



Determinants of Hand Hygiene Behaviour for Disease Prevention in Military Contexts: An Integrative Literature Review

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The purpose of this study was to identify determinants that support hand hygiene behaviour in a military context. Thus, the results could support the health education professionals of the Centre for Military Medicine, which is the unit responsible for the Finnish Defence Forces' medical care. The research question was: What kind of determinants might affect the hand hygiene behaviour in a military context?

Communicable diseases in a military context are a relevant and continuous problem. The significance and effect on the target population can be seen on at the individual health, security, and economical levels. Good hand hygiene is maybe the most important single factor in disease prevention. Research targeting the behaviour determinants of hand hygiene gives a better understanding of the phenomenon for health providers and policy makers.

Behaviour Centred Design (BCD) was the framework used in this study. BCD was designed to be used in human behaviour change interventions. In this study it provided the behavioural determinant categories which were used for categorising and analysing the data found.

Integrative literature review was the research method used in this study. Through various stages, "hand washing behaviour" became the actual search term. Due to the paucity of behavioural research in the military environment, the target group had to be expanded to include environments with similarities such as hierarchy, instructions and supervision. The data search was done using the ProQuest and PubMed electronic databases. After a three-phase evaluation from the original 396 studies found, 10 studies were included in this research. The data quality assessment was done using a Mixed Methods Appraisal Tool. The data was analysed, and significant data categorised using framework analysis, based on the behavioural categories of BCD.

In this work, the findings were presented through BCD categories. Numerically, the largest number of factors with a positive effect on hand hygiene behaviour were found from brain category including subcategories like executive control, motivation, and reactive behaviour. In those categories were determinants like training, feedback, desire to protect others, habits, signs encouraging hand washing, and attitudes which all were mentioned in more than one study. Other determinants that were mentioned more often than in one study were self-efficacy, well-equipped handwashing facilities, and clean sinks. These determinants belong to the capabilities and infrastructure categories. An undeliberate discovery of this review was how knowledge alone was not a significant determinant of behaviour change.

None of the studies included were from the military environment, which shows how under studied the subject is in that context. Determinants related to communal environments were mapped although the sample was quite small, but it fit well into the framework used and the framework itself proved its usability. The findings reveal that while awareness of hand hygiene is high, the gap between intention and behaviour remains a challenge, highlighting the need to build education beyond just sharing information.

Keywords: Hand hygiene behaviour, determinants of behaviour, Infection prevention, military.

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1 Introduction

The background of this study arises from the need to reduce infections among conscripts during their military service or deployed personnel during military crisis operations. Infectious disease prevention in the military context plays a crucial role on multiple levels, not only in safeguarding the health of troops and individuals but also in ensuring operational safety and minimising lost duty days (Davis et al. 2020; Kim et al. 2018; Michel et al. 2014; Sanchez et al. 2015; Queiros-Reis et al. 2021). There is only one hand washing behaviour related study among Finnish Defence Forces conscripts from year 2013, and it is only available in Finnish (Laine, Hankonen, Haukkala & Jallinoja 2013). Considering the importance of the matter in question, further research is clearly needed.

The importance of handwashing with soap and water is recognised as one of the most critical infection disease prevention actions (WHO 2017). When infection prevention training aims to improve hygiene, focusing on factors that motivate hand hygiene behaviour has proven to be more effective (White et al. 2020). In this study, handwashing serves as the key behaviour, believed to enhance the research outcomes (Atkins et al. 2017). Moreover, when the desired outcome is behaviour change, the emphasis must remain on the behaviour itself (Aunger & Curtis 2016).

The integrative literature review was chosen as the study method because it enables a broad perspective on data collection from various types of research (Whittemore & Knafl 2005, 548). Existing data related to hand hygiene was utilised to identify determinants that motivate the behaviour. These determinants were then categorised and analysed using Behaviour Centred Design as the framework for data analysis (Aunger, White, Greenland & Curtis 2017).

One purpose of this thesis is to offer health education professionals a research-based summary of the evidence about factors influencing hand hygiene behaviour, which can be utilized into health education. This work could be used also as a part of formative evaluation phase of real-world health education project planning (Bauman & Nutbeam 2014, 35).

2 Background

This work is based on health promotion, health education, and disease prevention, with the aim of producing valid research data that can be applied in these areas in working life. While the focus of the research is on determinants related to behaviour, the issue is first examined from a broader perspective. For this reason, the background is approached from a health educational point of view.

2.1 Definitions of the terms

Definitions used by the World Health Organisation (WHO) can be found from “Health promotion glossary of terms 2021”. In this study definitions from that book will be used to define the relevant health related terms to give the reader a better understanding of the terms used in this thesis and the value base that guides the work. WHO “health promotion glossary” was chosen as a source for definition because it has been produced since 1986 and developed and evaluated regularly over the years ever since (WHO 2021, 1). Definitions of the terms are presented here so that the reader gets a better overall picture of the health promotion concept and its terminology.

2.1.1 Health promotion

Health promotion is defined by WHO (2021, 4) as: “Health promotion is the process of enabling people to increase control over, and to improve their health.” This concept applies to both small projects targeting individuals and large-scale national programmes. At the implementation level, health promotion is prioritised in five key areas: policy, environment, community, personal, and health services (WHO 2021, 4). The purpose of this study is to examine and identify the behaviour-motivating determinants that could be used in health education within a military environment, with the hope that these determinants will be useful across all the levels mentioned above.

