Source: Author's Survey, 2018

4.3.2 Description of Self-Reported Handwashing Behaviour

Within the past 24 hours of the survey, 1299 key moments requiring adherence to HWWS were reported by participants. Of this figure (*i.e.* 1,299), the rate of reported HWWS (after toilet use, and before meals) was 63%. Further details are presented in Table 4.8.

Table 4.8: Rates of Reported HWWS

Critical Times/ Key Moments	Number of Key Moments	Number of HWWS events	Rates (%)
After toilet use	634	450	71
Before meals	665	372	56
All Key Moments	1,299	818	63

Source: Author's Survey, 2018

4.3.3 Psychosocial Predictors of Handwashing Behaviour

Table 4.9: Psychosocial Predictors of Intention and HWWS [p<0.05*]

Variables	Behavioural Intention			Reported HWWS-After Toilet Use			Reported HWWS-Before Meals		
	Crude *p*-value	Adjusted *p*-value	Beta Coef(β)	Crude *p*-value	Adjusted *p*-value	Beta Coef(β)	Crude *p*-value	Adjusted *p*-value	Beta Coef(β)
Knowledge	0.991	-	0.001	0.038	0.202[f]	-0.03	0.306	-	-0.035
Attitude	0.001	0.046[a]	0.125	0.154	-	0.033	0.001	0.001[i]	0.098
P. susceptibility	0.001	0.001[b]	0.101	0.065	-	0.030	0.001	0.595[j]	0.013
P. severity	0.001	0.822[c]	0.011	0.284	-	0.051	0.116	-	0.068
Skill	0.001	0.084[d]	0.026	0.001	0.008[g]	0.041	0.001	0.007[k]	0.050
Subjective norms	0.001	0.001[e]	0.263	0.004	0.011[h]	0.053	0.001	0.001[l]	0.110

*All *p*-values were adjusted for clustering using the robust standard errors
a,b,c,d,e- Adjusted for all psychosocial variables with crude p<0.05 when tested against behavioural intention
f,g,h- Adjusted for age, and all psychosocial variables with crude p<0.05 when tested against HWWS-after toilet use
i,j,k,l- Adjusted for age, and all psychosocial variables with crude p<0.05 when tested against HWWS-before meals

Psychosocial predictors of 'behavioural intention' were identified to be attitudes to HWWS (*p*=0.046; β=0.120; 95% CI 0.00-0.24), perceived susceptibility (*p*=0.001; β=0.101; 95% CI 0.04-0.16) and subjective norms (*p*<0.001; β=0.263; 95% CI 0.20-0.33). With regard to the practice of HWWS-after toilet use, handwashing skill (*p*=0.008; β=0.037; 95% CI 0.01-0.07) and subjective norms (*p*=0.011; β=0.055; 95% CI 0.01-0.10) were identified as predictors. Also, attitudes to

HWWS (p=0.001; β=0.098; 95% CI 0.04-0.16), handwashing skill (p=0.007; β=0.050; 95% CI 0.01-0.09), and subjective norms (p<0.001; β=0.110; 95% CI 0.05-0.17) were identified as predictors of HWWS-before meals. Details are presented in table 4.9.

4.3.4 The Intention-Behaviour Relationship

To determine whether or not behavioural intention will predict reported handwashing behaviour, a logistic regression model was run using the pairs 'intention after toilet use' and 'practice of HWWS after toilet use'; and 'intention before meals' and 'practice of HWWS before meals'. With respect to the first pair, the model adjusted for the variables age, handwashing skill, and subjective norms. With regard to the second pair, the model adjusted for age, attitude, skill and subjective norms. All models were further adjusted for clustering using the robust standard errors.

Results of the adjusted model showed a statistically significant relationship between intention (to wash hands with soap after toilet use) and practice of HWWS after toilet use (p=0.003, β=0.247; 95% CI 0.08-0.41). Similarly, an adjusted model showed a statistically significant relationship between intention (to wash hands before meals) and practice of HWWS before meals (p<0.001, β=0.346; 95% CI 0.19-0.50).

4.3.5 Motivation for Adherence to Handwashing with Soap

The survey identified self-assigned reasons for adherence to the practice of HWWS to include; removal of pathogens from hands, removal of dirt from hands, desire to gain respect from peers, desire to make hands smell good, a quest to make hands look attractive, and an act to stimulate appetite for food. The dominant motive underlying HWWS was identified to be the removal of pathogens from hands (34%). The second frequent motivation was the removal of dirt from the

hands (30%). Also, twenty-two percent of the responses were linked to the desire to make hands smell good. Figure 4.1 is a column chart comparing the varied motives for HWWS.

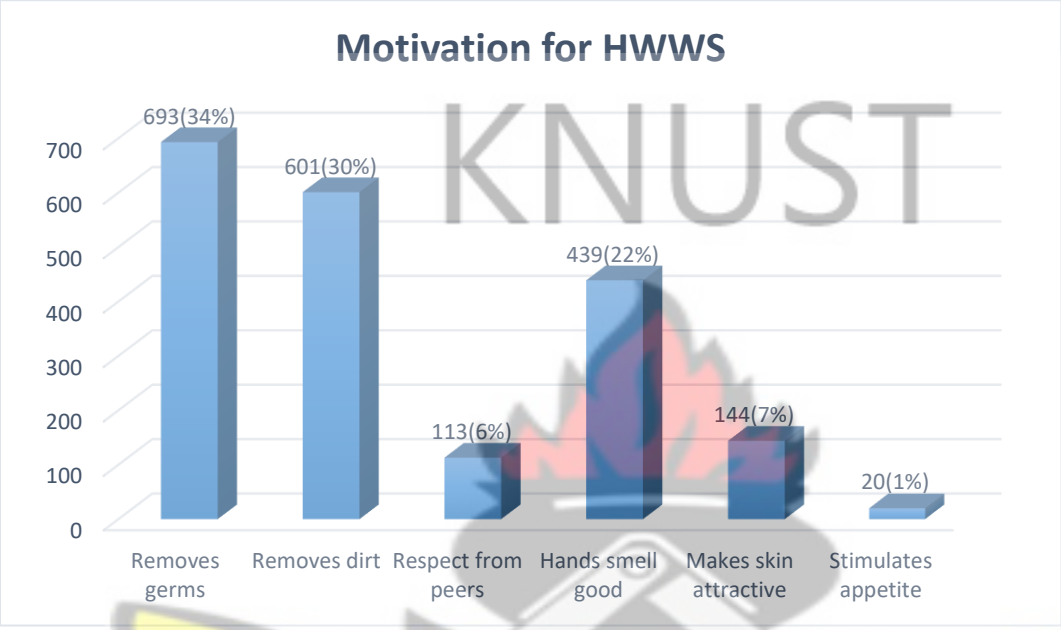

Figure 4.6: Motivation for HWWS

Source: Author's Survey, 2018

CHAPTER FIVE

DISCUSSIONS

The discussions chapter is organised into three parts. Part one discusses the results of the first objective of the study. Part two presents a discussion of results specific to the second and third objectives; while Part three discusses the results on objective four. Objective one sought to describe the distribution of functional hand hygiene facilities in schools. Objective two sought to determine the effect of a hand hygiene educational intervention (named *HandsCare*) on behavioural intention, while the third objective sought to determine the effect of the aforementioned intervention on the practice of HWWS. The forth objective sought to examine the psychosocial predictors of reported handwashing behaviour.

5.1 Part 1: Distribution of Functional Facilities in Schools

The results have shown a WASH facility deficiency among participating schools. Few schools (16%) had functional water facilities. Similarly, few schools had functional handwashing stations, even though every school is required to have a functional handwashing station for pupils' use. For the purpose of this study, a functional handwashing station refers to a set-up which provides running water and soap for pupil's use. Furthermore, a large number of schools (33%) had their pupils wash hands in a shared receptacle and dry hands with a common towel. Most schools (68%) had soap available to students on the day of observation. With respect to toilet facilities, only half of the number of schools had functional facilities within the schools' premises. From a global perspective, only 21% of schools in the developing world have been reported to have handwashing facilities (UNICEF, 2015).

The availability of soap in schools is crucial to the promotion of school-based handwashing with soap (HWWS). However, the mere availability of soap does not imply the existence of a handwashing station, as additional facilities are required (*e.g*. a facility providing running water). Though the results show that most schools had soap available, it is also evident that few schools had a functional handwashing station, and therefore the use of soap (which was mostly found in front of the offices of teachers) could have been used for other purposes such as washing teachers' dishes after meals.

In a study conducted in five geographical regions of Ghana, authors reported that although soap was observed in 96% of households, they were mostly used for other purposes apart from handwashing (*e.g*. washing dishes) (Scott *et al*., 2007). In another study conducted in four urban areas of Ghana, authors reported the availability of soap in 83% of participating schools (Monney *et al*., 2014). The results presented above appear to be consistent with that generated by this study. On the contrary, results of a study conducted in Senegal reported that only 10% of participating schools had soap available to students (Sidibe & Curtis, 2007).

In a situation in which only half of the number of schools had functional toilet facilities, students could potentially resort to public toilet facilities, private homes or open defecation. It is however worth noting that the existence of a toilet facility in a school does not automatically guarantee its usage. Factors such as facility age, and facility type could influence facility usage (Garn *et al*., 2014). In this study, a simple pit latrine is identified to be the most common toilet facility in participating schools (88%). This condition obviously raises concern since a pit latrine is an unimproved toilet type, and hence not recommended for a school setting (Adams *et al*., 2009).

Furthermore, the situation in which only 19% of schools had handwashing facilities attached to (or located within the premises of) toilet facilities appears worrisome and inconsistent with existing guidelines for setting up WASH facilities in schools (Adams *et al*., 2009). The proximity of a handwashing facility to a toilet facility is essential as the handwashing facility can serve as a *cue to action* in terms of HWWS after toilet use. Also, it can potentially reduce the time required to access a handwashing facility after a person has used the toilet. Time has been cited by a previous study as a reason for non-compliance with safe handwashing behaviour (Kelcíkova *et al*., 2011).

The situation in which a large number of schools use a shared receptacle for pupils' handwashing, and a shared cotton towel for students' hand drying leaves much to be desired. In a country where dirrhoeal diseases continue to claim thousands of lives annually (UNICEF-GHANA, 2016), the implications of this practice on cross-infections is a matter of concern. In a recent study conducted in pre-schools located within the Greater Accra Metropolis of Ghana, eight (8) different bacteria, two (2) different parasites and a fungus were observed in water samples collected from a shared receptacle used by school children for handwashing (Tetteh-Quarcoo *et al*., 2016).

The gloomy situation described above could potentially be explained in part by the WASH facility deficiency which appears to be characteristic of many schools in the Municipality. The result of the Scalogram analysis points to a situation where many schools lack basic facilities such as a functional water facility, a functional handwashing station, paper towels, and a fund for providing and maintaining WASH facilities. Sixteen percent of schools had a 0.0 index on the Scalogram Matrix indicating the non-existence of any of the WASH facilities considered by the study. The WASH facility deficiency characterising participating schools is similar to a situation reported in Malawi where only 33% of handwashing facilities in schools were functional, and no school had

soap available for handwashing (Save the Children, 2008). An intervention by government and civil society organisations in addressing the situation will be timely.

5.1.1 Differences and Associations between Key Variables

The mean student enrolment of schools which had functional toilet facilities was higher than the mean student enrolment of schools which lacked a functional toilet facility. The higher student enrolment figures observed among schools with functional toilet facilities could suggest the possibility of a facility-driven selection of schools by parents or guardians. However, it is beyond the purview of this present study to draw such conclusions. The existence of a functional toilet facility was however not associated with the existence of a functional handwashing station, which is an issue of concern considering the crucial complementarity of a handwashing station and a toilet facility (Adams *et al*., 2009).

Furthermore, a greater proportion of schools which had functional water facilities onsite also had functional handwashing stations. The existence of a functional water facility in a school is crucial to the setting up of a functional handwashing station. Among others, this facilitates the provision of adequate running water which is key to the practice of proper handwashing with soap (CDC, 2015; WHO, 2009).

Similarly, a greater proportion of schools which had funds for water supply also had functional handwashing stations. To ensure the sustainability of functional handwashing stations in schools, the role of a budgetary allocation is imperative, and this study shows that financial provisions are essential to the existence of functional handwashing stations in schools. Recognizing the crucial role of adequate funds, it is a concern that most schools (73%) lacked this provision. In a study

conducted in Nicaragua, 95% of schools did not have budgetary allocations for the provision of an essential WASH commodity as soap (Jordanova *et al*., 2015).

5.2 Part 2: Effect of a Hand Hygiene Educational Intervention (*HandsCare*) on Intention to Wash Hands with Soap, and the Practice of HWWS

5.2.1 Intervention Effect on Behavioural Intention

At two-weeks post-intervention, the difference in behavioural intention between the two study groups was statistically significant [after toilet use (p=0.032, d=0.5); and before meals (p=0.020, d=0.2)]. This result warrants the rejection of the first null hypothesis of the study. Thus, *HandsCare* (*i.e.* the theory-based hand hygiene educational intervention) demonstrated effectiveness in positively influencing pupils' intention to wash hands with soap at the two critical times adopted for the study. Nonetheless, the size of effect when Cohen's Classification Guideline was used could be described as between 'low' and 'moderate' for the two critical times (d=0.2 and 0.5).

From Table 4.6, it can be observed that the intervention arm of the study recorded a significant difference (p<0.001) of eight percent change for each 'intention' variable from pretest to posttest. On the other hand, in the control arm, the score for one of the 'intention' variables (*i.e.* intention to wash hands after toilet use) declined at follow-up. This difference can be explained by the absence of the influence of the intervention, *HandsCare*. It is worth mentioning that there is a paucity of studies in the literature which have sought to determine the effect of a hand hygiene educational intervention on behavioural intention, though a few studies (*e.g.* Sniehotta *et al*., 2005) exist in other domains such as physical activity.

It is worth mentioning that 'intention' does not necessarily predict behaviour. This phenomenon is widely referred to as the "intention-behaviour gap"(Godin *et al*. 2005; Sniehotta *et al*. 2005). For example, a lack of *self-efficacy* and *cue to action* could inhibit a progression from intention to practice (Sniehotta *et al*. 2005). In the field of physical activity for example, Rhodes and Yao (2015) have reported a decline in the practice of behaviour after intention was increased in an experimental manipulation. In spite of these recent reports on the intention-behaviour gap, the crucial role of intention in influencing the practice of behaviour remains widely accepted.

5.2.2 Intervention Effect on Practice of HWWS

Post intervention scores showed a significant difference between the intervention and control arms, with respect to the proportions of pupils practicing HWWS before meals (p=0.012). Similarly, a significant difference was observed between the two study arms, with respect to the proportion of pupils practicing HWWS after toilet use (p=0.005). These results warrant the rejection of the second null hypothesis of the study. The size of effect was observed to be very large (d=2.6) with respect to the proportion of pupils practicing HWWS after toilet use, when Cohen's classification guideline was used. Regarding the proportions of pupils practicing HWWS before meals, the size of effect was identified to be medium (d=0.5).

With respect to the pre and posttest scores, the intervention arm recorded an 88% difference for the practice of HWWS after toilet use, while an 18% difference was recorded for the practice of HWWS before meals. The difference in handwashing behaviour at the two critical times could be explained by the innate variable "Disgust" which may characterise toilet use (Curtis, 2007). In estimating the sample size of this trial, it was conjectured that the intervention will be able to detect (at follow-up) a 60% reduction in the proportion of pupils who do not practice proper handwashing. In the light of this, it can be observed that the intervention succeeded in achieving a posttest score

higher than the anticipated 60%, with regard to HWWS after toilet use (88%); but lower than the 60%, with regard to HWWS before meals (18%). Regarding the control arm, the difference in pre and post scores was only 2% for each of the variables measured under the practice of HWWS (*i.e.* HWWS after toilet use and HWWS before meals). It is evident from the aforementioned summary that *HandsCare* demonstrated a positive influence in the enhancement of the outcome variables of the study. In a study conducted in Egypt which used a quasi-experimental design, authors reported that a health educational programme was effective in improving handwashing practices (Moussa *et al.*, 2015). Conversely, a cluster-randomised trial by Graves *et al*. (2011) conducted in Kenya which combined the provision of handwashing facilities with a poster contest reported that the intervention was not effective in improving handwashing practices. A careful review of the work of Graves *et al*. indicates that their intervention failed to target the skill-development dimension of hand hygiene education, an essential learning domain which makes the practice of proper HWWS possible.

5.2.3 Explanation for Intervention effect on Behavioural Intention, and Practice of HWWS

With respect to the variables which might contribute to explaining the intervention effect on intention, and practice of HWWS, Table 4.5 shows a significant between-group difference for handwashing skill (p=0.004; d=3.2), and attitude (p=0.040; d=0.21), but not knowledge (p=0.067). The above could mean that *HandsCare* is not a knowledge-based intervention but rather an intervention which has the strength to enhance positive attitudes and skills. Although the intervention on attitude was low (d=0.21), it can be observed that the its effect on handwashing skill was very large (d=3.2), according to the Cohen's classification guideline. It is worth noting that the variables *attitude*, *skill* and *knowledge* are intervention variables and therefore the enhancement of these has implications on the post-intervention scores of behavioural intention, as

well as practice of HWWS. Though there was not a significant between-group difference in the knowledge scores at follow-up, the pre and post scores for knowledge increased by 7% in the intervention arm, but 4% in the control arm (*see Table 4.6*).

From both empirical and theoretical perspectives, it is known that the variable '*knowledge*' alone may not trigger intention, and also the adoption of a behaviour (Lopez-Quintero *et al*., 2009). From this study, it can be observed that although the control arm had a higher knowledge score at baseline, this did not translate into improved intention, and practice. The significant between-group difference for handwashing skill (p=0.004; d=3.2), and attitude (p=0.040; d=0.21) could explain the intervention effect on behavioural intention and practice of HWWS.

5.3 Part 3: Psychosocial Predictors of Reported Handwashing Behaviour

5.3.1 Reported Handwashing Behaviour

The baseline rate of self-reported practice of HWWS following toilet use (71%) and before meals (56%) is inconsistent with the baseline rates (observed rate of HWWS after toilet use was 2%, while that of HWWS before meals was 1%). The inconsistency between the self-reported rates and the observed rates may be explained by the overestimation which tends to characterise self-reported data. Clearly, a study on hand hygiene is a socially sensitive phenomenon and can lead to obtaining *socially desirable responses*, thereby inflating handwashing rates (Grimason *et al*., 2014; Curtis *et al*., 2009). The above results support the call to employ a structured observation when measuring the practice of HWWS (Curtis *et al*., 2009).

5.3.2 Predictors of Reported Handwashing Behaviour

Attitude to handwashing predicted behavioural intention as well as the practice of HWWS before meals. Also, perceived susceptibility was identified as a predictor of intention; subjective norms

predicted both intention and practice of HWWS at the two critical times. In addition, handwashing skill was identified as a predictor of the practice of HWWS at the two critical times.

From the above, the role of attitude, and subjective norms in predicting both intention and practice can be seen to be crucial. These findings are consistent with the Theory of Planned Behaviour (TPB) which stipulates that attitude to a behaviour is a predictor of behavioural intention (Ajzen, 1988). In a study by Lopez-Quintero *et al.* (2009), respondents who demonstrated positive attitudes to proper handwashing were twice more likely to demonstrate positive intentions to practice proper handwashing as compared to participants who reported negative attitudes. The crucial role of subjective norms implies the need for interventionists to involve *Significant Others* such as teachers, parents and other role models of pupils in the design and implementation of school-based hygiene promotion programmes. Similarly, the crucial role of handwashing skill as a predictor of HWWS implies the need to significantly develop the psychomotor (skill-based) learning domain in any hand hygiene educational intervention in schools. Furthermore, it gives an indication that cognitive (knowledge-based) approaches alone may not be effective to trigger the adoption of a proper handwashing behaviour.