2.1.2 Health education

Health education is defined by WHO (2021, 18) as: “Health education is any combination of learning experiences designed to help individuals and communities improve their health by increasing knowledge, influencing motivation and improving health literacy” (WHO 2021, 18). The foundation of this thesis lies in infectious disease prevention as a key focus of health education, particularly for individuals working within a group setting. When designing health education in any environment, the concept of a “learning experience” must always be taken into account. Health education is not merely about sharing information; it is about providing training that aims to drive behavioural change.

2.1.3 Health literacy

Health literacy is defined by WHO (2021, 6) as: “Health literacy represents the personal knowledge and competencies that accumulate through daily activities, social interactions and across generations. Personal knowledge and competencies are mediated by the organizational structures and availability of resources that enable people to access, understand, appraise and use information and services in ways that promote and maintain good health and well-being for themselves and those around them” (WHO 2021, 6). Health literacy is a somewhat controversial topic, as knowledge alone does not necessarily translate into behaviour. However, when health literacy is tied to a specific context, it is more likely to produce meaningful results (Nutbeam 2019). For this reason, this work focuses on the determinants of behaviour within this particular context.

2.1.4 Disease prevention

Disease prevention is defined by WHO (2021, 5) as: “Disease prevention describes measures to reduce the occurrence of risk factors, prevent the occurrence of disease, to arrest its progress and reduce its consequences once established” (WHO 2021, 5). In this context, the focus is on health education that encourages hand hygiene behaviour to lower risk factors. Too often, efforts are directed at dealing with problems after they arise, instead of trying to stop them from happening or lower the impact beforehand.

2.2 Significance to target population

According to Bauman and Nutbeam (2014, 3), defining the problem is the first phase of health promotion. Key questions to consider during this phase are significance and impact on the target population, as well as other factors affecting the community, such as safety or economic implications (Bauman & Nutbeam 2014, 3). In this case, the problem arises from the assumption that infections in military organizations spread rapidly due to close contact among personnel in living quarters or through contaminated water or food caused by poor hygiene. By conducting a literature review, it is possible to evaluate the validity of this assumption in a military context.

In military environments, infectious diseases are a leading cause of casualties. During deployments, whether for combat or peacekeeping, limited medical resources and long evacuation distances can make outbreaks a serious security risk by reducing operational readiness and overwhelming available medical facilities. Infection prevention and control during deployment is a shared responsibility, as outbreaks are often linked to personnel behaviour, such as eating outside authorised dining facilities or neglecting hygiene practices (Queiros-Reis, Lopes-João, Mesquita, Penha-Gonçalves & Nascimento 2021; Davis, Biswas & White 2020; Michel et al. 2014).

Sanchez et al. (2015) examined the impact of military-related respiratory infections on the U.S. military over more than a hundred years. Their study highlighted that acute respiratory diseases are particularly problematic for new recruits in military training environments, where crowded living conditions and increased physical and psychological stress is more than they are used to. Respiratory infection rates are consistently higher among recruits than among more experienced military personnel. Hospitalisation rates for respiratory diseases are at least three to four times higher than among comparable civilian adults in the United States, accounting for 25% to 30% of hospital admissions related to infectious diseases. (Sanchez et al. 2015.)

Infection outbreaks not only impact the health of the troops but can also be evaluated from an economic perspective in terms of "duty days lost." Schrader et al. (2017) developed a cost-effectiveness model to assess the economic impact of infections. They found that seeking treatment earlier could reduce the duration of illness, thereby decreasing the loss of duty days. However, behavioural change requires adjustments to treatment guidelines as well. From a health education perspective, they noted that many service members did not seek help from medical treatment facilities, even while suffering from acute watery diarrhoea during deployment. (Schrader, Tribble & Riddle 2017.) Educating troops about treatment paths for gastrointestinal infections could improve understanding, encouraging individuals to seek help earlier and, in turn, reducing sick days among the forces during deployment.

According to a retrospective study by Peytremann, Baduraux, O'Donovan, and Loutan (2001), conducted between 1975 and 1995 among expatriate UNHCR workers, the leading cause of medical evacuation was infections (18.8%), followed by obstetric-gynaecological conditions (17.2%) and accidents (8.2%) (Peytremann et al. 2001). Similarly, Vilkmán, Pakkanen, Laaveri, Siikamäki, & Kantele (2016), in their study on traveller's health, found that 79% of travellers experienced illness during or after travel. The most common issues were diarrhoea (69%), skin problems (17%), fever (17%), vomiting (12%), respiratory infections (8%), and urinary tract infections (4%). While most infections were mild, 25% of travellers were still symptomatic upon returning home (Vilkmán et al. 2016). Although these studies did not focus on military personnel, it is reasonable to assume that the deployment environment abroad shares similar risks. Additionally, family members may also face exposure to diseases brought back by personnel returning home.

Summarising the findings above, the existing problem is clearly defined. The importance of disease prevention in military contexts is well-documented in numerous studies. Communicable diseases during deployment, military exercises, or garrison living conditions remain a persistent issue. The scale of the problem is evident, with impacts at individual, security, and economic levels. The significance and effect of communicable diseases on the

target population are undeniable, and based on the literature, the issue meets the theoretical criteria for health education.

2.3 Target population

The structure of the Finnish Defence Forces consists of employed personnel and young adults completing their military service. In 2023, there were 13,067 people working in the Finnish Defence Forces, excluding conscripts and personnel deployed in military crisis management. The mean age of personnel was 41.8 years, with 81% being men and 19% women. In 2023, 19,529 people completed their military service, of whom 917 were women (Puolustusvoimien henkilöstötilinpäätös 2023, 6). The mean age of male conscripts at the start of their service was 19.2 years (Suikkanen et al. 2023). No data on the mean age of female conscripts was available. Military service must commence no later than the year the person turns 29 years old (Asevelvollisuuslaki 1438/2007). Most conscripts have completed either a high school diploma or a vocational qualification by the time they start their service (Oppivelvollisuuslaki 1214/2020).

In the Finnish Defence Forces, officers and non-commissioned officers are responsible for training young conscripts, but civilians also contribute as experts of their own field. In other words, the educational background of the military personnel training conscripts encompasses various educational levels and a wide age range (Puolustusvoimien henkilöstötilinpäätös 2023, 16). Additionally, some operational units within the Finnish Defence Forces have few or no conscripts at all. This highlights that the military environment is not a homogenous community. National characteristics and organizational structures may influence to finding in such a way that foreign behavioural studies taking place in a military environment would not necessarily be completely generalizable into the Finnish military environment either.

2.4 Planning solution

In the second phase, possible solutions to the problem need to be examined and evaluated (Bauman and Nutbeam 2014, 3). According to Atkins et al. (2017) finding a key behaviour that is relevant to the problem is the first step and using that finding is believed to improve the outcome of research (Atkins et al. 2017). This claim is in line with Whitemore and Knafel (2005) belief that too many variables can make it challenging to obtain the necessary data from the original research (Whitemore & Knafel 2005, 548).

According to the WHO Global Infection Prevention and Control Unit (2017), a literature review provides strong evidence for the critical role of hand hygiene in preventing the spread of microbes and infections. However, simply being aware of the importance of hand hygiene is not enough to translate knowledge into action; technical and time resources must also be made available to enable the practical application of proper hand hygiene practices. This

highlights the importance of training through organisation to establish opportunities, policies, and supervision for effective hand hygiene, which is maybe the single most important factor in disease prevention (WHO 2017).

Kim et al. (2018) studied the effectiveness of handwashing in preventing respiratory infections under field conditions during a four-week military exercise. They conducted a quasi-interventional study, comparing two battalions operating under identical training conditions. The only difference was the timing of the handwashing intervention: the early handwashing group (n=631) began intensive handwashing at the start of the exercise, while the late handwashing group (n=660) started in the third week. The early handwashing group reported 82 cases of respiratory infections, compared to 182 in the late handwashing group. Over the four weeks, the cumulative case rate was 15% lower in the early handwashing group, meaning 103 fewer patients compared to the late handwashing group (Kim et al. 2018).

Michel et al. (2014) reviewed the French military strategy for preventing communicable diseases during deployments. In their study, they highlighted the advantages of health education both before and during operations. Although health education is only one aspect of the strategy, which also includes risk assessment, immunisation, protective measures, prophylaxis, and health surveillance. Importance of health education was acknowledged in the context of military deployments. However, the specific benefits of health education were not directly studied. (Michel et al. 2014.)

The military often relies on immunisation, orders, operational procedures, and supervision, with the importance of handwashing being acknowledged and emphasised. This highlights a clear issue in the form of communicable infections and the potential of handwashing behaviour as a solution to prevent them. Therefore, the study should focus on how hand hygiene behaviour can be effectively influenced.

The effectiveness and positive outcomes of educational interventions are closely linked to the quality of their implementation. When the primary goal is to influence preventive behaviour rather than merely increase knowledge of the subject, a systematically developed intervention based on research and theory provides a more solid foundation. Health education aimed at behaviour change can be an effective tool, particularly when the individual's learning experience is taken into account (Kok, van den Borne & Mullen 1997).

Health literacy is an essential component of health education, which in turn can be regarded as the foundation of health promotion. Golden and Earp (2012) examined the ecological model using articles related to health education and behaviour. They found that the articles included in their study primarily focused on interventions at the intrapersonal and interpersonal levels, rather than at the institutional, community, or policy levels. The socio-ecological approach proved particularly effective when addressing a single topic within a

specific environment (Golden & Earp 2012). This aligns with Nutbeam's (2019) assertion that health literacy is situational and that the content of health education materials should be tailored to the context and needs of the target group (Nutbeam 2019). This provides guidance for this study: focusing on a single topic, handwashing, within the military context.

3 Theoretical framework

Most health promotion theories integrate elements from psychology, management, sociology, marketing, and political science. Many of these can be described as theoretical frameworks or models. While health promotion projects are often implemented without a theoretical basis, but based on research evidence, the use of theory offers significant advantages for the success of a project. Theories can help to better understand the nature of the problem, describe and illustrate context-specific motivations and needs, explain the determinants of behaviour, and develop a method for project evaluation. (Nutbeam, Harris & Wise 2010, 1.)

3.1 Behaviour related theories

When selecting a suitable theory, consideration should also be given to the environment in which the health education or promotion project will be implemented, ensuring the theory aligns with the overall context. The practical application of this study's findings in an online training environment inspired an exploration of theories used in research on health-related and e-learning behaviours. All the theories presented are part of the process of establishing the theoretical foundation for this work.

Gaube, Fischer, and Lermer (2021) studied the hand hygiene behaviour of hospital visitors. In addition to examining hygiene behaviour, the study aimed to identify a theoretical model suitable for explaining and understanding visitors' hand hygiene-related behaviour. The study combined three theories: the Theory of Planned Behaviour (TPB), the Health Action Process Approach (HAPA), and the Theoretical Domains Framework (TDF). All three were found to be valid for studying behaviour related to hand hygiene. However, HAPA and TDF were found more practical than TPB in this context, as they included a greater number of constructs, which helped categorise and identify correlations between individuals' explanations and behaviours. (Gaube et al. 2021.)