5.3.3 The Intention-Behaviour Relationship

Results of this study show that intention to wash hands with soap is associated with handwashing behaviour. This result lends credence to the utility of the construct 'behavioural intention' (which emanates from the Theory of Planned Behaviour) in predicting school children's handwashing behaviour. Thus, it can be emphasised that behavioural intention remains an important determinant of school children's handwashing behaviour. Notwithstanding this result, it is important to reiterate that, in practice, behavioural intention may not always predict behaviour.

5.3.4 Motivation for Handwashing

The dominant motivation for handwashing with soap was reported to be the removal of pathogens from hands. This is an indication that the Germ Theory may still hold utility when delivering hand hygiene educational interventions among school children. The Germ Theory, which was popularized between 1850 and 1920 posits that specific diseases are caused by specific microscopic organisms (Harvard University, 2018). The second major motivation for handwashing with soap was identified as the removal of dirt from hands. The removal of dirt and oils from the hands appear to be a key advantage of HWWS especially when compared with the use of a hand sanitizer, which many experts agree to its inability to remove dirt and debris from hands (Filion *et al.*, 2011).

5.4 Reflection on Results - Within the Context of the Study's Theoretical Framework

From the theoretical framework guiding this study, a hand hygiene educational intervention which enhances hygiene behavioural capacity (*i.e.* hygiene knowledge and handwashing skill), attitude to HWWS, subjective norms, perceived susceptibility and perceived severity will likely enhance behavioural intention (BI) and subsequently the practice of HWWS. The interactions must however occur within an enabling physical and social environment in order to achieve success.

The study results give an indication that handwashing skill, attitudes, subjective norms and perceived susceptibility are key variables within the theoretical framework which could trigger BI. From the results, although *hygiene knowledge* and *perceived severity* may not explain an enhancement of BI, it may be prudent not to overlook their potential relevance in any hand hygiene educational intervention. With regard to the environmental level variables presented in the theoretical model, the study was unable to statistically test for their correlation with BI due to the

collinearity of the data. Future studies may want to examine this using a larger number of clusters. With regard to the intention-behaviour relationship, the result indicates that intention to wash hands with soap does predict handwashing behaviour. From these reflections, it can be concluded that the individual-level variables of this study's theoretical framework are supported by empirical evidence generated by the study, except for the variables *knowledge* and *perceived severity*.

5.5 Potential Limitations of the Study

The geographic scope of this study was limited to the Ejisu-Juaben Municipality (EJM). In the light of this, the generalization of results generated by the study is limited to geographic locations and settings that share the socio-economic and cultural characteristics of the EJM. Another potential limitation borders on the use of self-reported data to answer the fourth research question of the study (*i.e.* predictors of self-reported handwashing behaviour). The use of self-reported data has the tendency to introduce some socially acceptable responses into the dataset which can lead to the inflation of variables such as reported handwashing practice.

Also, a potential limitation would be the use of a small number of schools for the cluster-randomised controlled trial; this can potentially limit external validity of study results. In spite of the aforementioned potential limitations, the researcher adopted robust procedures which ensured that threats to internal validity were reduced to the barest minimum.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This section has been organised in accordance with the core themes of the research as encapsulated in the specific objectives. It summarizes the evidence without repetition of the statistics which have been presented in the previous chapters. In order to enhance sequence flow, conclusions on the second and third objectives are presented under a single caption.

6.1.1 Distribution of Functional Facilities in Schools

This study has generated evidence pointing to a hand hygiene facility deficiency across a range of schools in the Ejisu-Juaben Municipality. With the aid of a Scalogram Matrix, it was observed that some participating schools lacked a single hand hygiene facility for use by pupils. Few schools had functional water points onsite; similarly, few schools had functional handwashing stations for pupils' use. Also, many schools had their pupils wash hands in a single receptacle (bowl) and dry hands with a common cotton towel, which according to scientific evidence facilitates cross-infection. Furthermore, the study has shown that schools with financial provision for water supply were more likely to have a functional handwashing station. For providing and maintaining WASH facilities, most schools relied on the sporadic donations from the Parents and Teachers Association (PTA) and also funds generated during schools' religious functions ("Worship" sessions), and not the 'Capitation Grant' from the government.

6.1.2 Effect of *HandsCare* on Behavioural Intention, and the Practice of HWWS

The study has shown a low rate of proper handwashing practice among school children through a structured observation. More importantly, the study has shown that a theory-driven hand hygiene educational intervention (*HandsCare*) involving school children and targeting the cognitive, affective and psychomotor learning domains has a medium to a very large effect size, with respect to the practice of handwashing with soap. With respect to behavioural intention, the intervention yielded a low to a medium effect size. Thus, *HandsCare* demonstrated varied degrees of effectiveness in positively influencing pupils' intention to wash hands with soap and improving the practice of HWWS at the two critical times adopted for the study. At follow-up, the intervention was observed to have significantly enhanced the affective (attitude to HWWS) and psychomotor (skills for HWWS) learning domains. In the light of the evidence, the effectiveness of *HandsCare* could be attributed to its effect on *attitude to HWWS,* and *skills for HWWS*, but not significant change in knowledge of hand hygiene.

6.1.3 Psychosocial Predictors of Reported Handwashing Behaviour

The study has shown that handwashing skill, attitude to handwashing, subjective norms, and perceived susceptibility are predictors of intention to wash hands with soap and/or the practice of HWWS. With regard to the intention-behaviour relationship, the result indicates that intention to wash hands with soap does predict handwashing behaviour. The identification of handwashing skill as a predictor of HWWS (and not knowledge) implies the need to significantly develop the psychomotor (skill-based) learning domain in any hand hygiene educational intervention in schools. It further gives an indication that cognitive (knowledge-based) approaches alone may not be effective to trigger the adoption of proper handwashing behaviour. With subjective norms

predicting intention and behaviour, the role of *Significant Others* in the design and implementation of school-based hand hygiene educational programmes can be described as crucial.

6.2 Recommendations for Policy and Practice

The recommendations have been organised under the key findings of the study which include; hand hygiene facility deficiency in schools, low rate of HWWS and the effectiveness of *HandsCare,* and 'Handwashing Skill' as key psychosocial predictor of handwashing behaviour.

6.2.1 Hand Hygiene Facility Deficiency in Schools

Addressing the problem of hand hygiene facility deficiency in schools within the Ejisu-Juaben Municipality (EJM) will require a broad approach involving all relevant stakeholders including the government, educational authorities and civil society organisations. Such a broad approach is expedient due to the synergy it brings to bear in tackling the identified problems. The following recommendations are useful ingredients for developing a comprehensive strategy for improving on WASH facilities and advancing WASH in schools (WinS) in the Ejisu-Juaben Municipality (EJM) and beyond:

- In a bid to ensure that the "Capitation Grant" adequately complements the IGF in a manner that helps to improve on WASH facilities in schools, the Ghana Education Service (GES) should determine beforehand a certain minimum percentage of the "Capitation Grant" that should be used for maintaining WASH facilities in schools, and periodically monitor to ensure that the School Management Committee (SMC) is keeping to the required percentage.
- With support from the Ghana Education Service (GES), the Ejisu-Juaben Municipal Education Directorate should set up a unit within its outfit which is to be headed by the

local SHEP coordinator. This unit should be mandated and strengthened to mobilise resources from which basic schools within the municipality will be supported in terms of WASH facility provision and maintenance.

- The SMC should be reminded and encouraged regularly through circulars from the Municipal Education Directorate to organise periodic WASH fund-raising events in partnership with civil society organisations such as faith-based organisations and corporate Ghana. In addition, the SMC could partner with traditional authorities to organise fund raising events at community durbars and similar events in aid of advancing WASH in their respective schools.
- The Ministry of Education in collaboration with the Ministry of Local Government and Rural Development, and the Ministry of Sanitation should collaborate and oversee the establishment and/or strengthening of an inter-agency committee at the local level with representations from the Metropolitan/Municipal/District (MMD) Education Directorates, the Metropolitan/Municipal/District Assemblies (MMDAs), the MMD Health Directorates, and other development partners. This committee should be tasked to ensure (*e.g.* through supervision and demand for accountability) that key players such as the local government authority are fulfilling their mandate of building improved WASH facilities and conducting periodic maintenance as required by the Education Act (Act 788). To ensure sustainable financing for the pursuit of this role, the aforementioned ministries should work towards the enactment of a legislative instrument which set aside a certain percentage of the DACF for improving WASH facilities in basic schools. With respect to routine maintenance of WASH facilities, the inter-agency committee should be made to

play a supervisory role in ensuring that SMCs fulfil this responsibility in their respective schools.

6.2.2 Low Rate of HWWS and the Effectiveness of a Theory-Based Hand Hygiene Educational Intervention (*HandsCare*)

The following are recommended towards ensuring the sustainability of the delivery of a theory-based hand hygiene educational package in basic schools, and subsequently improving the low observed rate of HWWS among pupils:

- The GES with the support of its partners should organise periodic in-service training on hand hygiene for basic school teachers so they will be better equipped to act as 'hygiene role models' of their pupils and subsequently offer theory-based hand hygiene education which enhances theoretical constructs such as subjective norms, attitudes and behavioural capacity (especially hand hygiene skills). Similarly, as much as possible, SMCs should incorporate handwashing educational sessions into PTA meetings to encourage and equip parents to promote the practice at home. Tools developed as part of this research could aid the conduct of such training programmes.
- The Municipal Education Directorate should consider creating a time slot in the calendar of basic school pupils for conducting periodic skill-based hygiene education, with emphasis on HWWS under running water at critical times. Such a time slot could be weekly and could be an extension of the existing "worship" session or the physical education session or an entirely standalone session. The hand hygiene educational manual developed as part of this research could be useful for this educational initiative.

- As part of the 'speech and prize giving days' organised periodically by SMCs, prizes should always be reserved for the best students in terms of hand hygiene behaviour. An observational checklist developed as part of this research could be adapted and used for monitoring pupils hand hygiene behaviour in the school setting.

6.2.3 'Handwashing Skill' as Key Psychosocial Predictor of Handwashing Behaviour

The predictive ability of handwashing skill with regard to the practice of HWWS at the two critical times implies the need for increased focus on the psychomotor learning domain in any hand hygiene educational intervention. Thus, skill-based hand hygiene education is strongly recommended for school health promotion practitioners and educationists. Thus, there should be a paradigm shift from cognitive approaches to hand hygiene promotion to approaches that seek to significantly enhance the psychomotor learning domain.

6.3 Recommendations for Research

The following are recommended for future research.

- A large-scale study investigating hand hygiene behaviour in schools across Ghana would be required to better conclude on the national situation with respect to handwashing rates, predictors of HWWS, behavioural patterns as well as bottlenecks in achieving improved hand hygiene conditions in Ghanaian schools.
- Further studies may be required to determine the effect of *HandsCare* beyond two weeks post-intervention. This will enable an understanding of whether intervention effect will reduce over time.

- A qualitative research may be required to explore reasons behind the differences in intervention effect between the two critical times - HWWS after toilet use, and HWWS before meals.

- Future studies could examine the environmental variables such as school regulations or policies on hygiene, and how these may influence behavioural intention and the handwashing behaviour of school children

- Future studies could investigate the rate and determinants of teachers' hand hygiene intention and behaviour, and a health promotion intervention which could potentially enhance their hand hygiene behaviour

6.3 Contribution of Research to Knowledge

The study has contributed to knowledge in the following ways:

1. A comprehensive definition of hand hygiene has been propounded by the author and subsequently published. Such a comprehensive definition could not be identified in the body of literature (*paper attached as appendix 9*).
2. A framework to guide the design of school-based hand hygiene educational interventions has been published from this study. Such a framework could not be identified in the body of published works.
3. The study has led to the development of a matrix on the distribution of functional hand hygiene facilities in the Ejisu-Juaben Municipality, which hitherto was lacking. This would be a useful document to guide hand hygiene facility planning and intervention within the municipality. The matrix is published and attached as *appendix 9*.

4. An educational manual underpinned by behaviour change theories and models has been developed from this research (manual is in use within participating schools). The manual is developed for use by teachers and other trainers involved in hand hygiene education in basic schools.
5. The study is the first in Ghana to employ an experimental design to generate evidence pointing to the effectiveness of a theory-based hand hygiene educational intervention in schools.

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APPENDICES

Appendix 1: Scoping Search Strategy

SEARCH TITLE: HAND HYGIENE EDUCATION IN SCHOOLS

1.0 Introduction

Literature search in Health Promotion tends to be complicated as literature is often scattered among numerous databases (Jackson and Waters, 2005; Peersman and Oakley, 2001). This situation can be attributed to the multidisciplinary nature of the field of health promotion (Beahler, 2000). The disciplines which underpin to health promotion include psychology, sociology, epidemiology and education, social policy, politics of integration, economics, communication, and social marketing (Macdonald and Bunton (2004). This search strategy is organised according to the following headings: Definition of search terms, Databases and engines consulted, and Connecting Search terms/Phrases.

2.0 Defining Search Terms

A worksheet adapted from the Humboldt State University (2008) was used to carve the approach for electronic database searching. The approach commences with the following steps.

Step 1: Summary of topic and identification of key concepts

From the topic, three key terms were identified, which are *hand hygiene*[1], *education*[2] and ***school***[3]

Step 2: Selection of related phrases

For key phrase 1, identified related phrases were '*handwashing', 'handwash' and 'hand sanitation'*. The identified related phrases for key phrase 2, were *'promotion', 'intervention',*

'behaviour change', 'project', and 'programme'. Regarding key phrase 3, the related phrases generated were *'school age', 'grade', 'level', 'primary', 'children' and 'adolescents'*.

3.0 Databases Consulted

Taking cognisance of the key search terms which emerged under section 2.0, the following databases were consulted: PubMed, Educational Resources and Information Centre (ERIC), Cochrane Library, EBSCO host (Medline, CINAHL, Academic search complete, PSYC INFO, PSYC ARTICLE, *etc*.), googlescholar and Hinari.

4.0 Connecting Search Terms/Phrases

Boolean Operators such as AND and OR were used to connect search terms. The table below shows the connection between search terms. Also used for enhancing comprehensive retrieval of articles was *'word truncation'*. For example, root words like '*hygiene**' was word truncated related words such as *'hygienic'*.

Phrase Connection

Phrase 1		Phrase 2		Phrase 3
"Hand hygiene*"		"education"		"school age"
OR		OR		OR
"Hand washing"		"promotion"		"grade"
OR	AND	OR	AND	OR
"Handwash"		"behaviour change"		"level"
OR		OR		OR

"Hand sanitation"		"intervention" OR "project" OR "programme"		"primary" OR "children" OR "adolescents"

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Appendix 2a: Questionnaire for measuring handwashing behaviour of students

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF HEALTH PROMOTION AND EDUCATION

SCHOOL OF PUBLIC HEALTH

QUESTIONNAIRE

(TO BE ADMINISTERED BY RESEARCHER)

MEASURING HANDWASHING BEHAVIOUR OF JUNIOR HIGH SCHOOL CHILDREN

Questionnaire Code: [_____] Name of School: [_____]

Interviewer ID: [_____] Grade/Class of Student: [_____]

Student's Code: [_____] Date: [____/_____/_____]

SECTION A: SOCIO-DEMOGRAPHICS

1. Age (*in completed years*):……
2. Sex: a)[__]Male b)[__]Female
3. Religion: a)[__]Christianity b)[__]Islam c)[__]Traditional d)[__]Other (specify)…….
4. Highest educational level of father: a)[__]Tertiary b)[__]Secondary c)[__]Basic/Middle school d)[__]Primary e)[__]No formal education
5. Highest educational level of mother: a)[__]Tertiary b)[__]Secondary c)[__]Basic/Middle school d)[__]Primary e)[__]No formal education
6. Occupation of household head /bread winner: a)[__]Farming b)[__]Civil/Public service c)[__]Clergy d)[__]Self-employed e)[__]Unemployed

SECTION B: HANDWASHING BEHAVIOUR OF STUDENTS

*For questions 7 to 12, guide student to recall his/her handwashing behaviour. If an answer is "not at all" then write **0**; If it is Once, then write **1**; If it is 2 times, then write **2**; If it is 3 times, then write **3**, and so on.*

After Visiting the Toilet:

7. Within the past 24 hours, how many times have you visited the toilet? …….. time(s)
8. Of these visits, how many times did you wash your hands with water only? ……... time(s)
9. Of these visits, how many times did you wash your hands with water and soap? ……... time(s)

Before Eating:

10. Within the past 24 hours, how many times have you eaten with your bare hands?……time(s)
11. Of these moments, how many times did you wash your hands with water only before eating?

    …….. time(s)
12. Of these moments, how many times did you wash your hands with water and soap before eating?

    …….. time(s)

Behavioural Intention (*Circle the number that best describes your answer*)

13. "*Within the next one month, I plan to wash my hands with soap any time I use the toilet?*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

14. "*Within the next one month, I want to wash my hands with soap any time I use the toilet*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

15. "*Within the next one month, I plan to wash my hands with soap any time I am about to eat*".

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

16. "*Within the next one month, I want to wash my <u>hands with soap</u> any time I am about to eat*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

SECTION C: KNOWLEDGE OF HANDWASHING/ MOTIVATION FOR HWWS

17. What is the total knowledge score of student?.....

No	Statements/Items	Circle the Correct Answer
a	"Germs can be found in faeces"	True or False
b	"Germs cannot move from faeces to our hands"	True or False
c	"Germs cannot be spread by shaking hands"	True or False
d	"Germs cannot make a person get diarrhoea"	True or False
e	"Handwashing with water alone will make the hands less clean than handwashing with soap"	True or False
f	"Using soap for handwashing can help to kill germs on the hands"	True or False
g	"It is not important to wash your hands with soap after using the toilet"	True or False
h	"Handwashing before eating is more important than handwashing after eating"	True or False
i	"Washing your hands under running water is more useful than washing your hands in a shared bowl"	True or False
j	"Hands should be washed with soap at key times even if they do not look dirty"	True or False

18. Why will you wash your hands with soap (*Tick all that applies*)

a)[____] It removes germs from the hands e)[____] It makes the skin look attractive

b)[____] It removes dirt from the hands f)[____] Other (specify)……

c)[____] To gain respect from school mates g)[____] No reason

d)[____] It makes the hands smell good

SECTION D: ATTITUDE – HANDWASHING WITH SOAP (HWWS)

Handwashing with Soap After Using the Toilet (*Circle the number that best describes your opinion*)

19. Washing my hands with soap after using the toilet is.....

1	2	3	4	5
Not important				**Important**

20. Washing my hands with soap after using the toilet is .....

1	2	3	4	5
Bad				**Good**

21. Washing my hands with soap after using the toilet is a .....

1	2	3	4	5
Useless				**Useful**

Handwashing with Soap Before Eating (*Circle the number that best describes your opinion*)

22. Washing my hands with soap before eating is.....

1	2	3	4	5
Not important				**Important**

23. Washing my hands with soap before eating is .....

1	2	3	4	5
Bad				**Good**

24. Washing my hands with soap before eating is a .....

1 2 3 4 5

Useless **Useful**

SECTION E: FACTORS INFLUENCING HANDWASHING - PERCEIVED SUSCEPTIBILITY AND SEVERITY (*Circle the number that best describes your opinion, as you read the statements*)

25. "*I can get diarrhoea if I do not wash my hands with soap after using the toilet*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

26. "*I worry that I may get diarrhoea if I do not wash my hands with soap after using the toilet*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

27. "*I can get diarrhoea if I do not wash my hands with soap before I eat*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

28. "*I worry that I may get diarrhoea if I do not wash my hands with soap before I eat*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

29. "*Getting diarrhoea is serious"*

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

30. "*I see diarrhoea to be dangerous*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

SECTION F: FACTORS INFLUENCING HANDWASHING - SKILL FOR HWWS [Observational Form adapted from WHO 2009[1] and FAD Company, 2007[2])]

31. What is the total skill score of the student?.....

(Instruction: *Take student to a handwashing station and observe his/her handwashing skill, using the supplementary sheet provided. Then indicate the total skill score in the space above)*

No.	**Expected Actions**	**Yes=1** **No=0**
1	Turns on clean running water	
2	Gets hands wet	
3	Applies soap to hands to cover all hand surfaces	
4	Rubs palms together, with fingers interlaced (in-between fingers)	
5*	Rubs one palm over the back of another hand and vice versa, with fingers interlaced (in-between fingers)	
6*	Rubs thumb with your other palm, and vice versa	
7*	Cleans top of fingers and/or under finger nails	
8	Washes both wrists with palm	
9	Rinses hands and wrists thoroughly with running water	

[1] WHO (2009) *Hand hygiene: Why, how and when?* Geneva: WHO Press.