Kapo, Mujkic, Turulja, and Kovačević (2021) studied e-learning in the context of continuous learning, while Zhang, Liu, Wang, Zhang, and Wang (2020) focused on mobile health service adaptation. Both studies incorporated theoretical frameworks as part of their data collection processes. Together, they reviewed 29 studies and found that the Technology Acceptance Model (TAM) was the most frequently referenced framework, appearing in 17 studies. Additionally, the Theory of Planned Behaviour (TPB) was referenced in five cases, while the

Theory of Reasoned Action (TRA), Health Belief Model, Protection Motivation Theory, Expectancy Disconfirmation Theory, and Expectation Confirmation Theory were each cited twice. (Kapo et al. 2021; Zhang et al. 2020.)

According to Davis, Bagozzi and Warshaw (1989), TAM was developed as a tool for researchers to identify the determinants of acceptance for technical solutions. The goal was to develop a model that would help predict and explain the factors influencing the behaviour of the target group. In particular, the purpose was to trace the influence of external factors on people's internal beliefs, attitudes, and intentions. TRA is the theoretical background on which TAM is built. In simplified terms, TAM suggests that behavioural intention is influenced by attitudes, which in turn are based on assumed usability and ease of use. (Davis et al. 1989.)

The TPB was introduced by Ajzen (1991) as a continuation and extension of the Theory of Reasoned Action developed by Ajzen and Fishbein in 1980. According to Ajzen (1991), behavioural intention is influenced by three different components. The first is attitude towards the behaviour, which is shaped by beliefs and expectations about the behavioural outcomes. The second is the subjective norm, which refers to social pressure either supporting or opposing the behaviour. The third is the degree of perceived behavioural control, which relates to the perceived level of difficulty in performing the behaviour and the control beliefs associated with it. (Ajzen 1991.)

An assessment of the theories within the available resources highlights two widely used options: TAM and TPB, both of which are built on TRA as their theoretical foundation. Both theories agree that intention is a prerequisite for behaviour. While TPB is less commonly used in the e-learning environment, it is widely applied in health education, particularly in studies on infection prevention.

In an online course, attitudes towards using the technical application itself may not play a significant role, which is why TAM is unlikely to add much value to health education in an e-learning setting. The focus of health education is on attitudes, behaviour predictability, and the variables that help turn intention into action. A recognised weakness of both TAM and TPB is that intention does not always lead to behaviour, a phenomenon known as the "intention-behaviour gap." Sheeran and Webb (2016) found that only about half of intentions result in actual behaviour. (Sheeran & Webb 2016.) Similarly, providing information on the importance of handwashing does not automatically change handwashing behaviour. According to O'Boyle, Henly, and Larson (2001), even registered nurses working in intensive care units adhered to handwashing regulations less than 70% of the time (O'Boyle et al. 2001).

To tackle the intention-behaviour gap, Gaube et al. (2021) used the HAPA and TDF in their study, where they found the TDF to be superior to both TPB and HAPA. The goal of health education is to target the factors that motivate behaviour. The Theoretical Domains Framework (TDF) is a consensus-based framework that integrates multiple theories,

specifically focusing on behaviour change. It is built around 12 theoretical domains: (1) knowledge, (2) skills, (3) social/professional role and identity, (4) beliefs about capabilities (self-efficacy), (5) beliefs about consequences (anticipated outcomes), (6) motivation and goals (intention), (7) memory, attention, and decision processes, (8) environmental context and resources, (9) social influences, (10) emotions, (11) behavioural regulation, and (12) the nature of behaviour (Michie et al. 2005).

Gaube et al. (2021) noted that the TDF does not include a formal path describing how the domains interact to shape human behaviour. This means that while each domain can play a role in predicting behaviour, not all are necessarily relevant in every case. (Gaube et al. 2021.) The TDF could serve as a valuable tool for identifying, defining, and categorising factors that influence handwashing or other behaviours related to infection prevention. It could be particularly useful during course or project planning, for example, through qualitative interview research. (Atkins et al. 2017.)

The multitude of theories and their complexity present challenges for practical application, particularly in integrating theory into this thesis and literature review. Furthermore, the theoretical framework must align with the structure of the research. Although the TDF appears promising for qualitative interview research, it is not specifically designed for use in literature review studies.

3.2 Behaviour Centred Design

Applied science research requires a practical framework, and it is even better if the framework has been previously used in hygiene-related behaviour research, as in this case. Many theories overlook various factors that influence behaviour, particularly those connected to motivational drivers and habit formation. Behaviour centred design, developed at the London School of Hygiene and Tropical Medicine, addresses these gaps by focusing on compatibility and reinforcing learning solutions. (Aunger et al. 2017.)

Behaviour centred design (BCD) is a framework for designing interventions to change human behaviour, particularly in public health and development contexts. It combines insights from behavioural science, psychology, and design thinking to create effective and sustainable solutions. The BCD approach focuses on understanding the target behaviour and its context, identifying the drivers and barriers to behaviour change, and guiding the design of interventions to address these factors. (Aunger & Curtis 2016.)

White, Thorseth, Dreibelbis, and Curtis (2020) adapted the BCD checklist in their study of handwashing in a domestic setting because they found that BCD covers a broader range of behavioural factors and defines them more clearly than other models. The determinants in BCD include factors related to the brain (such as knowledge, risk perception, motives,

reactions, and psychological trade-offs), the body (characteristics and sensations), the settings where the behaviour occurs (infrastructure, props, roles, routines, and norms), and the broader environment (biological, physical, and social environments, as well as the wider context). BCD has also been widely applied in studies on handwashing and other behaviour change interventions. (White et al. 2020.)

The BCD checklist provides a more concrete tool for data analysis than any other theory and has been used in similar research approaches before. The definitions of each BCD determinant were adapted from the BCD checklist and partially from White et al. (2020), then tailored to fit the context of this research (Aunger et al. 2017; White et al. 2020). The BCD behavioural determinants are presented in Table 1.

Table 1: The BCD checklist

Behavioural determinants defined by the BCD		Definitions of each determinant as they relate to handwashing in research context
Environment	Physical	Living environment in garrison or temporary living environment like in exercises
	Biological	Environment factors like risks of diseases during flu season.
	Social	Role models and social pressure influence in a hierarchical system
Brains	Executive	Understanding the importance and benefits of hand washing, policies guiding the activity
	Motivated	Hand washing motives for the behaviour can include, among other things, disgust, affiliation, fear, and comfort
	Reactive	Functions that are automatically connected to hand washing
Body	Characteristics	The influence of sociodemographic characteristics on behaviour
	Senses	Hand washing behavioural sensory observations or sensations during or after the procedure
	Capabilities	The skill required for high-quality hand washing. Individual readiness to wash hands when necessary
Settings	Stage	Spaces available for handwashing in the built environment and training conditions
	Roles	The roles and responsibilities of different persons for carrying out the activity (e.g. the person responsible for supervision)
	Routine	Daily activities which include hand washing
	Norms	Hand washing policies, orders and supervision
	Props and Infrastructure	Time, availability of soap and water, cleanliness of facilities, possibility for drying hands
External context	Political and historical context	Pressure from outside the military and reputational damage during disease outbreaks

The BCD framework could also provide a strong foundation for the entire health education project. In this case, the process would be more comprehensive and divided into five steps, known as ABCDE (Aunger et al. 2017). This process is highly comparable to the Finnish Defence Forces' 2020 education concept and NATO guidelines. Both the Finnish Defence Forces' guideline material, "Oppimateriaalin pedagoginen suunnittelu" (Pedagogical Design of Study Material) by Vekkaila (2020), developed for the PVMoodle workspace, and NATO learning guidelines are based on the ADDIE model (Vekkaila 2020; NATO 2019). Both the BCD and ADDIE models are presented side by side in Figure 1.

The Behaviour Centred Design approach	ADDIE model
<ul style="list-style-type: none"> • Assess: Determinants of desired behaviour • Build: Formative research filling knowledge gaps • Create: Design promotion intervention • Deliver: implement the intervention • Evaluate: Did the desired change occur? 	<ul style="list-style-type: none"> • Analysis: Identify outcome, resources required, knowledge gaps • Design: Use analysis to design study experience • Development: Build the end product • Implement: Present the product to target population • Evaluate: Did the product make effect?

Figure 1: BCD and ADDIE model comparison (Aunger et al. 2017; Spatioti, Kazanidis & Pange 2022)

4 Aim, purpose, and research question of the work

The aim of this thesis is to identify potential determinants that could support hand hygiene behaviour in a military context.

The purpose of this thesis is to explore the determinants that positively influence communicable disease prevention behaviour, particularly hand hygiene. These findings could help guide the planning of practical health education projects.

The research question is: What kind of determinants might affect the hand hygiene behaviour in a military context?

5 Methodology

The research method used in this study is an integrative review. While a qualitative interview study could have been chosen to examine hand hygiene behaviour in a military environment, starting directly with such research would have been challenging due to the limited knowledge of this phenomenon. In this study, the integrative review is used to explore previous research to better understand behavioural determinants. This approach aims to support future studies by providing better understanding of hand hygiene behaviour in a military context. (Torraco 2016.)

An integrative literature review allows for a broad perspective on the phenomenon being studied and enables information gathering from various types of studies. This approach facilitates a more comprehensive synthesis of findings across qualitative, quantitative, and mixed-methods research. It adds depth, supports the generalisability of results, and provides a well-rounded understanding of the factors influencing hand hygiene behaviour in the studied contexts. (Whittemore & Knafl 2005.)

This literature review follows the five-step framework outlined by Whittemore and Knafl (2005). These steps are presented in graphical form in figure 2.