[2] F. A. Davis Company, Wilkinson & Van Leuven/Procedure Checklists for Fundamentals of Nursing, 2007

10	Dry hands with a single use towel or air dry hands (shake hands in the air)	
	Total Score	

*Step 5, 6 and 7 may not necessarily follow the above order.

SECTION G: FACTORS INFLUENCING HANDWASHING-SUBJECTIVE NORMS/SELF-EFFICACY (*Circle the number that best describes your opinion, as you read the statements below*).

32. "*My teacher thinks I should wash my hands with soap after using the toilet and before eating*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

33. "*My parents think I should wash my hands with soap after using the toilet and before eating*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

34. "*My friends think I should wash my hands with soap after using the toilet and before eating*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

35. "*I want to do what my teacher thinks I should do*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

36. "*I want to do what my parents think I should do*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

37. "*I want to do what my friends think I should do*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

Self-Efficacy

38. "*I can by myself practice handwashing with soap under running water*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

39. "*I don't need anyone to help me if I want to wash my hands with soap under running water*"

Disagree Strongly	Disagree	Not sure	Agree	Agree Strongly
1	2	3	4	5

Experience with Diarrhoea

(Explain diarrhoea to child as passing out three or more watery stools within a day, or more frequently than is normal for the individual).

40. Within the past 2 weeks, have you had diarrhoea? [ ] Yes [ ] No

Appendix 2b: School Assessment for Handwashing Facilities

CHECKLIST

Observer ID: [_____] Date: [____/_____/_____]

Checklist Code: [_____]

Name of School: [_____]

Instruction: The checklist is to aid an inspection of existing handwashing facilities in participating schools, with the assistance of the head teacher of the school visited, or an authorized representative

Characteristics of School

1. Category of school:

   [____] Public [____] Private

2. Community within which school is located: ……

3. Educational circuit within which community is located: ……

4. Student enrolment: JHS 1 =…….: JHS 2 =…….: JHS 3 =…….: Total =……

Water-Accessibility and Source

5. Does school have regular* water supply? [___]Yes [___]No
6. Is water point within the school compound? [___]Yes [___]No
7. If water point is outside school compound, what is the estimated distance (in meters) away from school?.....
8. Is water source accessible to students for handwashing? [___]Yes [___]No

*students had water supply either the day before or the morning prior to the survey

9. What is the school's main water source? (*Tick one that applies*)

S/N	Water Source	Tick
i	Piped/Tap water	
ii	Borehole	
iii	Protected dug well	
iv	Unprotected dug well	
v	Rainwater collection	
vi	Tanker truck	
vii	Surface water (river, stream, pond, etc)	
viii	Other (please specify)…….	

10. Is this water point accessible to students with mobility impairment? [___] Yes [___] No

Existence of Handwashing Facilities and Stations

11. Does a handwashing station exist in school for JHS students? [__]Yes [__]No
12. How many handwashing stations exist (a) for students?..... (b) for teachers?.....
13. Is the handwashing station functional? (*functional handwashing station should be providing both running water, and soap*)

[___]Yes [___]No

14. From the table below, tick all the facilities for handwashing which were available in school

S/N	Facility	Tick

i	Sink with tap	
ii	Veronica bucket with tap	
iii	Veronica bucket without tap	
iv	Poly-tank with tap	
v	Poly-tank without tap	
vi	Communal handwashing basin	
vii	Basin for collecting waste water	
viii	Soap (include plain soap, detergent, antiseptic soap)	
ix	Cotton towel/napkin (communal use)	
x	Paper towel	
xi	Others(specify)……..	

15. Is there a budgetary allocation for regular water supply? [___] Yes [___] No
16. What is the source of funds for this allocation?

    [___]Capitation grant [___] IGF [___] Local community [___] NGO

    [___]Local Authority
17. Is there a budgetary allocation for the maintenance of handwashing station(s)?

    [___]Yes [___]No
18. What is the source of funds for this allocation?

    [___]Capitation grant [___] IGF [___] Local community [___] NGO

    [___]Local Authority [___]PTA [___]Other

Toilet Facility – Functionality and Accessibility

19. Does a toilet facility exist in school for JHS students? [__]Yes [__]No

20. Is toilet facility functional? (*functional facility should be in use on the day of observation*)

[___]Yes [___]No

21. Type of toilet: (a) WC (b) Pour flush (c) Pit latrine (d) Ventilated improved pit (e) Other(specify)……

22. Does toilet facility have a handwashing facility inside or attached to it? (a) Yes (b) No

23. In all, how many cubicles(rooms) are there?.....

24. Is there a separate section for males and females? (a) Yes (b) No

25. Do teachers have a separate own toilet / separate cubicle? (a) Yes (b) No

26. If yes, what is the type of toilet used by teachers (a) WC (b) Pour flush (c)Pit latrine (d) Ventilated improved pit (e) Other(specify)……

27. Any other observation?

……

.....

.....

Appendix 2c: Structured Observation Tool

STRUCTURED OBSERVATION OF HANDWASHING BEHAVIOUR

Date:______________**Enumerator Name:** ____________**School:** _______________ **Start Time:** ______ **End Time:** ______

No.	**Time**	**Critical Time:** 1. After Toilet Use 2. Before Eating	**Who?** 1. Student 2. Teacher 3. Food vendor	**Hands cleaned?** 1. Yes 2. No 3. Could not see	**What was used?** 1. Water with Soap 2. Water alone 3. Hand Sanitizer	**How long was hand cleaning?** Time in Seconds:	**Was HWWS done properly?** (refer to sheet on proper steps) **Answer Yes/No Yes=1, No=0**	**How hands dried?** 1. Air dry (hands shaken in air) 2. Shared Towel 3. Personal Handkerchief/cloth 4. Paper towel/tissue	**Comments:**
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	
		1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐ Other:	1☐ 2☐ 3☐	1☐ 2☐ 3☐ Other:			1☐ 2☐ 3☐ 4☐ Other:	

Appendix 2d: Checklist for Intervention Fidelity Assessment

S/N	PARAMETERS/MEASUREMENT ITEMS	YES/NO (Yes=1; No=0)
	Adherence	
1	How well do teachers adhere to the instructions for intervention delivery as contained in the educational manual?	
2	How well do teachers avoid a drift from the content of the educational manual?	
	Duration	
3	Did a teaching session last within the expected time allotted for it?	
4	Was a daily activity implemented within the total hours allotted for it?	
5	Was the intervention delivered within the number of days allotted for its?	
	Quality of delivery	
6	Was the teacher's enthusiasm evident?	
7	Was the teacher engaged in delivering the content?	
8	Was the instruction explicit? strategic? systematic?	
	Student responsiveness	
9	Was the teacher making sure that students were engaged, and that students were understanding the material and if not, doing something to change that?	
10	Does teacher supervise all students to practice HWWS at a functional station?	

Appendix 3a: Permission Letter from Ejisu-Juaben Municipal Education Directorate

GHANA EDUCATION SERVICE
EJISU-JUABEN MUNICIPAL

In case of reply the number and
date of this letter should be quoted

Municipal Education Office
P.O. Box 30
Ejisu-Ashanti

Tel. No. 03220-201779

30th May, 2016

REPUBLIC OF GHANA

My Ref. No: GES/ASH/EJM/IUO/125/VOL.1
Your Ref. No.

MR. EMMANUEL APPIAH-BREMPONG
PhD STUDENT, KNUST
DEPT. OF HEALTH PROMOTION & EDUC.
SCHOOL OF PUBLIC HEALTH

LETTER OF INTRODUCTION
NAME : MR. EMMANUEL APPIAH-BREMPONG

I write to introduce to you the above mentioned personality to your outfit.

He is embarking on a three (3) year PhD research which seeks to determine the "Effectives of a hand hygiene training intervention for influencing hand-washing with soap and the experience of diarrhoea among basic school children". The study targets both private and public schools within Ejisu-Juaben Municipality.

As part of the research, the candidate will solicit information from your school by visiting and performing other related activities.

Counting on your usual co-operation.

EDWARD ADAMS
(MUNICIPAL DIRECTOR OF EDUCATION)

Appendix 3b: Permission Letter from Kwabre East District Education Directorate

GHANA EDUCATION SERVICE

KWABRE EAST DISTRICT EDUCATION OFFICE

P.O BOX 30
MAMPONTENG-GHANA
TELEFAX 03220-74577
DIRECTOR'S OFFICE 03220-70647
E-mail – kwabreeast@yahoo.com

OUR REF NO. GES/ASH/KD/GP.

Your Ref :.....

REPUBLIC OF GHANA

DATE : 10TH AUGUST 2016

THE DEAN OF COLLEGE OF HEALTH SCIENCE
KNUST
SCHOOL OF PUBLIC HEALTH
DEPT. OF HEALTH PROMOTION & EDUC.
KUMASI

APPROVAL

Mr. Emmanuel Appiah-Brempong, a PhD candidate of the Department of Health Promotion and Education, School of Public Health, KNUST, is permitted to conduct his research in our district.

Kindly give him your co-operation.

CHRISTIANA ABRAFI AMPEH (MS.)
DISTRICT DIRECTOR OF EDUCATION

Appendix 3c: Research Approval Letter from the Committee of Human Research Publication and Ethics (CHRPE), KNUST/KATH

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/402/16

31st August, 2016.

Mr. Emmanuel Appiah-Brempong
Department of Community Health
School of Medical Sciences
KNUST-KUMASI

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Effectiveness of a Theory-Based Hand Hygiene Educational Intervention for Enhancing Handwashing with Soap among Junior High School Students in the Ejisu-Juaben Municipality of Ghana."***

Proposed Site: ***Ejisu-Juaben Municipality.***

Sponsor: **Principal Investigator.**

Your submission to the Committee on Human Research, Publications and Ethics on the above named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 30th May, 2016 from the Municipal Education Office, Ejisu-Juaben (study site) indicating approval for the conduct of the study in the Municipality.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning 31st August, 2016 to 30th August, 2017 renewable thereafter. The Committee may however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Yours faithfully,

Osomfuor Prof. Sir J. W. Acheampong MD, FWACP
Chairman

Appendix 4: Assent Form for School Children (Adapted from Seattle Children's Hospital Foundation & University of Washington, 2013)

Research Assent Form

What is a research study?

Research studies help us learn new things. We can test new ideas. First, we ask a question. Then we try to find the answer.

This paper talks about our research and the choice that you have to take part in it. We want you to ask us any questions that you have. You can ask questions any time.

Important things to know…

- You get to decide if you want to take part.
- You can say 'No' or you can say 'Yes'.
- No one will be upset if you say 'No'.
- If you say 'Yes', you can always say 'No' later.
- You can say 'No' at anytime.

Why are we doing this research?

We are doing this research to find out more about hand washing.

What would happen if I join this research?

If you decide to be in the research, we would ask you to do the following:

- Tell us what you know about handwashing
- Tell us when you wash your hands
- Show us how you wash your hands
- Give an answer to similar questions on handwashing which will be read by a person on the research team

Could bad things happen if I join this research?

We do not know of any bad thing that can happen to you. We will try to make sure that no bad things happen.

You can say 'no' to what we ask you to do for the research at any time and we will stop.

Could the research help me?

We think being in this research may help you because you will remind yourself of issues on hygiene. Also, someday we hope it will help other kids who are in junior high school like you.

What else should I know about this research?

To thank you for being in the study, we would give you a piece of soap to take home after the research. You can ask questions any time.

Is there anything else?

If you want to be in the research after we talk, please write your name below. We will write our name too. This shows we talked about the research and that you want to take part.

Name of Participant _____
(To be written by child/adolescent)

Printed Name of Researcher _____

Signature of Researcher _____

_____ _____
Date ***Time***

Original form to: Research Team File

Copies to: Parents/Guardians

Appendix 5a: Information Sheet for Parents/Guardians

Title of Research: **A Theory-Based Hand Hygiene Educational Intervention for Enhancing Proper Handwashing Behaviour among Children in the Ejisu-Juaben Municipality of Ghana**

INFORMATION SHEET FOR PARENTS AND GUARDIANS

Your son or daughter is being invited to participate in a study on hand hygiene behaviour. You will need to decide whether or not he/she should participate in this study. Before you do so, please take time to read the information on the study which is presented below. Thank you for deciding to read further.

Who is conducting the study?

The study is being conducted by Emmanuel Appiah-Brempong, a Ghanaian pursuing a doctor of philosophy (PhD) degree at the School of Public Health, Kwame Nkrumah University of Science and Technology (KNUST)-Ghana. The PhD study is supervised by Prof. Muriel Harris of the University of Louisville - USA, Prof. Gabriel Gulis of the University of Southern Denmark-Denmark, and Dr. Samuel Kofi Newton of KNUST, Ghana.

What is the purpose of the study?

The study seeks to assess the handwashing behaviour of junior high school children. An understanding of the factors influencing the handwashing will help in the design of future interventions in the area of school hygiene.

Where will the study be done?

The study will be done in selected junior high schools within the Ejisu-Juaben municipality of the Ashanti region.

Why has my child been asked to take part in the study?

The school attended by your child has been selected to participate in the study and so are all the junior high school (JHS) children in the school. Recognizing that your child is a JHS student and can give sound reasons for his/her handwashing behaviour, he/she has been chosen to represent the views of JHS students in the Ejisu-Juaben municipality.

What happens if he/she takes part in the study?

A team of researchers will visit your child's school, and specifically his/her class and ask him/her questions about his/her hand hygiene behaviour. The questions will include how important handwashing is to your child, the moment at which he/she washes his/her hands, and how he/she washes his/her hands. The questions will take between 20-30 minutes. After about a month, the research team will re-visit your child's school and ask your child the same set of questions. Your child will be given an opportunity to ask any question about hand hygiene or about the research before, during and after our interaction with him/her.

Is it compulsory for my child to take part?

No it isn't. Your child's participation is completely voluntary. When you decide to allow your child to participate, you will be required to sign/thumbprint an assent form (which accompanies this information sheet) to indicate your willingness to allow your child to participate in the study. After you have signed/thumb printed the assent form, you are still free to decide at any point in time to ask your child to withdraw from the study if you find it necessary to do so.

Who has approved of this study?

The study has been carefully reviewed and given an approval by the Committee on Human Research and Ethics of the Kwame Nkrumah University of Science and Technology. In addition, the study has been approved by the Ejisu-Juaben Municipal Education Directorate, a regulatory body of all junior high schools within the study area.

What are the disadvantages or risks for taking part?

Deciding that your child should take part means that he/she will give up some of his/her time to answer questions from the research team. However, we do not foresee a significant negative effect of the time given on your child's academic performance. Your child's class teachers and mates are all being targeted to participate in the study.

What are the advantages or benefits of taking part?

By participating in the study, your child may learn about the importance of practicing safe hand practices. He/she may also learn about how to properly wash hands. This knowledge could help your child to avoid some common diseases associated with unsafe hand hygiene. Also, the information which will be provided by your child would help in the design of future interventions on hand hygiene and also shape school health policy in the area of hygiene. Lastly, to compensate for the time given up by your child, he/she will be given a piece of soap to facilitate proper handwashing at home, at the completion of the study.

Will my information or that of my child be kept confidential?

Yes, all information given by your child will be kept strictly confidential. Neither your name nor that of your child will be recorded. Instead the research team will use codes to identify the responses given by your child. Even so, the codes and responses will be available to only the research team and not any other person.

What will happen to the results of the research study?

The results of the study will be presented at scientific conferences and also published in scientific journals. You will be able to obtain a copy of the unpublished report by contacting Emmanuel Appiah-Brempong (*contact details are presented at the bottom of this page*).

Who is funding this research?

The research is being funded by the Building Stronger Universities Project (BSU), a KNUST/DANIDA collaboration.

Thank you for taking time to read this information sheet and considering your child's participation in the study. If you will want further information on the research, please contact Emmanuel Appiah-Brempong at the following address:

Contacts Address

Department of Health Promotion and Education,

School of Public Health,

Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Tel: 0208905920; *E-mail:* e.brempong@yahoo.com:

Further, if you have any concern about the conduct of this study, your welfare or your rights as a research participant, you may contact:

The Office of the Chairman

Committee on Human Research and Publication Ethics

Kumasi

Tel: 03220 63248 or 020 5453785

Date: ……

Appendix 5b: Parental Consent Form

Title of Research: **A Theory-Based Hand Hygiene Educational Intervention for Enhancing Proper Handwashing Behaviour among Children in the Ejisu-Juaben Municipality of Ghana**

PARENTAL CONSENT FORM

Statement of person obtaining informed consent:

I have fully explained this research to _____ and have given sufficient information about the study, including that on procedures, risks and benefits, to enable the prospective participant make an informed decision to or not to participate.

---------- ---------- ----------

Name of person taking consent Date Signature

Statement of person giving consent:

1. I confirm that I have read and understand the information sheet dated …….. for the above research

2. I understand that my child's participation in the above research is voluntary and that I am free to withdraw him/her from the study at any time, without giving any reason, without my legal rights being affected.
3. I understand that by signing this consent form, I agree to my child's participation in the above research

---------- ---------- ----------

Name of parent/guardian Date Signature/thumbprint/initials

Statement of person witnessing consent (Process for Non-Literate Participants):

I _____ (Name of Witness) certify that information given to _____ (Name of Participant), in the local language, is a true reflection of what l have read from the study Participant Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate): _____

Appendix 6a: Information Sheet for Teachers

Title of Research: **A Theory-Based Hand Hygiene Educational Intervention for Enhancing Handwashing with Soap among Junior High School Children in the Ejisu-Juaben Municipality of Ghana**

INFORMATION SHEET FOR TEACHERS

You are being invited to participate in a research on hand hygiene behaviour among junior high school children. You will need to decide whether or not you want to participate in this research. Before you do so, please take time to read the information on the research which is presented below. Thank you for deciding to read further.

Who is conducting the research?

The research is being conducted by Emmanuel Appiah-Brempong, a Ghanaian pursuing a doctor of philosophy (PhD) degree at the School of Public Health, Kwame Nkrumah University of Science and Technology (KNUST)-Ghana. The PhD research is supervised by Prof. Muriel Harris of the University of Louisville - USA, Prof. Gabriel Gulis of the University of Southern Denmark-Denmark, and Dr. Samuel Kofi Newton of KNUST, Ghana.

What is the purpose of the research?

The research seeks to assess the handwashing behaviour of junior high school children. An understanding of the factors influencing handwashing will help in the design of future interventions in the area of school hygiene.

Where will the research be done?

The research will be done in selected junior high schools within the Ejisu-Juaben municipality of the Ashanti region.

Why have I been asked to take part in the research?

Your school has been selected to participate in the research based on an inclusion criteria developed by the research team. As it is your core duty to offer teaching to the junior high school children in your school, we will require your assistance in the delivery of an educational intervention to the children during the research period.

What happens if I take part in the research?

You will be trained by the research team to delivery an educational intervention to the junior high school children of your school. The training will be in the area of hand hygiene and will occur within a period of one school week. Each day's session will have a duration of not more than 2 hours. After the training, the research team will give you a teaching guide which will guide you as you deliver an educational intervention to the students subsequently. The research team will always be available to offer any assistance which you may require in course of delivering this educational intervention.

Is it compulsory for me to take part?

No it isn't. Your participation is completely voluntary. When you decide to participate, you will be required to sign a consent form (which accompanies this information sheet) to indicate your willingness to participate in the research. After you have signed the consent form, you are still free to decide at any point in time to withdraw from the research if you find it necessary to do so.

Who has approved of this research?

The research has been carefully reviewed and given an approval by the Committee on Human Research and Ethics of the Kwame Nkrumah University of Science and Technology. In addition, the research has been approved by the Ejisu-Juaben Municipal Education Directorate, a regulatory body of all junior high schools within the study area.

What are the disadvantages or risks for taking part?

Deciding that you will take part means that you will give up some of your time for training and then deliver training to your students.

What are the advantages or benefits of taking part?

By participating in the research, you have the opportunity to increase in knowledge in the area of hand hygiene. This can enhance your teaching and influence your personal life positively. Also, the information to be generated from this research would help in the design of future interventions on hand hygiene and also shape school health policy. Lastly, to compensate for the time you will give for the research, you will be given a flash drive containing the materials used for the training.

Will my information be kept confidential?

Yes, all information about you which you will share in course of the research will be kept strictly confidential.

What will happen to the results of the research?

The results of the research will be presented at scientific conferences and also published in scientific journals. You will be able to obtain a copy of the unpublished report by contacting Emmanuel Appiah-Brempong (*contact details are presented at the bottom of this page*).

Who is funding this research?

The research is being funded by the Building Stronger Universities Project (BSU), a KNUST/DANIDA collaboration.

Thank you for taking time to read this information sheet and considering to participate in the research. If you will want further information, please contact Emmanuel Appiah-Brempong at the following address:

Contacts Address:

Department of Health Promotion and Education,

School of Public Health,

Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Tel: 0208905920; *E-mail:* e.brempong@yahoo.com:

Further, if you have any concern about the conduct of this study, your welfare or your rights as a research participant, you may contact: The Office of the Chairman, Committee on Human Research and Publication Ethics, Kumasi

Tel: 03220 63248 or 020 5453785 Date: …….

Appendix 6b: Informed Consent Form for Teachers

Title of Research: **A Theory-Based Hand Hygiene Educational Intervention for Enhancing Proper Handwashing Behaviour among Children in the Ejisu-Juaben Municipality of Ghana**

TEACHERS CONSENT FORM

Statement of person obtaining informed consent:

I have fully explained this research to _____ and have given sufficient information about the study, including that on procedures, risks and benefits, to enable the prospective participant make an informed decision to or not to participate.

---------- ---------- ----------

Name of person taking consent Date Signature

Statement of person giving consent:

1. I confirm that I have read and understand the information sheet dated …….. for the above research

2. I understand that participation in the above research is voluntary and that I am free to withdraw from the study at any time, without giving any reason, without my legal rights being affected.
3. I understand that by signing this consent form, I agree to participate in the above research

---------- ---------- ----------

Name of parent/guardian Date Signature/thumbprint/initials

Appendix 7: Protocol for Hand Hygiene Education (Manual)

PROTOCOL FOR THEORY-BASED HAND HYGIENE EDUCATIONAL INTERVENTION

DAY 1

MODULE 1: DIARRHOEA TRANSMISSION AND PREVENTION

Session 1: Socio-cultural myths about diarrhoea transmission and prevention

Objective:
To assist pupils to identify the existing socio-cultural myths about diarrhoea.

Expected Outputs:
Pupils will have increased knowledge of the existing myths about diarrhoea rooted in socio-cultural beliefs

Materials: Whiteboard (or its alternative), markers (or alternatives), and posters.

Teaching Methods: Pupil-centred discussions and presentations

Duration: 30 Minutes

Learning Steps

1. Lead a discussion of pupils' existing beliefs about diarrhoea[3] transmission and prevention
   - Use the following questions to get the discussion going
     "What do people in your community say about diarrhoea?"
     "What do you say about diarrhoea?"
     "Can it spread from one person to another?"
     "How does it spread from person to person?"
     "Can the spread of diarrhoea be prevented?"
     "How do you think it can be prevented?"

[3] For the purpose of this manual, diarrhoea is defined as passing out three or more loose or watery stools per day (or more frequent passage than is normal for the individual) (WHO, 2017)

2. Allow pupils to freely discuss what they know about the topic
3. Use the board or flip chart to write down what the pupils say during this session – especially take note of messages that will be discussed during the lesson.

Session 2: Facts about diarrhoea transmission and prevention

Objective:

To assist pupils to appreciate the facts about diarrhoea transmission and prevention.

Expected Outputs:

Pupils will have increased knowledge of the **F-Diagram** which explains the various transmission routes of germs which cause diarrhoea

Materials: Whiteboard (or its alternative), markers (or alternatives), and posters.

Teaching Methods: Pupil-centred discussions, illustrations and presentations

Duration: 40 Minutes

Learning Steps

1. Allow pupils to recap the myths about diarrhoea which were expressed by them in the previous session
2. Mount at least 2 pictures of the F-Diagram (on an A-2 paper) and allow pupils to observe it closely
3. Carefully present to pupils the facts which corresponds to the various myths which were expressed earlier (*some facts are presented under trainer's notes*).
4. Allow pupils to mention to you the discrepancies between their earlier view on diarrhoea and what is presented by the F-Diagram.
5. Distinguish between facts and myths. Guide the discussion in order to reinforce correct thinking and dispel any myths.
6. Ask pupils questions in order to establish an understanding of the presentation.

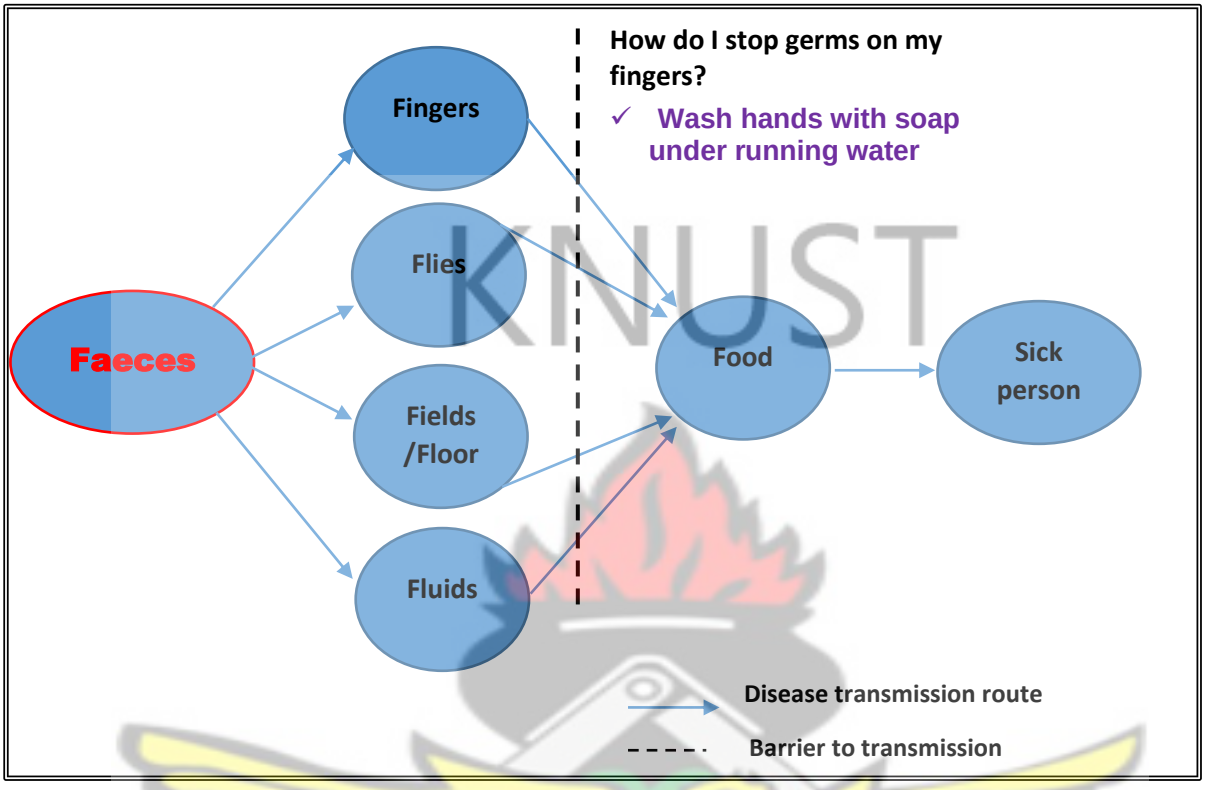
    - Use the following questions to get the discussion going
      "What do you know about germs"
      "Are germs really on my hands?"
      "How do hands get germs on my hands?"
      "Do germs really cause diarrhoea?"
      "How does diarrhoea spread from person to person?"

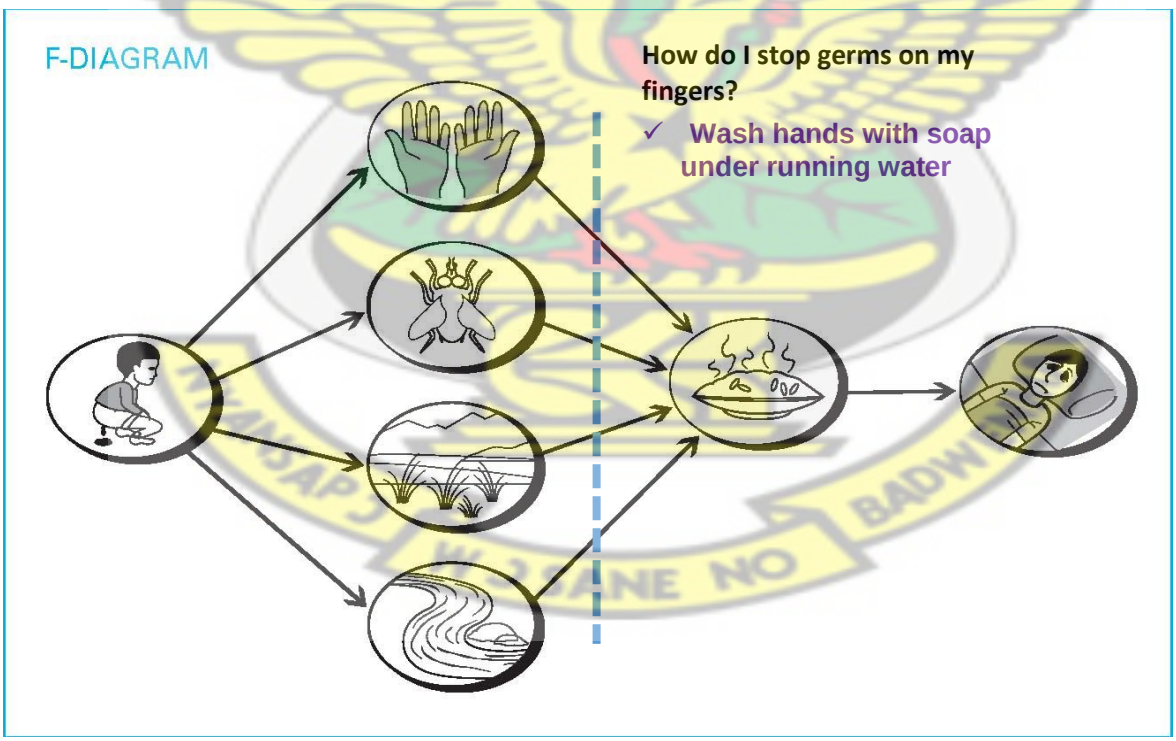
"Can the spread of diarrhoea be prevented?"
"How do you think it can be prevented?"

Trainer's Notes:

- Germs are very tiny and cannot be seen with the eyes unless one looks into a microscope (*show children a picture of a microscope and explain its use*)
- Germs can be very dangerous to humans when they get into the human body. Germs can make a person sick and even cause him/her to die when they get into the body
- Millions of germs can be found in human faeces (toilet). They can be found in the faeces of little children too!
- When we go to the toilet and fail to wash our hands with soap, then we carry the germs on our **fingers** (hands) to places where food or water (fluids) is served. When we touch the food or water with our fingers, then the germs get into it. Anybody who eats this food or drink this water can fall ill. The person can vomit, go to toilet many times (sometimes more than 3 times in a day), which will make the person very weak. We say the person has diarrhoea.
- The germs can also be carried away by **flies** to the home. Sometimes, the germs can be carried by our feet to other places where human activities go on (*eg.* **Fields, floor**). Anybody who gets germs on the hands can spread it to his/her friends or relatives by just shaking hands with them.
- You can stop germs from staying on your hands by washing your hands with soap under running water anytime you use the toilet and also before you eat.

The F-Diagram (Simplified)





Adapted from Wagner and Lanoix (1958)

Source: Curriculum Development Centre & FAO of UN, 2004

DAY 2

MODULE 2: VULNERABILITY TO DIARRHOEA AND ITS SERIOUSNESS

Objectives:

- ✓ To assist pupils to appreciate the fact that they are prone to diarrhoea
- ✓ To enhance the knowledge of pupils on the effects of diarrhoea on their health and education

Expected Outputs:
Pupils will know that they are susceptible to diarrhoea and that diarrhoea can adversely affect their health and educational aspirations

Materials: Whiteboard (or its alternative), markers (or alternatives) and posters.

Teaching Methods: Story-telling, pupil-centred discussions and presentations

Duration: 40 Minutes

Learning Steps

1. Narrate the story of Kwadwo Amo and his notion that "*African germs are not harmful*", and how diarrhoea hindered his dream of becoming a lawyer in future
2. Ask pupils to mention the lessons they have gathered from the story of Kwadwo Amo.
   - Pupils should be allowed to reflect on the questions below:
     "Can I get diarrhoea?"
     "By what means can I get diarrhoea?"
     "Does it matter if I get diarrhoea?"
3. End by stating the statistics on diarrhoea deaths in children

Trainer's Notes:

<u>The Story of Kwadwo Amo</u>
Once upon a time, there was a boy named Kwadwo Amo. He was 14 years old and attended Adukrom JHS. Kwadwo was very confident both at home and at school, and had the dream of becoming a lawyer in future. He always loved to argue, and was nicknamed by his friends as "Mr Negative" due to his attitude of always taking a negative position on issues which were discussed in class. One thing was certain, he loved being on the negative side of issues.

There were many times that Kwadwo will simply argue against strong facts which were presented by his teacher in class. A typical example was when he argued against the fact that germs can cause illness. He will often make fun of the lessons on germs with the following words: "*African germs are not harmful*".

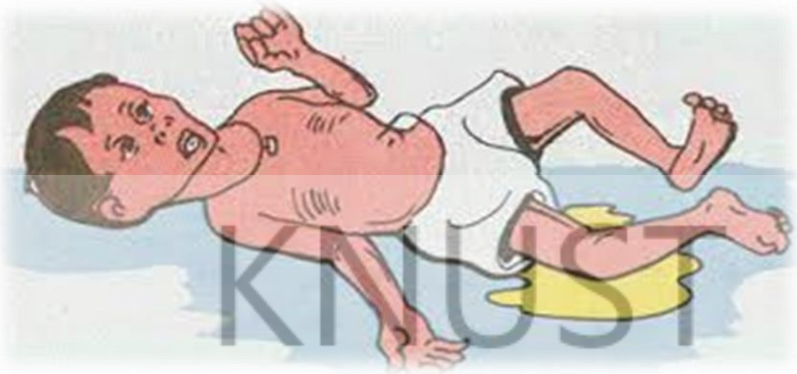
During one vacation, Kwadwo Amo visited his uncle, Inspector Asamoah who is a police officer living in a big city. His uncle lived with his wife and two children. One day, Kwadwo and his cousins asked permission from Inspector Asamoah to visit the childrens' park within the city to have some fun. On their way to the park, Kwadwo decided to buy food from a rice seller who was by the road side. His cousins advised him that the food was too exposed to flies and so he should avoid it. As usual Kwadwo ignored his cousins' advice with the words "*African germs are not harmful*". After Kwadwo had bought the rice and was preparing to eat, his cousins' again prompted him to wash his hands with soap. Again, Kwadwo ignored them and said "*African germs are not harmful*", and so ate the food hurriedly.

That night, Kwadwo had severe pains in his stomach, and visited the toilet many times until he was so weak and therefore cried out loud for help. When his uncle got to his room, he realized that Kwadwo had fainted. He rushed him to the hospital, but unfortunately he was declared dead by the doctor in charge. Kwadwo's dream of being at the university and becoming a lawyer someday failed to come to pass. Little did he know that "*African germs are very harmful*".

Facts on diarrhoea

- Globally, diarrhoea kills about 2 million children every year[4]
- About 9 out of 10 diarrhoea cases occur among children[5]
- Diarrhoea is a leading cause of childhood death in sub-Saharan Africa[6]
- Every year, over 10,000 children in Ghana die as a result of diarrhoea and pneumonia[7]

[4] Curtis (2007)
[5] UNICEF-GHANA (2015), WHO (2001)
[6] O'Reilly *et al.* (2012)
[7] UNICEF-GHANA (2016)



Source: http://medifitbiologicals.com/diarrhoea/

DAY 3

MODULE 3: DIARRHOEA PREVENTION USING HANDWASHING WITH SOAP

Session 1: Significance of handwashing with soap (HWWS) under running water

Objective:
To assist pupils to appreciate the importance of HWWS under running water as a means of preventing the spread of germs which cause diarrhoea.

Expected Outputs:
Pupils will have increased knowledge of the importance of HWWS under running water, in blocking the transmission of bacteria and viruses which cause diarrhoea

Materials: Whiteboard (or its alternative), markers (or alternatives) and posters.

Teaching Methods: Pupil-centred discussions, and presentations

Duration: 40 Minutes

Learning Steps

1. Allow pupils to recap the previous lessons. As you ask pupils about what they can remember from the previous lessons, write their responses on the board.
2. Begin by asking pupils who have washed their hands with <u>water only</u> that day to explain why they used water only.

3. Afterwards ask pupils who have ever washed their hands with <u>water and soap</u> to explain why they used soap
4. Assist pupils to understand that handwashing with water only does not produce the same effect as handwashing with soap. Explain to them why this is so.
5. Introduce pupils to the critical times or key moments for HWWS, with emphasis on *'after using the toilet'* and *'before eating'*.
6. Mention the facts about low rate of HWWS in Ghana.
    - Use the following questions to get the discussion going

      "What do you think will be some of the reasons why some people will not wash their hands with soap?"

      "Why should I wash my hands with soap?"

      "When should I wash my hands with soap?"

Trainer's Notes:

- It is possible to find many people wash their hands with water only. But very few people wash their hands with soap under running water, after using the toilet and before eating.
- In Ghana, less than 1 out of 10 (4%) nursing mothers (mothers with babies) were observed to wash their hands with soap under running water[8]; less than 1 out of 10 (5%) basic school children were observed to wash their hands with soap under running water before eating[9]. From these, it is obvious that handwashing with soap is a huge problem in Ghana.
- When people are asked why they do not wash their hands with soap, they often give reasons such as: "I don't believe germs are on my hands", "I don't believe germs can make me sick", "I don't have time", "I don't see dirt on my hands", etc. They must remember that "germs are very harmful".
- Washing hands with water only cannot adequately remove germs from the hands. That is why you need to add soap.
- Washing hands together in a single bowl or basin can leave the germs still hiding on your hands. That is why you need to wash your hands under running water (or water that flows away)
- There are certain times that it becomes most important to wash your hands with soap, we call these times "critical times" or "key moments". These critical times include the following: After using the toilet, before eating, after

[8] Scott *et al*., (2007)
[9] Steiner-Asiedu *et al*., (2011)

touching a child's stool (toilet), before feeding a child, after blowing your nose, before handling drinking water, after playing with a pet, etc.

- Research has shown that if you take 10 cases of diarrhoea, about 4 of the cases could have been prevented if people washed their hands with soap under running water[10].

Session 2: Proper handwashing with soap (HWWS) – Practical session (at the handwashing station[11])

Objective:
To enhance the knowledge and skills of pupils to be able to practice proper HWWS

Expected Output:
Pupils' knowledge and skills will be enhanced to be able to practice proper HWWS

Facilities/Materials: Veronica bucket (Bucket with tap), running water, bar soap/liquid soap, paper towel.

Teaching Methods: Demonstrations, discussions, and rotational practice by pupils

Duration: 2 hours (with 2 break periods)

Learning Steps

1. Allow pupils to recap the previous lessons. Emphasis the need to use soap for handwashing, as well as the critical times/ key moments for HWWS.
2. Take pupils to a handwashing station
3. Mention the ten (10) steps for HWWS (and all at once) to pupils
4. Then go through the steps again but this time demonstrating as you mention each step (Allow an assistant to mention the steps as you demonstrate to pupils)
5. Invite a pupil to demonstrate as you mention the steps to him/her. Invite some more pupils to do same.
6. Now, without mentioning the steps, demonstrate HWWS to pupils (repeat to be sure pupils have grasped the steps)

[10] Freeman *et al*. (2014)
[11] Any set-up that provides running water and soap. This can be a "Veronica Bucket" (with a tap fixed to it) or a "Tippy-Tap".