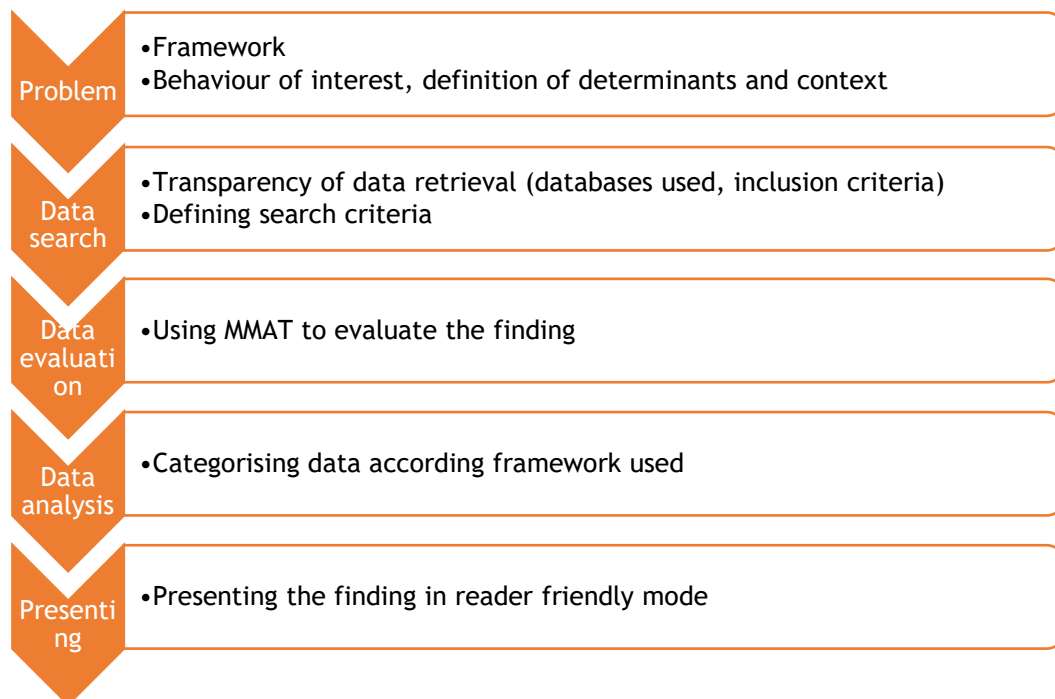


Figure 2: Five steps framework (Whittemore & Knafl 2005)

5.1 Problem identification

Integrative reviews benefit from a strong theoretical and philosophical framework to guide the analysis (Kirkevold 1997) and clear problem identification and framework will provide clear boundaries for research (Whittemore & Knafl 2005).

According to Atkins et al. (2017), identifying a behaviour relevant to the problem is the first step, as this is believed to improve research outcomes. Additionally, other context-related behaviours are often dependent on this key behaviour (Atkins et al. 2017). This aligns with Whittemore and Knafl's (2005) belief that too many variables can make it difficult to identify the data needed from the original research (Whittemore & Knafl 2005). The harmful impact of infections in the research context has already been discussed earlier and can be considered significant. The importance of handwashing has also been highlighted as one of the most effective infection prevention measures (WHO 2017). This study examines determinants that influence or motivate handwashing behaviour in military environments or in similar settings, such as workplaces characterised by hierarchy, guidance, and supervision.

The previously introduced framework of this study, the BCD approach, along with Table 1, forms the basis of this study, providing the behavioural determinant categories that have been integrated into the research. The BCD framework offers a systematic theoretical background against which the data is analysed. Definitions of each determinant have been adapted and modified from the BCD checklist template (Aunger et al. 2017) and from White et al. (2020) to suit this research and context, to help the categorisation of the data. (Aunger et al. 2017; White et al. 2020.)

The PICO model is used here primarily to help the reader understand the problem definition, rather than as a guide for the search process, as its reliability can be questioned (Frandsen, Nielsen, Lindhardt & Eriksen 2020; Schiavenato & Chu 2021). The PICO model is presented in table 2.

Table 2: PICO model

Population	Military personnel
Intervention	Health education
Comparison/Context	Hand hygiene behaviour
Outcome	Identify the determinants of hand hygiene behaviour to develop effective health education

5.2 Data search

The first pilot data search was conducted on 14 September 2024 using the search terms “hand washing” OR “handwashing” OR “hand hygiene” AND “military” OR “soldier” OR “armed forces” OR “army” in the ProQuest and PubMed (Medline) databases. A total of 71 studies were identified, but after a three-phase evaluation, only one study met the requirements. This pilot search revealed that the terms "hand washing" and its synonyms primarily lead to studies focusing on the correlation between infections and hand washing, rather than on the factors driving handwashing behaviour.

Another issue that emerged from the data search was the scarcity of research conducted in military environments, particularly on behaviour. Although the primary population of interest in this study was military personnel, the pilot search revealed the need to expand the population to include similar environments. These include work communities with comparable characteristics, such as hierarchy, instructions, and supervision. Accepted environments included workplaces, schools, universities, prisons, or health facilities. This adjustment was not used during the data search but was made during the data screening phase. Studies focusing only on children (under 18), elderly people (over 60), families, family relationships, homes, households, a single gender, or those related to a specific disease were excluded.

Due to the issues mentioned above, the data search term was changed to a “hand washing behaviour”. Data search was done 21.9.2024 using ProQuest and PubMed (Medline) databases. The databases were chosen for their comprehensiveness. Geography was not used as an exclusion criterion during the search, but its relevance was assessed for each study during the data evaluation phase. Inclusion criteria are presented in following table.

Table 3: inclusion criteria

	Inclusion criteria	Exclusion criteria
Search terms mentioned in abstract	“Hand washing/handwashing behaviour/behavior”	
Publication type	Peer reviewed academic research article	
Publication date	2010-2024	
Language	English	
Availability	Available using Laurea licence from a reliable scientific publication channel	
Context	military, community, individual	including only children (age under 18), or only elderly people (age over 60), families, family relationships, home, household, only one gender or related to a specific disease
Geography	significance to be assessed during data evaluation	

Zotero was used to store and process the data found. Its duplicate identification feature made it easy to remove duplicate from the collected data. All accepted data was saved in PDF format in Zotero, simplifying data management, while the PDF search function helped in reviewing the content of the texts. After removing duplicates, first evaluation was conducted by quickly reviewing the titles and abstracts to assess the relevance of the context and confirm whether the source was a scientific publication. At this stage, data that matched the exclusion criteria mentioned earlier was removed, while unclear cases were saved for further investigation.