7. Ask a pupil to demonstrate HWWS for all to observe. Ask other pupils to point out what they think went well and what they think did not go so well (repeat this to be sure pupils are picking up lessons).
8. Allow pupils to practice HWWS as they take turns

Trainer's Notes:

Steps to Proper Handwashing with Soap under Running Water[12]

Step	Expected Actions
1	Turn on clean running water
2	Get your hands wet
3	Apply soap to your hands to cover all hand surfaces
4	Rub your palms together, with fingers interlaced (in-between fingers)
5	Rub one of your palms over the back of the other hand and vice versa, with fingers interlaced (in-between fingers)
6	Rub your thumb with your other palm and vice versa
7	Wash the tip of your fingers & clean under your finger nails
8	Wash both of your wrists with your palm
9	Rinse your hands and wrists well with running water
10	Dry your hands with a single use towel or air dry hands (shake hands in the air)

Source: https://www.newsghana.com.gh

[12] WHO (2009), CDC (2015), Hand Hygiene Australia (2016)

...by washing your hands with soap

under running water at critical times!!!

Source: Author's Field Photos

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Appendix 8: Test/Analysis Assumptions

Fisher's Exact Test

- More than 20% of expected cell counts of a given table should be less than the value 5.

An example is shown below:

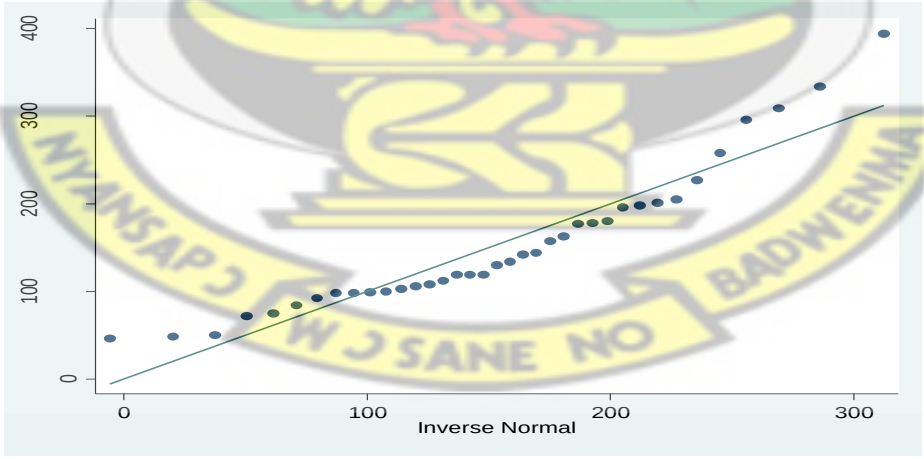

```
. tab FunctionalityHWSS AvailFuncWater
```

Functionality of Students' HW Station	Functional Water Facility		Total
	Outside_S	Within_Sc	
No	30	1	31
Yes	1	5	6
Total	31	6	37

Student's *t*-Test

Example:

- Homoscedasticity of response variable '*student enrolment'*.



Assumptions of a Scalogram Model

1. That facilities included are essential to the social organisation (i.e. organisation of WASH behaviour) of a given setting
2. That an included facility exists in at least 1 setting
3. That a total centrality of any given facility is 100%

Appendix 9: Scientific Papers Emanating from Research

Paper 1

International Journal of Public Health
https://doi.org/10.1007/s00038-017-1066-2

REVIEW

A framework for designing hand hygiene educational interventions in schools

Emmanuel Appiah-Brempong[1] · Muriel J. Harris[2] · Samuel Newton[3] · Gabriel Gulis[4]

Received: 18 August 2017 / Revised: 6 December 2017 / Accepted: 14 December 2017

Abstract

Objectives Hygiene education appears to be the commonest school-based intervention for preventing infectious diseases, especially in the developing world. Nevertheless, there remains a gap in literature regarding a school-specific theory-based framework for designing a hand hygiene educational intervention in schools. We sought to suggest a framework underpinned by psychosocial theories towards bridging this knowledge gap. Furthermore, we sought to propound a more comprehensive definition of hand hygiene which could guide the conceptualisation of hand hygiene interventions in varied settings.

Methods Literature search was guided by a standardized tool and literature was retrieved on the basis of a predetermined inclusion criteria. Databases consulted include PubMed, ERIC, and EBSCO host (Medline, CINAHL, PsycINFO, etc.). Evidence bordering on a theoretical framework to aid the design of school-based hand hygiene educational interventions is summarized narratively.

Results School-based hand hygiene educational interventions seeking to positively influence behavioural outcomes could consider enhancing psychosocial variables including behavioural capacity, attitudes and subjective norms (normative beliefs and motivation to comply).

Conclusions A framework underpinned by formalized psychosocial theories has relevance and could enhance the design of hand hygiene educational interventions, especially in schools.

Keywords Hand hygiene · Education · School · Theories · Framework

Introduction

Hand hygiene as a structured intervention to prevent the spread of infections began only some few decades ago. In the early 1960s, the Center for Disease Control (CDC) published a guideline instructing healthcare professionals to practice handwashing with soap (HWWS) for 1–2 min before and after patient contact. This position is, however, challenged by some authors who have suggested that hand hygiene practice and research in the clinical setting dates back to the 1840s, when it was discovered by Ignaz Semmelweis that puerperal fever could be prevented by adhering to hand hygiene disinfection; which eventually led to his introduction of handwashing standards in obstetric clinics (Kelcíkova et al. 2012; Potter 2001).

The threats posed by infectious diseases to the global public health deserve increased attention. Infectious diseases continue to claim thousands of lives, especially in developing countries, where relatively little investments are made by the governments to create an enabling environment which enhances the pursuit of hygiene (Cross and Coombes 2014). In Africa, for example, while cholera claimed 1583 lives in 2014, the Ebola virus disease killed a

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woeful number exceeding 11,000 people at the end of the first quarter of 2016 (WHO 2016). Cholera continues to be endemic in many developing nations around the world. For example, in Ghana, a total of 28,975 cases of cholera (CFR = 0.8%) resulting in 243 deaths were recorded between June 2014 and August 2015 (WHO 2015).

Among children, diarrhoea continues to claim lives which could have been preserved. Diarrhoea and respiratory illness account for about five million deaths in children every year, and are mentioned as the top two killers of children worldwide (Curtis et al. 2011). It is estimated that by the year 2030, approximately 24 million children could lose their lives as a result of diarrhoea, if global efforts are not intensified (UNICEF 2016). It is worth noting that about 60% of diarrhoeal mortality worldwide is attributable to poor water, sanitation and hygiene (Prüss-Ustün et al. 2014).

Though hygiene promotion has received relatively less attention from donors and governments, especially when compared to other health issues such as malaria and HIV, the evidence is clear that the contribution of hygiene-related diseases namely diarrhoea and pneumonia to child mortality is greater than the contribution of all the other child illnesses combined (UNICEF 2016). Interventions on hand hygiene have often targeted clinical settings and related ones with few targeting the school setting, despite the fact that school-based hygiene interventions are essential for fostering life-long learning (Snel and Shordt 2005; Adams et al. 2009). Also, school children can be good agents of health behaviour change in homes and the community, as they tend to be more receptive to new behaviours as compared to the adult population.

School-based hand hygiene interventions often seek to influence knowledge, attitudes, practices, illness or absenteeism due to illness. Some authors have underscored the importance of regular hygiene education in preventing the spread of infectious disease pathogens among children in the school setting (Jefferson et al. 2009). It is, therefore, not uncommon to find practitioners resort to hand hygiene education as an intervention for promoting safe hygiene practices in schools, especially in the developing world. Nevertheless, from our literature search, no school-specific theory-based framework was identified which could aid practitioners in the design of hand hygiene educational interventions in schools, though some guidelines and frameworks exist for other settings such as the clinics. In the absence of such a theory-driven framework, a school-based interventionist could resort to a trial and error in intervention design and evaluation (Melnyk and Morrison-Beedy 2012) and risk missing out on an opportunity to enhance construct validity (Stein et al. 2007).This paper attempts to contribute to bridging this gap, and consequently contribute to the enhancement of effectiveness in hand hygiene intervention delivery in schools. We begin with a contribution to the conceptualisation of hand hygiene. Subsequently, a critique of the notable hand hygiene approaches is presented. Also, we discuss the available evidence bordering on the existence of a school-specific theoretical framework for the design of a school-based hand hygiene educational intervention. On the basis of the identified gap in literature, the paper finally suggests a framework underpinned by multiple psychosocial theories for the design of a school-based hand hygiene educational intervention.

Methods

Hygiene promotion literature tends to be scattered across many databases, potentially due to the multiple disciplines which make contribution to hygiene promotion. Databases and search engines which were consulted to guide the literature search of this study included PubMed, ERIC, Cochrane Library, EBSCO host (Medline, CINAHL, Academic search complete, PsycINFO, PsycARTICLE, PsycLIT), Hinari and googlescholar. Only literature published in English were retrieved, and there was no limit to a particular time frame of published literature.

A search strategy, developed with guidance from a tool developed by the Humbolt State University (2008) guided the free literature search. Key search terms used included '*hand hygiene*', '*handwashing*', '*handwash*', '*hand sanitation*'. Others were '*education*', '*promotion*', '*intervention*', '*behaviour change*', '*project*', *and* '*programme*'. In addition, '*school*', '*school age*', '*grade*', '*level*', '*primary*', '*children*' *and* '*adolescents*' were used. Boolean operators were used to combine search terms, and words were truncated where necessary to ensure a more comprehensive search. Data from the recruited studies were extracted using a template developed by authors. In an attempt to report the existence or otherwise of a school-specific theoretical framework for hand hygiene education, articles were included if they met the following criteria: (1) study was on hand hygiene (2) intervention study (3) implemented in a school setting (4) evaluates hand hygiene education (5) published in English language.

Results

Towards a definition of hand hygiene

A review of the body of literature suggests a few attempts at defining the term *hand hygiene*, though the term *hygiene* has received varied conceptualisations. According to the US Center for Disease Control and prevention, hand

hygiene "includes handwashing (washing hands with non-antimicrobial soap), antiseptic handwash (washing hands with water and soap or another detergent containing an antiseptic agent), antiseptic hand rub (rubbing hands with an antiseptic hand rub) and surgical hand antisepsis (pre-operative antiseptic handwash or hand rub performed by surgical personnel)" (CDC 2015). As comprehensive as the above definition may appear, it is limited in the following ways:

- The use of local cleansing agents as alternative to soap is not conspicuous in the definition.
- The purpose of engaging in the act of handwashing or hand rubbing is not reflected.
- The definition appears to be skewed towards hand hygiene pertaining to the hospital setting and may not be applicable to other settings such as the school.

On the basis of the above discussion, we suggest the following definition of hand hygiene. The proposed definition seeks to address the aforementioned limitations, and this implies that it is potentially relevant for the conceptualisation of hand hygiene in varied settings:

> *"An activity involving the use of soap or other effective local agents in which running water is provided, or the use of a hand-rub containing the right proportion of alcohol or related substance, which cleanses the hands of micro-organisms of disease causing potential".*

Common approaches to hand hygiene

There are different approaches existing for hand hygiene. These approaches are often tied to the setting within which hand hygiene occurs. For example, within the clinical setting, gloves may be used as a hand hygiene strategy complementing handwashing with soap. In a school or community setting, the commonest approach for hand hygiene is observed to be handwashing with soap or ash/soil in the absence of soap. Also, the use of hand sanitizers or rubs tends to be common in clinical settings and many other workplaces.

The use of hand sanitizers

Earlier guidelines for hand hygiene placed more emphasis on the use of water and soap, than the use of a waterless hand sanitizer in the clinical settings (Hospital Infection Control Practices Advisory Committee 1995). Recent guidelines for clinical settings, however, appear to place emphasis on hand sanitizers, especially in instances where the hand is not visibly dirty (WHO 2009). A typical hand sanitizer consists of ethanol, isopropanol, and n-propanol. The antimicrobial activity of the aforementioned alcohols is tied to the ability to denature proteins (Jumaa 2005). An alcohol concentration of 60–95% is considered as most effective (Jumaa 2005; Centers for Disease Control and Prevention 2002). When applied to the skin, alcohols are known to have the most rapid bactericidal effect when compared to other disinfectants (*ibid*). A quantity of 3 mL of hand sanitizer, lasting for 20–30 s on the hands has been recommended (Hand Hygiene Australia 2016; Widmer 2000).

The use of hand sanitizers is not without criticism. Hand sanitizers can be criticized for not being able to rid the hands of debris and some oils which may serve as hiding places for some micro-organisms on the hands (Filion et al. 2011). Also, there are concerns about the possible hand irritations and even skin damage as a result of the use of hand sanitizers (Larson et al. 2006).

Handwashing with soap (HWWS)

Handwashing with soap has been described as simple yet a complex practice. Though there is no single guideline for this practice, it is common to find many guidelines (CDC 2015; WHO 2009) outline steps including the following:

- Turn on clean running water.
- Get hands wet.
- Apply soap to hands to cover all the hand surfaces.
- Rub palms together, with fingers interlaced.
- Rub one palm over the back of another hand and vice versa, with fingers interlaced.
- Rub thumb with the other palm, and vice versa.
- Wash the tip of fingers and clean under finger nails (especially when hands are visibly dirty).
- Wash both wrists with palm.
- Rinse hands and wrists thoroughly with running water.
- Dry hands with a single use towel or air dry.

Regarding the duration for handwashing, WHO estimates a duration of 40–60 s for the entire handwashing procedure, beginning with the wetting of hands to the drying of hands (WHO 2009). The Center for Disease Control and Prevention has recommended a minimum duration of 20 s for the rubbing together of hands with soap (CDC 2015). This recommendation is in consonance with that published by Hand Hygiene Australia (2016). It is, however, worth mentioning that the duration for handwashing with soap has implications on the compliance to handwashing practice. A study by Kelcíkova et al. has shown that reasons for non-compliance to handwashing guidelines included the time required for handwashing with soap (Kelcíkova et al. 2012).

Critiques of HWWS borders largely on the reactive effects of cleansing agents. The notable agents being either

an antiseptic soap or a plain soap may come in the form of bars, liquid or leaflets. Some concerns have been expressed about HWWS from different but related perspectives. Larson has reported that HWWS could lead to damaged skin, which may be more heavily colonised by micro-organisms with pathogenic potential (Larson 1999). According to Nicolle, the use of soap for handwashing may result in skin irritation for some people (Nicolle 2007).

A suggested framework for hand hygiene educational intervention in schools

The literature search towards reporting on the existence or otherwise of a school-specific theoretical framework for hand hygiene educational intervention yielded an initial number of 1787 abstracts. When subjected to the study's inclusion criteria, 1697 were excluded, as they were not on hand hygiene but other fields of hygiene. The remaining 90 were further subjected to the inclusion criteria, where 30 were excluded as they were not intervention studies. When the remaining 60 were further subjected to the inclusion criteria, 47 were excluded as they failed to evaluate hand hygiene education. Two other studies failed to provide adequate information to make a determination and hence were excluded. Out of the remaining 11 studies, 6 were excluded as they were not school-based. The remaining 5 studies were used for the narrative synthesis. A flow-chart of the search in presented in Fig. 1 below.

The available evidence

Studies identified and subsequently examined to determine the existence of a school-specific theoretical framework for the design of school-based hand hygiene educational interventions were conducted in different countries. Two were conducted in the United States, the remaining three studies were conducted in Egypt, Ghana and Ethiopia. Studies assessed varied endpoints including hand hygiene knowledge, behavioural intention, practices, as well as absenteeism. Characteristics of the studies are summarized in Table 1.

Guinan et al. (2002) delivered a comprehensive handwashing programme which included a 1-h hygiene education and reported that the intervention reduced absenteeism in five elementary schools in Pennsylvania. In another study by Snow et al. (2008), a teacher's cue to action in combination with a hand hygiene educational intervention was delivered in a public elementary school in Utah. The authors reported that the intervention was effective in terms of improving the application of hand hygiene products.

In Egypt, Moussa et al. reported that the handwashing practice of elementary school children was improved following a health educational programme (Moussa et al. 2015). Lang (2012) in a qualitative study conducted among elementary school children in Ghana reported that hand hygiene knowledge and practice improved post intervention. Graves et al. conducted a study in Kenya, which implemented a handwashing educational intervention employing a poster design competition among primary school children, and evaluated its effect on handwashing practice (Graves et al. 2012). Authors reported that the intervention failed to achieve a significant difference between the intervention and control arms, regarding the frequency of handwashing.

Theoretical considerations

Though a greater number of the aforementioned studies reported a positive intervention outcome, a key question which remains is, what are the pathways through which the interventions yielded the reported outcomes? And within which school-specific theoretical framework did the interventions operate? These questions are crucial, as they provide an opportunity for the enhancement of the replicability of interventions which work, through an understanding of the interplay between formalized constructs or variables involved in an intervention delivery. None of the studies reviewed above makes reference to a school-specific framework underpinned by relevant theories which could be used for guiding the conceptualisation or design of school-based hand hygiene educational interventions.

In the light of the above gap in literature, we suggest a school-specific framework underpinned by multiple psychosocial theories to guide the future design of hand hygiene educational interventions in schools, while not discounting the utility of the framework for related settings. The framework is based on pertinent constructs which facilitate a thorough understanding of health behaviour and the change in children, and the logical relationships existing between the constructs. Key theories/models guiding the development of the framework are: the health belief model (HBM) by Rosenstock et al. (1988), social cognitive theory (SCT) by Bandura (1986), and the theory of planned behaviour (TPB) by Ajzen (1988). Figure 2 presents the proposed framework.

From Fig. 2, a school-based hand hygiene educational intervention should primarily target the individual-level variables namely behavioural capacity (i.e., knowledge and skill), perceived susceptibility, perceived seriousness, attitude and subjective norms (i.e., normative beliefs and motivation to comply). Nevertheless, the creation of an enabling school environment must form the basis for attempting to influence individual-level variables. In the light of this, practitioners should work together with relevant stakeholders to ensure that there are supportive handwashing facilities in the school, as well as a supportive

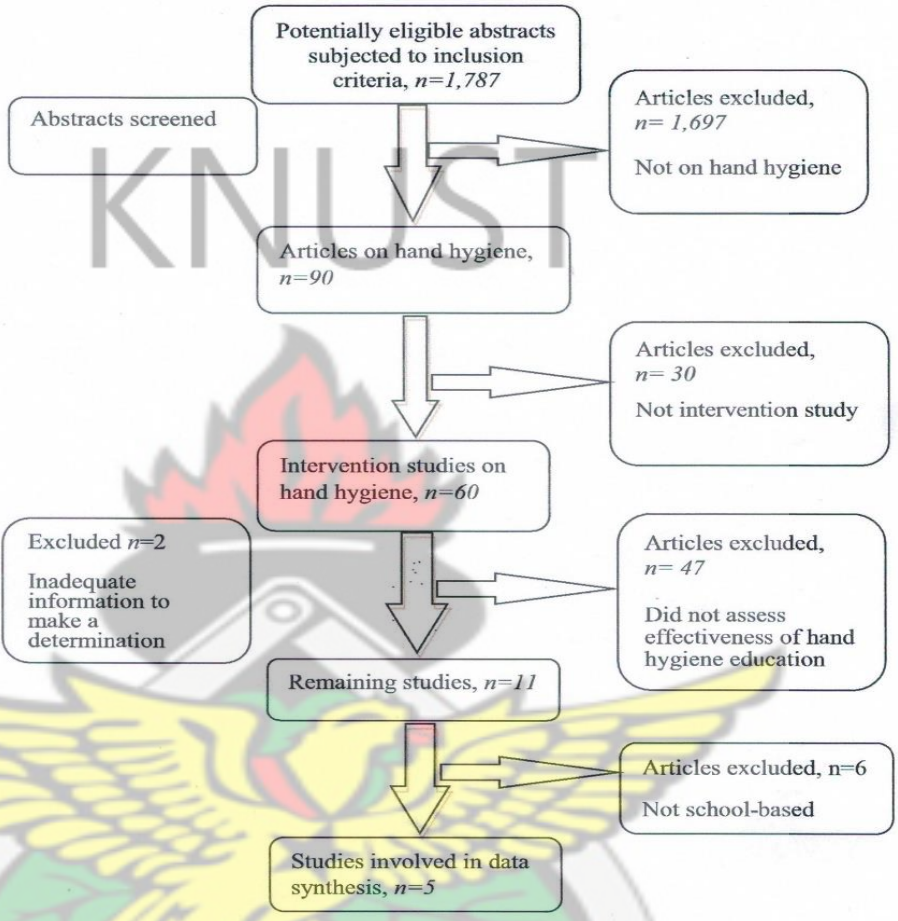

Fig. 1 A flow chart of the study selection process

school policy environment. The social cognitive theory (SCT) posits that the combined effect of knowledge and skill (behavioural capacity) can trigger the adoption of a behaviour (Bandura 1986). In a school-based hand hygiene education, practitioners ought to give substantial attention to the enhancement of the skill of target participants, and not merely the enhancement of knowledge. Rosenstock et al. have described perceived susceptibility as an individual's evaluation of his/her vulnerability to a given health condition (Rosenstock et al. 1988). In line with this description, a student will likely consider whether the failure to wash hands with soap could result in him/her contracting diarrhoea. In the event that a student concludes that he/she is prone to diarrhoea, then a further evaluation emerges which assesses the seriousness or otherwise of the consequences of diarrhoea, which when considered by the individual to be devastating to his/her aspirations could trigger an intention to adopt a healthful behaviour. This has been termed as perceived seriousness (Rosenstock et al. 1988).

Another individual-level variable which has been suggested to influence behavioural intention is subjective norms. Bennet and Murphy posited that subjective norms are determined by normative beliefs and the motivation to comply (Bennet and Murphy 1997). Normative beliefs have been described as the belief which an individual has about the approval or otherwise of a given behaviour by people considered to be significant others (Huesmann and Guerra 1997). In a school setting, such significant others could be teachers and respectable peers. Many studies have underscored the crucial role of teachers in influencing the handwashing behaviour of school children, even though few have assessed teachers' handwashing behaviour (Setyautami et al. 2012). In the home, significant others

Table 1 Characteristics of studies assessing school-based hand hygiene educational interventions

Study (location of study)	Type of intervention	Methodological approach	Study design	Setting	Method of analysis	Total participants	Key outcome(s) variables assessed	Reported results
Guinan et al. (2002) (Pennsylvania-USA)	Education and use of a hand sanitizer	Quantitative	Not reported	Elementary schools	Binomial distribution with parameters	290	Absenteeism	E
Snow et al. (2008) (Utah-USA)	Teacher cue to action and Hand hygiene education	Quantitative	Not reported	Public elementary school	A two sample test of proportion using STATA 8.0	492	Application of hand hygiene products	E
Moussa et al. (2015) (Egypt)	Health educational programme	Quantitative	Quasi-experiment	Primary schools	Descriptive stats using IBM SPSS 20.0. Qualitative analysis	450	Knowledge about HW HW Practices	E
Graves et al. (2012) (Kenya)	Provision of *HW facilities and education using a poster contest	Quantitative	Cluster-randomized trial	Primary schools	Two sample paired *t* test, Wilcoxon rank-sum non-parametric test	Not reported	HW practice	IE
Lang (2012) (Ghana)	Hand hygiene intervention	Qualitative	Not reported	Elementary schools	Not reported	1739	Hand hygiene Knowledge Hand hygiene practice	E

E effective, *IE* ineffective, *POs* primary outcomes, *HW* handwashing, *HH* hand hygiene

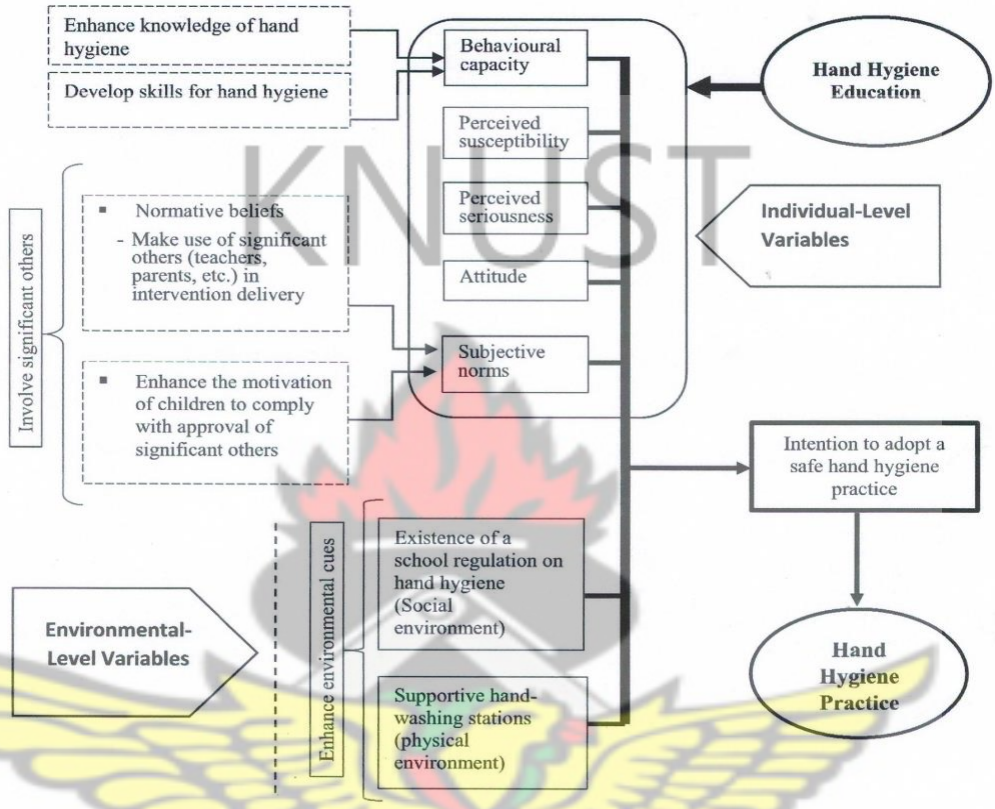

Fig. 2 A framework for designing hand hygiene educational intervention in schools

could be parents or older relatives. Apart from the school, children spend the rest of the day in the home. This brings to light the potential influence of parents or guardians on a child's handwashing behaviour even at school.

Within the context of handwashing with soap for example, the existence of an enabling physical environment is essential for encouraging the practice. The existence of functional facilities for engaging in the practice, such as running water, and soap are crucial to the adoption and maintenance of the behaviour. The importance of a functional handwashing facility for enhancing children's handwashing behaviour has been greatly established (UNICEF 2008; Adams et al. 2009). In addition, the social environment plays a critical role in the adoption and maintenance of hand hygiene behaviour in the school setting. An important variable pertaining to the school environment worth considering is school regulations or prohibitions pertaining to hand hygiene. This holds a potential for influencing students' handwashing behaviour.

Behavioural intention according to the theory of planned behaviour is the closest determinant of behaviour (Ajzen 1988; Lavin and Groarke 2005). It often presents itself as a moderator variable through which a behaviour is adopted or rejected.

Discussion

The studies evaluating a hand hygiene educational intervention in schools appear to be characterised by some design limitations. Several of such studies failed to demonstrate an intervention's theory of change or framework (Guinan et al. 2002; Snow et al. 2008; Moussa et al. 2015; Graves et al. 2012; Lang 2012), which is apparently required to explain the pathways to the intervention effect. The benefits of a theory-based intervention include the avoidance of a trial and error in intervention design and evaluation (Melnyk and Morrison-Beedy 2012), enhancement of construct validity and subsequently intervention

fidelity (Stein et al. 2007). The framework presented in this paper could play a useful role in this regard.

It is essential for frameworks of interventions to be based on formalized theories of behaviour change (Bandura 2004). The suggested framework thrives on constructs and variables emanating from formalized psychosocial theories, and these constructs have been applied empirically in several fields, many of which are hand hygiene related (e.g., Walker and Jackson 2015; Liao et al. 2011; Clayton and Griffith 2008), and also examined in a number of systematic reviews (e.g., Dreibelbis et al. 2013; Hardeman et al. 2002).

A crucial variable namely behavioural intention which is presented by the proposed framework has been described as the closest determinant of behaviour. However, over the years, there has been an increased understanding of the fact that intention does not necessarily predict behaviour. This phenomenon has been referred to as the "intention-behaviour gap" (Sniehotta et al. 2005; Godin et al. 2005). For example, a lack of self-efficacy could inhibit a progression from intention to behaviour (Sniehotta et al. 2005). A key lesson for practitioners seeking to bridge the intention–behaviour gap in a school setting could be to target variables including self-efficacy, and the enhancement of cues to action. A strategy to enhance self-efficacy among students could be the use of peer-led educational campaigns. Regarding cues to action, posters or stickers on hand hygiene at vantage points can potentially trigger safe hand hygiene practices among students.

The proposed framework is limited to a hand hygiene behaviour as an outcome variable, but in practice, some interventions seek to assess disease conditions associated with hand hygiene behaviour. From the body of literature, many studies can be identified which resorted to behaviour as an outcome variable (Moussa et al. 2015; Setyautami et al. 2012; Schmidt et al. 2009). A decision on an outcome variable is contingent on several factors including the intervention objectives, and the availability of resources in terms of time, funds and expertise.

Implications for research and practice

For researchers, the framework suggested in this paper is expected to spur more empirical studies seeking to establish the logical relationships existing among the variables and constructs and how these play out in a school-based hand hygiene educational intervention. Although the variables and constructs used for this framework emanate from well-established models and theories, it is expedient to strengthen the evidence base on how these variables and constructs interplay, and the possible moderator variables involved. Thus, more robust correlational studies may be helpful in this regard. For practitioners working in school health, the suggested framework could facilitate the conceptualisation, design and replicability of educational interventions. The obvious implications of this include the maximization of intervention effectiveness as well as efficiency.

Conclusion

A framework underpinned by multiple psychosocial theories could enhance the design of hand hygiene educational interventions in schools. The importance of drawing from multiple theories is varied and includes the avoidance of trial and error in intervention delivery, and an enhancement of construct validity and the strengthening of external validity of intervention results. We have contributed to the conceptualisation of hand hygiene, summarized the evidence bordering on the existence of a theoretical framework to facilitate the design of hand hygiene educational interventions in schools. In the light of the existing gap in literature, a school-specific framework underpinned by multiple psychosocial theories has been suggested, and could enhance the efforts of practitioners and researchers in the design of hand hygiene educational intervention in schools, while not discounting the utility of the framework for similar settings.

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Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest.

Ethical consideration No human participants or animals were involved in the study.

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Paper 2

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BMC Public Health

RESEARCH ARTICLE Open Access

Examining school-based hygiene facilities: a quantitative assessment in a Ghanaian municipality

Emmanuel Appiah-Brempong[1*], Muriel J. Harris[2], Samuel Newton[3] and Gabriel Gulis[4]

Abstract

Background: The crucial role of adequate water, sanitation and hygiene (WASH) facilities in influencing children's handwashing behaviour is widely reported. Report from UNICEF indicates a dearth of adequate data on WASH facilities in schools, especially in the developing world. This study sought to contribute to building the evidence-base on school hygiene facilities in Ghana. The study further explored for possible associations and differences between key variables within the context of school water, sanitation and hygiene.

Methods: Data was collected from 37 junior high schools using an observational checklist. Methods of data analysis included a Scalogram model, Fisher's exact test, and a Student's *t*-test.

Results: Results of the study showed a facility deficiency in many schools: 33% of schools had students washing their hands in a shared receptacle (bowl), 24% had students using a single cotton towel to dry hands after handwashing, and only 16% of schools had a functional water facility. Furthermore, results of a proportion test indicated that 83% of schools which had functional water facilities also had functional handwashing stations. On the other hand, only 3% of schools which had functional water facilities also had a functional handwashing stations. A test of difference in the proportions of the two sets of schools showed a statistically significant difference ($p < 0.001$).
In addition, 40% of schools which had financial provisions for water supply also had functional handwashing stations. On the other hand, only 7% of schools which had financial provisions for water supply also had functional handwashing stations. There was a statistically significant difference in the proportions of the two sets of schools ($p = 0.02$).

Conclusion: We conclude that it is essential to have a financial provision for water supply in schools as this can potentially influence the existence of a handwashing station in a school. An intervention by government, educational authorities and civil society organisations towards enabling schools in low resource areas to have a sustainable budgetary allocation for WASH facilities would be timely.

Keywords: School, Water, Hygiene, Functional, Facilities

Background

Infectious diseases continue to claim many lives especially among children. Though the developed world is not exempted from this phenomenon, the developing world is often hit the hardest. For example, diarrhoeal diseases have been listed as one of four leading causes of early death in all sub-Saharan African countries [1]. In the year 2015, approximately 1400 children lost their lives each day as a result of diarrhoea [2]. Preventing the spread of infectious agents in schools is a good way towards minimizing the infectious disease burden among children. The provision of adequate water, sanitation and hygiene (WASH) facilities in schools is crucial in ensuring the adoption and maintenance of safe sanitation and hygiene practices among school children.

The available evidence suggests that schools with better hygienic conditions tend to have less problems with disease causing organisms [3]. In the light of this, WASH in schools deserves increased attention both at the global and national levels. A laudable expression in

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the UN Sustainable Development Goals (SDGs) is the recognition of WASH in Schools (WinS) in Goals 4 and 6. However, such global expressions ought to be translated into national and local policies and actions in order to improve WinS substantially.

The crucial role of adequate WASH facilities towards influencing children's handwashing behaviour is widely known [4, 5]. A functional handwashing station in a school makes it possible for children to adopt the practice of handwashing with soap (HWWS). In spite of this importance, national monitoring systems for WASH which are intended to report on the availability and state of handwashing facilities in schools is generally weak especially in developing countries. Few developing countries have reliable data on hygiene facilities in schools, of which Ghana is no exception. According to UNICEF, only about half of its programme countries are able to report on WASH facilities in schools [6]. The dearth of reliable data on the functionality of WASH facilities in schools is worrisome, as such data is required for good programme design and management [6].

There is a paucity of studies examining hand hygiene facilities in African schools. In Ghana, Steiner-Asiedu et al. as well as Monney et al. have attempted to describe the available handwashing facilities in a sample of schools [7, 8]. However, no study was identified to have quantitatively explored the associations or variance between a functional water facility, financial provision for water supply, and existence of a handwashing station. The present study sought to employ a more robust quantitative approach to generate evidence on the existence and functionality of hygiene facilities within a representative sample of basic schools in a Ghanaian municipality. Precisely, we sought to test the following null hypotheses:

1. **Ho:** With regards to the existence of a functional handwashing station, the proportion of schools having a financial provision for water supply will not differ from the proportion of schools lacking a financial provision for water supply.
2. **Ho:** With regards to the existence of a functional handwashing station, the proportion of schools having a functional water facility will not differ from the proportion of schools lacking a functional water facility.

Methods

Approach and design

The methodological approach adopted for the study was quantitative. A study seeking to objectively assess the existence, proportions and relationships between existing facilities is better approached from a positivist perspective, and hence the choice of a quantitative methodology. A cross-sectional design was employed for this assessment, and so study variables were assessed at only one point in time.

Study population and sample size

The study population was made up of all public junior high schools within the Ejisu-Juaben Municipal Education Directorate. In all, there were 80 public junior high schools organised within 10 educational circuits. The list of schools was obtained from the Municipal Education Directorate. A representative sample of 37 schools was derived using two complementary formulas by Yamane and the Pennsylvania State University [9, 10].

Sampling technique

In a bid to ensure that each school in all 10 educational circuits had an equal chance of being a part of the study, and in a manner that enhances the external validity of study results, a *stratified random sampling* technique was employed. With this technique, educational circuits constituted the strata, while schools constituted the sample units. In line with the above technique, a *proportionate stratification* approach was used [11]. This approach ensured that the sample size (i.e. number of schools required from each educational circuit) of each stratum (i.e. an educational circuit) was proportional to the population size of the stratum being considered [12]. Table 1 shows the estimated number of schools from each educational circuit.

Description of data collection procedures and tools

Data was collected from March 2016 to July 2016, spanning a period of five calendar months. A checklist adapted from UNICEF and Moore et al. aided the environmental audit of schools in order to obtain first hand data on existing facilities [6, 13]. A decision on which facilities to target was guided by a WASH in schools monitoring package developed by UNICEF [6]. The observation tool was pretested in a junior high school located in a municipality which is contiguous to the geographic scope of this study (student enrolment, $n = 256$),

Table 1 School Selection

ID	EDUCATIONAL CIRCUIT	POPULATION SIZE OF CIRCUIT	ESTIMATED NO. OF SCHOOLS REQUIRED
A	Achinakrom	6	3
B	Bomfa	8	4
C	Ejisu	11	5
D	Fumesua	5	2
E	Kubease	8	4
F	Kwaso	9	4
G	New Koforidua	6	3
H	Ofoase	5	2
I	Juaben	14	6
J	Tikrom	8	4
TOTAL		80	37

Source: Developed based on a list obtained from the EJM Education Directorate, 2016

and was subsequently fine-tuned. For instance, after the pretest it became necessary to include an item that enabled the observation of a functional toilet facility within schools. This was essential due to the complementarity of the concepts of hygiene and sanitation. Where required, clarifications on facilities were sought from the head teacher or an authorized representative of the school. The checklist makes use of dichotomous questions and assesses the school environment based on predetermined parameters, including: accessibility and source of water point, existence of handwashing stations, functionality of toilet facility, and accessibility to the toilet facility.

Data was collected by the lead researcher with assistance from trained field enumerators. Field enumerators were given a 3-h training by the lead researcher who has substantial experience in observational studies. All field enumerators were university graduates serving as teaching and research assistants in a public university.

Data analysis

Descriptive statistical analysis was used in describing the existing facilities for handwashing in schools. For profiling the existing WASH facilities in participating schools, a scalogram model was used. In exploring for possible relationships between key variables, and differences in proportions of variables, statistical tests used were the Student's *t*-test, Fisher's exact test, and a two-sample proportion test. Data was analyzed using STATA *version 14.0* (*STATA Corp., College Station, Texas*).

Ethical considerations

The research protocol was reviewed and subsequently granted clearance by the Committee on Human Research, Publications and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology, Ghana. In addition, an approval to conduct the research was obtained from the Ejisu-Juaben Municipal Education Directorate of the Ghana Education Service, a regulatory body of all basic schools within the study area.

Results

Characteristics of schools, and distribution of facilities

Observations of hygiene facilities occurred in all 37 schools. All participating schools were public, and none was a single-sex school. The mean student enrolment was 153 (SD = 81.9). The minimum student enrolment was 46 while the maximum was 394. Table 2 presents summary statistics on the proportions of schools with specific facilities.

Soap was the most common item observed in participating schools. Sixty-eight percent (68%) of schools had soap available for use. Out of the number of schools having soap ($n = 25$), 4% had a liquid soap, while the remaining schools had a solid soap (96%). Sixteen percent (16%) of schools had a functional water facility within its compound. Most of these facilities were boreholes (in 83% of schools), and 17% had a stand-pipe (tap-water).

Of the 37 participating schools, 6 (16%) had a functional handwashing station. The average number of functional handwashing stations was 2 (SD = 0.98). Only 19% of schools had a handwashing facility attached to a toilet facility. Also, 23% of schools had a separate handwashing station for teachers. Also, 33% of schools had students washing their hands in a shared receptacle (bowl), 24% had students using a single cotton towel to dry hands after handwashing, and none of the schools had a paper towel displayed for hand drying.

With regards to functional toilet facilities, 56% had this within the school compound. The types of toilet facility observed were the WC (6%), VIP (6%) and the Simple Pit Latrine (88%). The mean number of cubicles within a toilet facility was 4.9 (SD = 2.6). All schools had a separate section of the toilet facility for males and females. Also, 75% of schools had a separate section designated for teachers.