The second evaluation phase involved a more detailed examination of the abstract and relevant sections of the text, focusing on the research content. This included assessing whether the study addressed factors related to handwashing behaviour or if it was mentioned solely as an infection prevention measure. At this stage, the context was also reassessed. Due to the limited amount of data, the term "hand hygiene behaviour" was accepted, even though it often included the use of hand sanitiser in addition to handwashing, or in many cases, both. Rejected data was moved to a separate folder, where it could be re-evaluated if needed.

In the third phase, the full text of the remaining 14 studies was thoroughly reviewed to identify determinants of handwashing. Studies that did not include any were excluded. The remaining data was read twice to ensure thorough analysis. During this phase, all potential references cited within the studies were screened, but none were added to the data for this

final phase. The target groups of the studies presented challenges; however, due to the limited amount of data, no studies were excluded at this point unless they clearly met the exclusion criteria. In the end, 10 articles were accepted for the study.

Separate PRISMA Preferred Reporting Items for Systematic Reviews 2020 flow diagram is used to present the selection proses of the literature to the readers in figure 3.

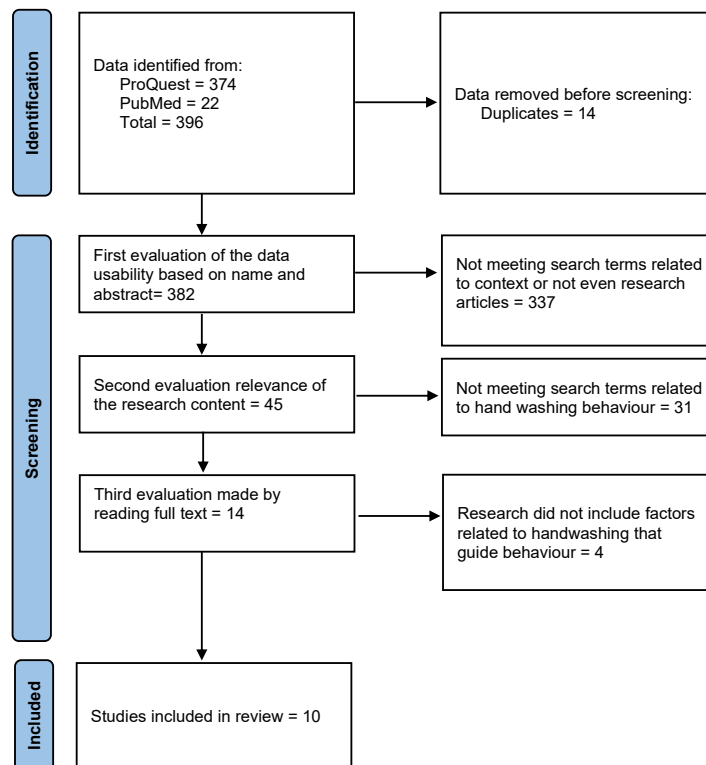


Figure 3: PRISMA 2020 flow diagram (PRISMA 2024)

5.3 Data evaluation

Data evaluation should include a quality assessment. As Whittemore and Knafel (2005) point out, evaluating the quality of primary sources in an integrative review is challenging due to their diversity, and there is no universally accepted standard for conducting such assessments (Whittemore & Knafel 2005, 549). In this study, the overall quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) scoring system developed by Hong, Gonzalez-Reyes, and Pluye (2018). This tool is specifically designed for evaluating studies with various research designs and is particularly suitable for mixed-methods and mixed-studies reviews (Hong et al. 2018).

According to the MMAT instructions, Hong et al. (2018) recommend presenting the ratings for each criterion individually to provide a more detailed assessment of the quality of the included studies, rather than calculating an overall score (Hong et al. 2018). Based on this recommendation, the quality comments “low” or “good” in the research table (Table 5) offer more detailed insights into each study’s relevance and its contributions to this research. The original data consisted of only two categories of studies, quantitative descriptive studies and mixed methods studies, and all of them were peer reviewed.

Quantitative studies particularly struggled with the quality question regarding the risk of nonresponse bias and the representativeness of the sample in the target population. Only two studies (Altın & Gök 2022; Borchgrevink, Cha & Kim 2013) were able to answer all questions positively. In several cases, the articles did not provide enough information to determine whether nonresponse bias was considered, though it is difficult to conclude that it was entirely overlooked. Another issue that received limited attention was the correspondence between the sample and the target group. In the study by Barrett and Cheung (2021), this deficiency was clearly acknowledged.

Apart from the shortcomings related to these specific questions, all other quality questions were addressed in the quantitative studies. The included mixed-method studies faced challenges with the question about how inconsistencies between quantitative and qualitative results were handled. Based on the research articles for these studies (Huis et al. 2012; Madden et al. 2022), this question could not be answered. The quality assessment questions are presented in Table 4, and the detailed evaluation table is included in Appendix 1.