A financial provision for running handwashing stations reportedly existed in 27% of schools. Two main streams of revenue for sustaining a WinS were identified. These were the "capitation grant" from central government, and the internally generated funds (IGF). Most schools (94%) depend largely on the IGF for maintaining WASH facilities. Inflows to the IGF were identified to be from the sporadic donations from the Parents and Teachers Association (PTA), as well as the weekly fundraising sessions held during religious activities in schools. With regards to the adequacy of funds for maintaining WASH facilities, all schools ($n = 21$) described their financial resources as inadequate.

A profile of facilities in schools

The observed handwashing (HW) and related facilities in participating schools are profiled with the aid of a scalogram model presented as Table 3. With reference to Table 3, columns 1 and 2 present a list of all sampled schools with their respective student enrolment figures. The second row presents the facilities assessed in this study. Corresponding to the facilities are codes indicating whether or not a particular facility exists in a particular school. Thus, code "1" means a facility exist, while code "0" means otherwise. At the base of the matrix are the corresponding weights of each of the facilities calculated by dividing the assumed centrality by the total number of facilities. Columns 11 and 12 shows the total number of facilities in each school as well as the centrality indices. Centrality index is a sum of the weights of all facilities which exist in a particular school.

Table 2 Proportion of Schools with Specific Facilities

S/N	Item	Number of Schools	Percentage (%)
A	Functional[b] water point/facility	6	16
B	Functional[b] water reservoir	4	11
C	Soap	25	68
D	Tap bucket (veronica bucket)	13	36
E	Shared/communal [a]HW receptacle	12	33
F	Receptacle (for waste water)	11	31
G	Paper/tissue towel	0	0
H	Shared cotton towel/napkin	9	24
I	Functional handwashing station	6	16
J	Functional toilet facility	21	56
Financial Provision for HW Facilities			
K	Financial Provision for facilities	10	27
L	Source of funds		
	o Capitation grant	1	6
	o Internally Generated	9	94

Source: Field Survey, 2017 [a]HW-Handwashing [b]Facility was usable on the day of observation

From Table 3, school with identifier 0037 had the highest centrality index (CI = 84.80) by having nearly all observed facilities in school. On the other hand, schools with the lowest CI include 0002, 0009, 0012, 0013, 0016, and 0019 (all with a CI = 0.0), depicting the non-existence of at least one of the facilities for which observations were made.

Differences in proportions of facilities in schools

Differences in proportions, and differences in means of group variables were explored and the results are presented in Table 4. Results of an independent samples *t*-test shows a statistically significant difference in mean student enrolment of schools which had a functional toilet facility and schools which did not a functional toilet facility [$t(35) = -2.06$, $p = .04$]: Schools which had a functional toilet facility were observed to have a higher mean enrolment fig. [M = 177(SD = 76)], when compared with schools which did not have this facility [(M = 123(SD = 82)]. On the contrary, there was no statistically significant difference in the mean student enrolment of schools where a functional handwashing station existed and schools where it did not exist [$t(35) = -0.38$, $p = .69$].

To determine the possible associations existing between explanatory variables (i.e. functional water facility, functional toilet facility, existence of a financial provision for water supply), and a response variable 'functional handwashing station', results of a Fisher's exact test (two-tailed) indicated a statistically significant association between 'functional handwashing station' and 'functional water facility' ($p < .001$; Fisher's exact), and also 'financial provision for water supply' ($p = .03$; Fisher's exact), but not 'functional toilet facility' ($p = .16$; Fisher's exact).

In a bid to further examine the differences in proportions of each of the pairs of categories of explanatory variables (where a statistically significant *p*-value was generated), results of a two-sample proportion test (two-tailed) indicated that 83% of schools which had functional water facilities also had functional handwashing stations. On the other hand, only 3% of schools which had functional water facilities also had functional handwashing stations. A test of difference in the proportions of the two sets of schools showed a statistically significant difference ($z = -4.87$, $p < 0.001$).

In addition, 40% of schools which had financial provisions for water supply also had functional handwashing stations. On the other hand, only 7% of schools which had financial provisions for water supply also had functional handwashing stations. There was a statistically significant difference in the proportions of the two sets of schools ($z = -2.38$, $p = 0.02$).

Discussion

Distribution of facilities in schools

The study has shown that most schools had soap available to students (68%). Also, few schools had a functional water facility (16%). Similarly, few schools had a functional handwashing station (16%), which leaves much to be desired, considering the fact that 21% of schools in the developing world have handwashing facilities [14]. Furthermore, a large number of students wash their hands in a shared receptacle and also dry their hands with a common towel. More so, only half of the

Table 3 A Scalogram Model on Schools and Functional Facilities

School Identifier	Student Enrolment M(SD) = 153(81.9)	Existing Functional Facilities								Total no. of facilities	Centrality Indices
		Water Point	Hand-washing Station	Water Reservoir	Tap Bucket	Soap	Receptacle (waste water)	Toilet	Budget-Water Supply		
0037	309	1	1	1	1	1	0	1	1	7	84.8
0027	198	1	1	1	1	1	0	1	0	6	74.8
0031	84	1	1	0	1	1	1	1	1	7	68.8
0023	178	1	1	0	1	1	0	1	1	6	59.8
0036	177	0	1	0	1	1	1	1	1	6	52.1
0028	201	0	0	1	0	1	1	1	0	4	42.7
0003	99	1	0	0	1	1	0	0	1	4	38.4
0015	46	1	1	0	0	1	0	0	0	3	37.4
0026	144	0	0	0	1	1	1	1	1	5	35.4
0029	258	0	0	1	0	1	0	1	0	3	33.7
0010	108	0	0	0	1	1	1	1	0	4	24.7
0001	119	0	0	0	0	1	1	0	1	3	23
0011	142	0	0	0	1	1	1	0	0	3	20.7
0025	103	0	0	0	0	1	0	1	1	3	18.7
0006	157	0	0	0	0	1	1	1	0	3	17.7
0008	98	0	0	0	1	0	0	0	1	2	17.7
0030	92	0	0	0	0	1	1	1	0	3	17.7
0034	180	0	0	0	0	1	1	1	0	3	17.7
0020	112	0	0	0	1	1	0	1	0	3	16.4
0032	50	0	0	0	0	1	1	0	0	2	13
0035	75	0	0	0	1	0	0	1	0	2	12.4
0024	196	0	0	0	1	1	0	0	0	2	11.7
0004	100	0	0	0	0	0	0	0	1	1	10
0005	205	0	0	0	0	1	0	1	0	2	8.7
0017	227	0	0	0	0	1	0	1	0	2	8.7
0022	106	0	0	0	0	1	0	1	0	2	8.7
0007	296	0	0	0	0	0	0	1	0	1	4.7
0018	163	0	0	0	0	0	0	1	0	1	4.7
0033	334	0	0	0	0	0	0	1	0	1	4.7
0014	48	0	0	0	0	1	0	0	0	1	4.0
0021	134	0	0	0	0	1	0	0	0	1	4.0
0002	98	0	0	0	0	0	0	0	0	0	0.0
0009	72	0	0	0	0	0	0	0	0	0	0.0
0012	119	0	0	0	0	0	0	0	0	0	0.0
0013	119	0	0	0	0	0	0	0	0	0	0.0
0016	394	0	0	0	0	0	0	0	0	0	0.0
0019	130	0	0	0	0	0	0	0	0	0	0.0
Total number of facilities		6	6	4	13	25	11	21	10		
Assumed centrality		100	100	100	100	100	100	100	100		
Weight		16.7	16.7	25	7.7	4	9.0	4.7	10		

Source: Author's Construct, 2017

Table 4 Differences in Proportions and Means

Student Enrolment		
Response Variables	*p*-value (α < 0.05)	Mean(SD)
Functional Toilet Facility	0.04	
- Exist		177(76)
- Does not exist		123(82)
Functional HWS*	0.69	
- Exist		165(92)
- Does not exist		150(81)
	Functional HWS	
Explanatory Variables	*p*, Fisher's Exact	Cramer's V
Functional Water facility	0.00	0.80
Functional Toilet facility	0.16	–
Financial Provision for WS[+]	0.03	0.39
Two-Sample Proportion Test		
	z (*p*-value)	Proportion (95% CI)
Functional Water facility	−4.87 (0.00)	
- Within School		0.83 (0.54–1.13)
- Outside School		0.03 (−0.03–0.10)
Financial Provision for water supply	−2.38 (0.02)	
- Exist		0.40 (0.10–0 .70)
- Does not exist		0.07 (− 0.02–0.17)

*HWS-Handwashing station [+]WS-Water supply

number of schools have a functional toilet facility within the schools' premises. In such a situation, students could potentially resort to public toilet facilities, private homes or open defecation. It is however worth noting that the existence of a toilet facility in a school does not automatically guarantee its usage. Factors including facility age, and facility type could influence facility usage [15]. In this study, a simple pit latrine is identified to be the most common toilet facility in participating schools (88%). This condition obviously raises concern since a pit latrine is an unimproved toilet type, and hence not recommended for a school setting [5].

The availability of soap in schools is crucial to the promotion of school-based handwashing with soap (HWWS). However, it is well understood that the mere availability of soap does not imply the existence of a handwashing station, as additional facilities are required. Though the results show that most schools had soap available, it is also evident that few schools had a functional handwashing station, and therefore the use of soap (which was mostly found in front of offices of teachers) could have been used for other purposes such as washing teachers' dishes after meals. The commonality of soap is consistent with the result of a study conducted in Ghana which showed that 96% of study settings had soap available, but were used for other purposes apart from handwashing (e.g. washing dishes) [16]; and with another which reported that 83% of a sample of schools in Ghana had soap available [8]. The result is however in contrast to that of a study conducted in Senegal which reported that only 10% of participating schools had soap available to students [17].

Furthermore, the situation in which only 19% of schools had a handwashing facility attached to (or located within the premises) of a toilet facility appears worrisome and inconsistent with existing guidelines for setting up WASH facilities in schools [5]. It is common knowledge that the proximity of a handwashing facility to a toilet facility can potentially influence adherence to HWWS after toilet use.

The situation in which a large number of schools use a shared receptacle for students' handwashing, and a shared cotton towel for students' hand drying leaves much to be desired. In a country where infectious diseases continue to claim many lives, the implications of this practice on cross-infections is a matter of concern. In a recent study conducted in Ghanaian preschools, 8 different bacteria, 2 different parasites and a fungus were observed in water samples collected from a shared receptacle used by school children for handwashing [18].

The gloomy situation described above could potentially be explained in part by the WASH facility deficiency which appears to be characteristic of many schools in the municipality. The result of the scalogram analysis points to a situation where many schools are constrained in terms of basic facilities such as a functional water facility, a functional handwashing station, paper towels, and a financial provision for WASH. An observation of the centrality indices from the scalogram matrix shows that some schools (16%) have as low as 0.0 index indicating the non-existence of any of the observed WASH facilities. The WASH facility deficiency characterising participating schools is similar to a situation reported in Malawi where only 33% of handwashing facilities in schools were functional, and no school had soap available for handwashing [19]. An intervention by government and civil society organisations in addressing the situation will be timely.

Differences in proportions of handwashing facilities

With respect to functional toilet facilities in schools, the mean student enrolment was higher for schools which had this facility when compared with schools which lacked this facility. The higher student enrolment figures observed among schools with a functional toilet facility could suggest the possibility of a facility-driven selection of schools by parents or guardians. However, it is beyond the purview of this present study to draw such conclusions since additional studies may be required to draw a conclusion. The existence of a functional toilet facility

was however not associated with the existence of a functional handwashing station, which is an issue of concern considering the crucial complementarity of a handwashing station and a toilet facility [5].

Furthermore, a greater proportion of schools which had a functional water facility also had a functional handwashing station. The existence of a functional water facility in a school is crucial to the setting up of a functional handwashing station. Among others, this facilitates the provision of adequate running water which has been identified as key to the practice of proper handwashing with soap [20, 21].

Similarly, a greater proportion of schools which had a financial provision for water supply also had a functional handwashing station. To ensure the sustainability of functional handwashing stations in schools, the role of a budgetary allocation is imperative, and the result of this study has shown that a financial provision is essential to the existence of a functional handwashing station in schools. Recognizing the crucial role of a financial provision, it becomes a concern that few schools reported the existence of this scheme (27%). This result is consistent with that of a study conducted in Nicaragua where 95% of schools did not have a budgetary allocation for the provision of an essential WASH facility as soap [22].

Limitation

The generalization of results of this study is limited to settings which have socio-economic characteristics similar to that of the geographic scope of this study.

Conclusion

The importance of having an enabling environment to enhance the adoption of healthful behaviours is widely known among the health promotion fraternity. Ensuring the existence of adequate hygiene facilities in schools is a good way towards creating an environment which enables the adoption and maintenance of a safe hygiene behaviour among school children. The evidence generated by this study suggests a hygiene facility deficit across a range of schools.

Also, results of this study indicate that there is not enough evidence to accept the two null hypotheses formulated. Thus, schools with a financial provision for water supply tend to have a functional handwashing station. Similarly, schools with a functional water facility within its compound tend to have a functional handwashing station. This implies that concerted efforts by government, educational authorities and civil society organisations towards assisting schools especially in low resource areas to have a sustainable budgetary allocation for WASH facilities will be imperative.

Abbreviations

CHRPE: Committee on Human ResearchPublication and Ethics; CI: Centrality Index; HA: Alternative Hypothesis; Ho: Null Hypothesis; HW: Handwashing; HWWS: Handwashing with Soap; M: Mean; SD: Standard Deviation; UNICEF: United Nations Children's Fund; WASH: Water, Sanitation and Hygiene; WinS: WASH in School

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

EAB facilitated the process of collecting, analyzing and interpreting research data. MJH provided content and methodological expertise in the design and implementation of the research. SN offered methodological scrutiny in the design of the research. GG initiated the conceptualisation of the research. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The research was approved by the Committee on Human Research, Publication and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology – Ghana. In addition, a written consent was obtained from the Ejisu-Juaben Municipal Education Directorate of the Ghana Education Service, a regulatory body of all basic schools within the study area.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

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Effect of a Theory-Based Hand Hygiene Educational Intervention for Enhancing Behavioural Outcomes in Ghanaian Schools: A Cluster Randomised Controlled Trial

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Introduction

The crucial role which hand hygiene plays in the fight against the spread of infectious diseases in schools is well reported (Ejemot-Nwadiaro et al., 2015). In spite of this, hygiene in schools has received a relatively little attention in terms of monitoring and financing, especially in the

developing world. For example, in a global study involving 54 countries, sanitation in schools was identified as the most comprehensively monitored component of the water, sanitation and hygiene (WASH) sector, whereas hygiene was identified as the least monitored (UNICEF, 2015).

Hand hygiene has been defined as "an activity involving the use of soap or other effective local agents in which running water is provided, or the use of a hand-rub containing the right proportion of alcohol or related substance, which cleanses the hands of micro-organisms of disease causing potential" (Appiah-Brempong et al., 2018:253). It is a simple phenomenon yet characterised by many complexities. With respect to handwashing with soap (HWWS), few people tend to adhere to this practice, even though its effectiveness is well reported in the body of literature (Freeman et al., 2014; Curtis et al., 2009).

In a bid to improve adherence to proper handwashing practices in schools, hand hygiene education appears to be the most common behaviour change intervention, especially in the developing world. Conventional hygiene educational interventions have focused on passing information unto people with the aim of enhancing knowledge (cognitive domain) on issues pertinent to safe hygiene. Conventional hygiene education has been viewed by many WASH experts as yielding less success, in terms of enabling people to adhere to safe hygienic practices (UNICEF, 2008). An alternative, which is a theory-driven hand hygiene education has been suggested by some authors (Trunnell & White, 2005a; Mortell *et al*., 2013).

Ironically, there is a paucity of robust evidence on the effectiveness of a theory-driven hand hygiene educational intervention which targets all three learning domains (*i.e*. cognitive, affective, and psychomotor). This paper attempts to contribute towards building an evidence-base with respect to the effectiveness of a theory-driven hand hygiene educational intervention. The study sought to determine whether or not a hand hygiene educational intervention underpinned by educational and psychosocial theories is effective in enhancing behavioural intention, and proper handwashing practices among school children in a Ghanaian municipality.

Methods

Study Design and Setting

The design was a two-arm Cluster Randomised Controlled Trial (cRCT), with an allocation ratio of 1:1. Schools constituted the clusters, with the individual units being the pupils. Thus, the unit of randomisation was a school and not individual pupils. A cRCT was adopted due to the practical difficulties associated with the randomisation of individual pupils into different study arms.

Study Participants

The primary participants of the study were Junior High School (JHS) children in the Ejisu-Juaben Municipality of Ghana. Secondary participants included JHS teachers in the same municipality.

Inclusion and Exclusion Criteria for Participating Schools

Schools which participated in the study met the following inclusion criteria:

- were regulated by the Ejisu-Juaben Municipal Education Directorate
- had a JHS section with grades 7, 8 and 9
- had a functional water facility sited within school compound
- had a functional toilet facility situated within school compound
- had a handwashing station providing running water and soap

On the other hand, a school was excluded if:

- School management did not agree to their participation in the study
- an intervention judged to be similar to that of this study was being implemented in the school or has been implemented within the past year

The Intervention (HandsCare): Description and Theoretical Basis

The intervention was named *HandsCare* to reflect the need to care for the hands by practicing handwashing with soap (HWWS), under running water, and at critical times. The aim of *HandsCare* was to develop three learning domains namely; cognitive, affective, and psychomotor. The content and delivery of *HandsCare* was driven by Bloom's Taxonomy of Learning Theory (Bloom, 1956), and psychosocial theories including the Theory of Planned Behaviour, Social Cognitive Theory, and the Health Belief Model. The aforementioned theories have demonstrated usefulness in understanding relationships between variables in a range of volitional health behaviors (Eshetu, 2013; White *et al*., 2015a; Dreibelbis *et al*., 2013; Dyson *et al.*, 2010).

Training of Teachers and Intervention Delivery

HandsCare was delivered by teachers, selected from intervention schools and trained prior to the intervention delivery. All training sessions were facilitated by the principal investigator, who has an advance training in health education and promotion, and teaches health education at the post-graduate level. The training was done within two (2) days, and lasted for a period of five (5) hours per daily session.

In-class hand hygiene education was done with the aid of relevant posters and a user-friendly educational manual. The manual was organised into three (3) modules and subsequently into sessions, with concise modular and sectional objectives which are in consonance with the key objectives of this research. Interventions were delivered within one calendar month and lasted for approximately two (2) hours per working day.

Intervention Fidelity

The fidelity of the intervention delivery was assessed using data obtained from a direct observation. This strategy has been described as being more reliable when compared to other strategies which rely on self-reported data (Breitenstein *et al*., 2010; Mellard, 2010). An observer checklist adapted from Mellard (2010) was used for data collection. Field observers were to tick YES/NO to indicate whether or not a particular measurement item was observed to have been delivered, and in a manner that conforms to the intervention protocol. The data gathered was subsequently analysed quantitatively, and showed that intervention delivery largely conformed to the study protocol.

Key Intervention Outcomes

The primary outcomes which *HandsCare* sought to enhance were HWWS - After Toilet Use; and HWWS - before meals. The intermediate outcomes were Intention to Practice HWWS - After Toilet Use; and Intention to Practice HWWS - Before Meals. Key explanatory variables assessed pre and post included hand hygiene related knowledge, attitudes to hand hygiene, and skills for practicing proper handwashing. All variables were measured quantitatively. The study adopted a

two-weeks post intervention assessment, which is in tandem with related studies such as Kamm *et al.* (2014), and Feikin *et al*. (2010).

Sample Size Estimation

Four clusters were estimated to detect at least a 60% reduction in the proportion of pupils who do not practice proper handwashing at follow-up. Statistical power was set at 80% while significance level was set at 5%. The average cluster size was estimated to be 153 and the intra-cluster correlation coefficient (ICC) was assumed to be 0.03 based on published studies (Hutchison 2009; Pickering *et al*. 2013). The assumed ICC was subsequently used for estimating the design effect (DE) which was required to adjust for clustering at the design stage. A formula developed by Thabane (2004) was used for estimating the sample size. All children present in schools at baseline who assented to participate, and whose parents had given a consent to their participation were recruited into the study. A total of 328 children were recruited from the intervention arm, while a total of 389 were recruited from the control arm at baseline.

Randomisation and Blinding

Schools were randomly allocated into the intervention and control arms using a *random number table.* Allocation of study arms, and the key outcomes measured were concealed to school children, their teachers and the school management. This was a measure to control for threats to internal validity of the research data.

Data Collection

Description of Measurement Techniques and Tools

Two key techniques were adopted for measuring study variables – self-report by participants, and a structured observation. Psychosocial variables were measured using a 5-point Likert scale. Sub-variables were tested for internal reliability using the Cronbach alpha score set at $\alpha \geq 0.7$. For example, Alpha scores generated were $\alpha=0.80$ for behavioral intention, and $\alpha=0.75$ for attitude, and $\alpha=0.74$ for subjective norms. The knowledge variable was however measured using a set of statements on hand hygiene for which participants were to provide correct answers. The skill variable was assessed by directly observing participants demonstrate the steps for proper HWWS at a handwashing station.

Regarding the primary outcome variables, a structured observation was used with the aid of a tool adapted from Pickering *et al*. (2014). A daily structured observation lasted for a period of 7-hours continuously.

Measures for Addressing Potential Confounders

At the design stage, several measures were used to address potential confounders which were classified into history effect, maturation effect, testing effect, selection bias, attrition effect, spill-over or diffusion effect, implementation effect, effect of the home environment, and effect of unreliable data gathering instruments. Further information on this is available on request. At the analysis stage, potential confounders were adjusted for statistically.

Data Analysis

A cluster-level analysis using an independent samples *t*-test was used for computing the difference between study arms with respect to study outcomes. This approach tends to be more robust in an analysis involving a few number of clusters (Eldridge & Kerry, 2012; Hayes & Moulton, 2009).

With respect to pre and post analysis of difference, a dependent samples *t*-test was used. This analysis adjusted for clustering using the robust standard errors. All statistical tests were done using S*tata/SE* 14 (Stata Corp., College Station, Texas).

Results

Progression of Clusters and Pupils through Phases of cRCT

A total of 37 potentially eligible schools were subjected to the study's inclusion criteria which resulted in the exclusion of 33 schools on the basis of a lack of functional water and toilet facilities within schools' compound. A functional water facility in a school was crucial for developing and assessing the handwashing skills of study participants. On the other hand, the existence of a toilet facility on a school's compound was crucial as it enhanced the validity of observational data on the practice of HWWS after toilet use. Figure 1 is a flowchart on the progression of clusters and pupils through the respective phases of the trial.

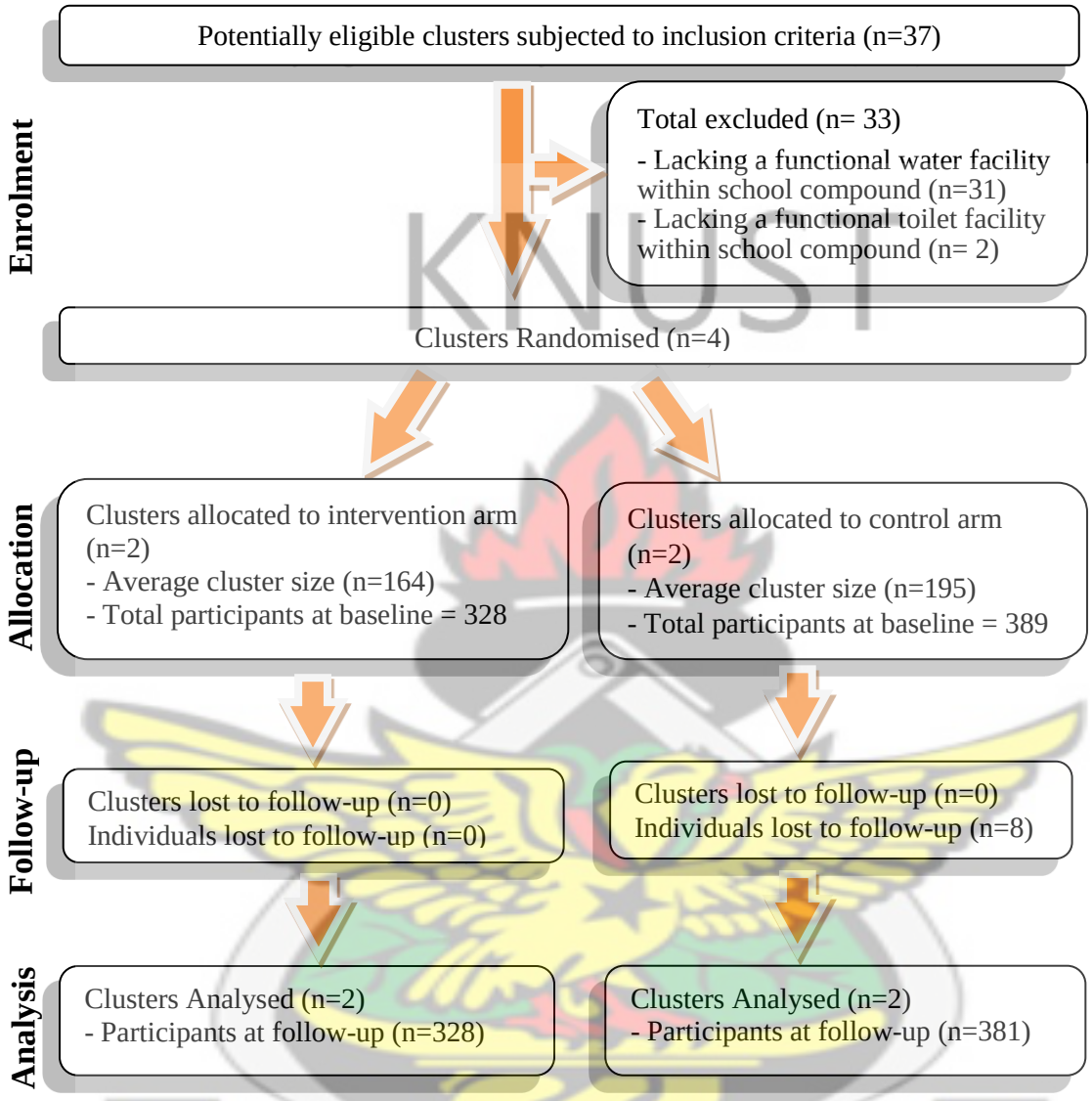

Figure 1: A Flow Chart of Clusters and Individuals

Baseline Characteristics of Study Arms

In a bid to reduce selection bias to the barest minimum, intervention and control arms were assessed statistically to determine similarity at baseline. The result of the assessment indicated that intervention and control arms were largely similar in terms of individual level characteristics of participants as well as relevant cluster-level characteristics.

Post Intervention Effect of *HandsCare*

Group Differences Regarding Behavioural Intention

At two weeks follow-up, a statistically significant difference was identified between the intervention and control arms with regard to *intention to wash hands with soap* [After toilet use (p=0.032, d=0.5); and Before meals (p=0.020, d=0.2)]. Details are presented by Table 1.

Table 1: Intervention effects at two-weeks follow-up (based on cluster summaries)

Variables	**Arm**		***p*-values (2-tailed) p <0.05 (Adjusted*)**	**Effect Estimate (Cohen's d)** †	**95% Conf. Interval**
	Intervention	**Control**			
Number of clusters	2	2			
Number of individuals enrolled at Baseline	328	389			
Number of individuals assessed at follow-up	328	384			
Primary Outcomes					
Observed HWWS–After toilet use					
- Proportions (SE)	0.88 (.004)	0.08 (.077)	0.005	2.6	1.9-3.3
Observed HWWS – Before meals					
- Proportions (SE)	0.19 (.011)	0.02 (.022)	0.012	0.5	0.2-0.8
Behavioural Intention					
- Intention - after toilet use [Mean(SD)]	9.34 (.093)	8.82 (.154)	0.032	0.5	0.3-0.6
- Intention - before meals [Mean (SD)]	9.08 (.042)	8.82 (.049)	0.020	0.2	0.1-0.3
Ancillary Outcomes					
Duration for handwashing [Mean (SD)] (Seconds)	32 (.813)	11 (.636)	0.002	0.9	0.4-1.4
- Knowledge [Mean (SD)]	8.37 (.026)	9.01 (.209)	0.067[a]	-	-
- Attitude [Mean (SD)]	14.62(.048)	14.29(.086)	0.040	0.21	0.1-0.4
- Skill [Mean (SD)]	9.10(.382)	5.01(.001)	0.004	3.2	2.9-3.4
- Perceived susceptibility [Mean (SD)]	18.95(.25)	18.35(.58)	0.147	-	-
- Perceived severity [Mean (SD)]	9.67(.084)	9.44(.046)	0.059	-	-

* Adjusted for clustering and variations in cluster weights
† Small effect = 0.2, medium effect=0.5, large effect=0.8, very large effect=1.3 (Cohen, 1992)
[a] Examined further to determine possible pre and post difference

Group Differences Regarding the Practice of HWWS

Similarly, a statistically significant difference was identified between the intervention and control arms with regard to the practice of HWWS [After toilet use (p=0.005); Before meals (p=0.012)]. The size of effect was d=2.6 (80% difference) with regard to HWWS–After toilet use, and d=0.5 (17% difference) with regard to HWWS – Before meals. Table 2 presents further information.

Intra-Cluster Correlation Coefficients (ICCs)

In a bid to contribute to the pool of ICCs which could aid future researchers conducting a cluster trial, ICCs were computed using primary data from this study. The ICCs estimated were 0.17 for the variable *practice of HWWS*, 0.04 for *intention to wash hands with soap*, 0.07 for *knowledge on hygiene*, and 0.01 for *attitude to HWWS*.

Intervention Effect - Pre and Post Scores

Regarding the intervention arm, a statistically significant difference was detected for all variables considered for the analysis (p<0.001). With regard to the control arm, there was no statistically significant difference between pre and post scores with respect to variables considered for the analysis. The intervention arm recorded an 88% difference with respect to the practice of HWWS after toilet use, while an 18% difference was recorded with respect to HWWS before meals. The difference in pre and post scores for the control arm was only 2% for each of the variables measured under the practice of HWWS. Figures 2 and 3 gives a visual impression of the pre and post scores for behavioural intention, and practice of HWWS.

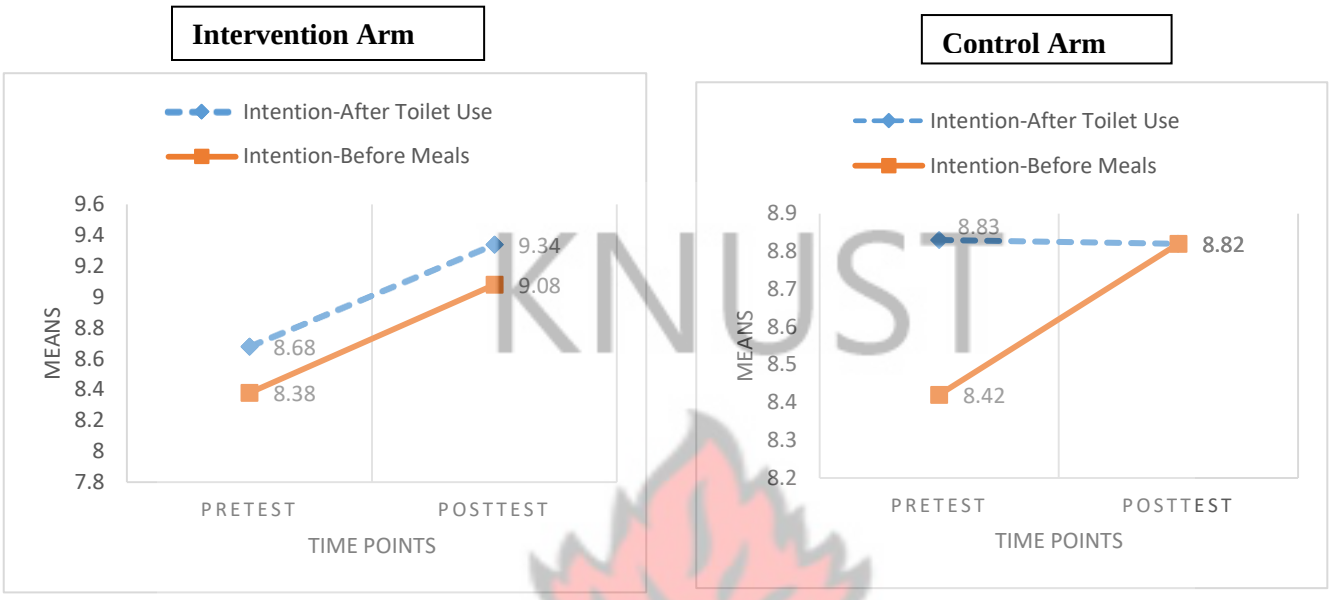

Fig. 2: Behavioural Intention Pre and Post

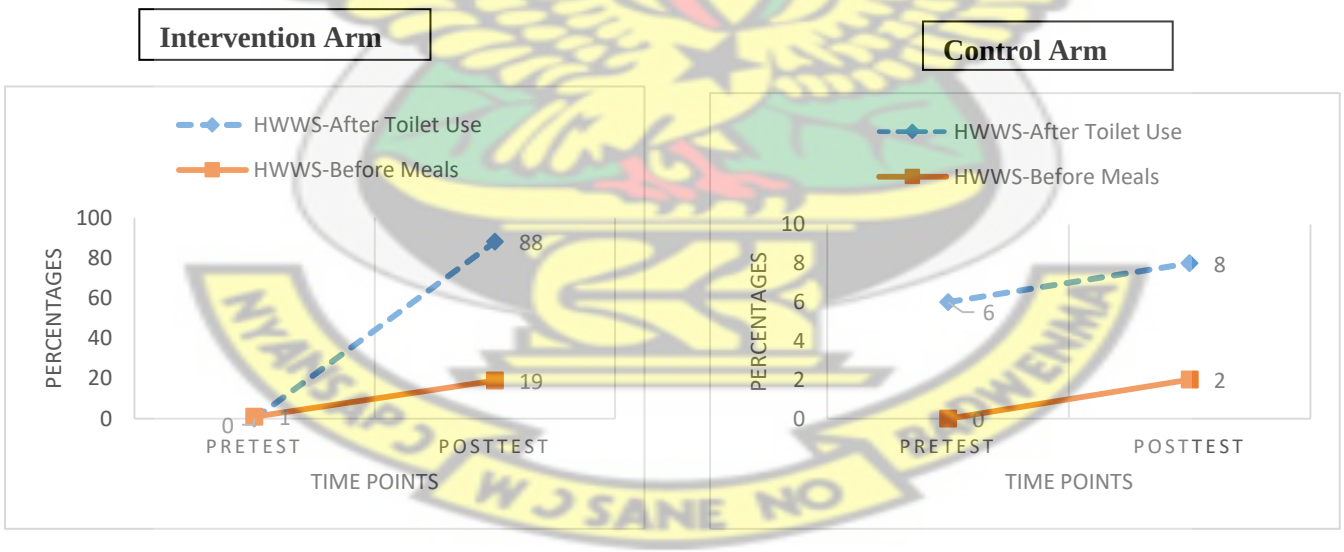

Fig. 3: Observed Practice of HWWS Pre and Post

Discussion

Intervention Effect on Behavioural Intention

At two-weeks, the difference in behavioural intention between the two study groups was statistically significant. Thus, *HandsCare* demonstrated effectiveness in positively influencing pupils' intention to wash hands with soap at the two critical times adopted for the study. Nonetheless, the size of effect could be described as between 'low' and 'moderate' for the two critical times (d=0.2 and 0.5), using Cohen's classification guideline. It is worth mentioning that there is a paucity of studies in the body of literature which have sought to determine the effect of a hand hygiene educational intervention on behavioural intention, though few studies exist in other domains such as physical activity (Sniehotta *et al*., 2005).

From a theoretical perspective, the TPB has posited that behavioural intention is the closest determinant of behaviour. But that notwithstanding, there is ample evidence to suggest that a high intention does not necessarily predict the practice of behaviour. This phenomenon has been described as the "intention-behaviour gap"(Sniehotta *et al*. 2005; Godin *et al*. 2005). In the field of physical activity for example, Rhodes and Yao (2015) have reported a decline in the practice of behaviour after intention was increased in an experimental manipulation. In spite of these recent reports on the intention-behaviour gap, the crucial role of intention in influencing the practice of behaviour remains widely accepted.

Intervention Effect on Practice of HWWS

The size of effect with respect to the proportions of pupils practicing HWWS before meals was observed to be very large (d=2.6), when Cohen's classification guideline was used. Regarding the proportion of pupils practicing HWWS after toilet use, the size of effect was identified to be medium (d=0.5).

It is evident from the study results that *HandsCare* demonstrated a positive influence in the enhancement of the outcome variables of the study. In a similar study conducted in Egypt which used a quasi-experimental design, authors reported that a health educational programme was effective in improving handwashing practices (Moussa *et al.*, 2015). However, it is worth-noting

that a quasi-experimental design is prone to a severe compromise of internal validity, as extraneous variables could interfere with the study results (Rosen *et al.*, 2006). Conversely, a cluster-randomised trial by Graves *et al*. (2011) conducted in Kenya which combined the provision of handwashing facilities with a poster contest reported that the intervention was not effective in improving handwashing practices. A careful review of the work of Graves *et al*. indicates that their intervention failed to include the skill-development dimension of hand hygiene education, an essential learning domain which makes the practice of proper HWWS possible.

Mediators of Intervention effect on Behavioural Intention, and Practice of HWWS

With respect to the variables which might explain the intervention effect on intention, and Practice of HWWS, Table 2 shows a significant between-group difference for handwashing skill (p=0.004; d=3.2), and attitude (p=0.040; d=0.21), but not knowledge (p=0.067). Though the intervention showed a low effect size on attitude, it can be observed that the intervention's effect on handwashing skill was very large (d=3.2), when Cohen's classification guideline is used. It is worth noting that the variables *attitude*, *skill* and *knowledge* are intervention variables and therefore the enhancement of these has potential implications on the post-intervention scores of behavioural intention, as well as practice of HWWS. Though there was not a significant between-group difference in the knowledge scores at follow-up, a pre and post assessment showed that scores for knowledge increased by 7% in the intervention arm, but 4% in the control arm. The increase occurring in the control arm could potentially be attributed to the testing effect (*i.e.* resulting from baseline assessment).

From both empirical and theoretical perspective, it is common knowledge that the variable '*knowledge*' alone may not trigger intention, and also the adoption of a behaviour (Lopez-Quintero *et al*., 2009). A possible explanation for the effectiveness of *HandsCare* could therefore be its effect on *skill* and *attitude* (p=0.004 and p=0.040 respectively).

Study Limitation

The geographic scope of this study was limited to the Ejisu-Juaben Municipality of Ghana. In the light of this, the generalization of results generated by the study may be limited to geographic

locations and settings which share in the socio-economic and cultural characteristics of the Ejisu-Juaben Municipality.

Conclusion

The results of this study indicate that a theory-driven hand hygiene educational intervention involving school children and targeting the three learning domains has a medium to a very large effect sizes, with respect to the practice of handwashing with soap. However, with respect to behavioural intention, the intervention yielded a low to a medium effect size. As the study has shown that knowledge of hand hygiene may not influence positive intentions and trigger the adoption of proper handwashing behaviour, it would be expedient for future interventionists to strategise towards the positive enhancement of participants' handwashing skills and attitudes to handwashing. This could be crucial in ensuring that intervention effects are maximized.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

Ethical Consideration

In order to ensure that standard research protocols have been adhered to right from the design stage of the research, the research proposal was submitted to the Committee on Human Research (CHRPE), Publications and Ethics of the Kwame Nkrumah University of Science and Technology for review and subsequently ethical clearance was granted unconditionally. In addition, the study sought for an assent from eligible pupils, and subsequent consent from parents or guardians.

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