Table 4: Quality assessment questions (Hong et al. 2018)

Quantitative descriptive studies	Is the sampling strategy relevant to address the research question?
	Is the sample representative of the target population?
	Are the measurements appropriate?
	Is the risk of nonresponse bias low?
	Is the statistical analysis appropriate to answer the research question?
Mixed methods studies	Is there an adequate rationale for using a mixed methods design to address the research question?
	Are the different components of the study effectively integrated to answer the research question?
	Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
	Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

5.4 Data analysis

The data analysis stage aims to provide a neutral interpretation of primary sources and a new synthesis of the evidence. Although it is one of the most challenging and error prone aspects of integrative reviews, strategies for analysing data are easily overlooked in the process (Whittemore & Knafl 2005). In this study, data was analysed using framework analysis, as a theoretical framework already existed. Framework analysis is particularly useful when reviewing a wide range of literature to systematically explore complex behavioural determinants (Mala Bridgelal, Campling, Grocott & Weir 2008).

This approach aligns well with the BCD framework, as it enables the categorisation and interpretation of behavioural determinants into domains, as shown in Table 1. By organising data within these domains, framework analysis facilitates a deeper understanding of hand hygiene behaviour in military contexts (Ward, Furber, Tierney & Swallow 2013).

To support the analysis process and data extraction, the included studies were compiled into a research table. The research table was used to organise the findings in a reader friendly way, ensuring transparency while improving clarity and comparability. The included studies, with more detailed information, are presented in the research table in Appendix 2.

The first step in data extraction was identifying the positive determinants reported to be associated with hand hygiene behaviour. These findings are presented in the results. If mentioned in the original studies, determinants with negative or no association with behaviour were also collected to provide a more comprehensive understanding of the phenomenon.

The next step involved comparing these positive determinants with the definitions in the BCD checklist (Table 1) and categorising them accordingly. Determinants with negative or no influence were not categorised further. Due to limited resources, the analysis relied on the determinants reported in the original articles. A more thorough approach would have involved collecting all identified factors and independently assessing the significance of each one, but this was not within the resources.

6 Results

6.1 Context of the studies included

Due to the lack of behavioural studies in a military environment, the included articles focused on community settings, with none specifically in a military context. Three of the articles were healthcare related, four were in university settings, and two in workplaces. Most participants

were female, which may be linked to their positive attitude towards participating in research and their majority representation in healthcare professions. One article focused on adults not connected to any specific context, but the age group and number of determinants were suitable for the study, so it was included. The country, context, gender, and age group of the included studies are presented in table 7.

Table 5: Context presentation

Ref. and country	Context	Age group
Altın, N. & Gök, Ş.E. 2022, Turkey	Hospital healthcare professionals, female 58%, male 42%	Not mentioned, but everyone was in working life
Barrett & Cheung 2021, United Kingdom	UK university students female 65,2% male 34.5%	73.4% age 18-25
Borchgrevink, Cha & Kim 2013, United States	College town restroom users female 60,5%, male 59,4%	61.6% college group and younger than college group age
Brown et al. 2022, United States	Randomly recruited U.S. adults, female 51,6%, male 48,4%	70,8 % age 18-59
Burusnukul & Broz 2013, United States	Students and employees of university Female 62.8% male 37,2%	49,2 % students, whole study mean age 37.49
Bülbül Maraş & Kocaçal 2024, Turkey	Nursing students Female 69,9% male 30,1%	Age 18-30 years
Daniel et al. 2022, Indonesia	University students female 74% male 26%	Mean age 23 years (range 17-43)
Huis et al. 2012, Netherlands	Hospital world related systematic review,	People in working life
Madden et al. 2022, United Kingdom	Workers and management, female 29%, male 71%	Mean age 46,3 77% age 21-55
Nickell & Hinsz 2023, United States	People working in food production, female 38,6% male 61,4%	Mean age 39,32

6.2 Determinants found

The positive determinants reported to influence hand hygiene behaviour, as identified in the primary articles, were compiled in table 8. Some studies also mentioned determinants with negative or no influence on behaviour; these were included to provide a broader perspective on the subject. Only determinants assessed as significant in the original studies were included.

Table 6: The determinants related to hand hygiene behaviour identified from the data

Ref.	Positive factors related to hand hygiene behaviour	Determinants not influencing behaviour or bad influence if mentioned
Altın & Gök 2022	Training, feedback of behaviour, high level of education, risk of contamination, morning time, male gender	
Barrett & Cheung 2021	Risk perception, advantages, time factors, habit and hand hygiene self-efficacy, female gender	Disease knowledge, Hand hygiene effectiveness knowledge, risk perception
Borchgrevink, Cha & Kim 2013	Morning time, female gender, clean sink, signs encouraging hand washing,	
Brown et al. 2022	Disease severity and susceptibility, protection of people important to them, habit (opportunity), signs encouraging hand washing	Model behaviour of others, worry about getting sick, understanding of the importance of hand washing
Burusnukul & Broz 2013	Protecting oneself and others, being role model, feeling good doing the right thing, signs encouraging hand washing	
Bülbül Maraş & Kocaçal 2024	Training, clean well equipped hand washing facilities, feeling good to follow procedure, beliefs about consequences, feedback	Knowledge, subjective norm
Daniel et al. 2022	Belief about time (attitude), personal obligation (personal norm), action control (self-regulation),	Severity to life, knowledge, self-efficacy
Huis et al. 2012	Social influence, attitude, self-efficacy, and intention	Bad influence: negative role models, a poor social culture, and disinterested management
Madden et al. 2022	Guidelines, training, well equipped facilities	Worry about getting sick
Nickell & Hinsz 2023	Training, attitudes, supervision, well equipped facilities, protecting others, female gender	

6.3 Determinants categorised according to the BCD framework

The data presented in Table 8 was then categorised according to the BCD framework and organised into Table 9. Each determinant was compared with the definitions provided in table 1 and placed in the appropriate category. Some categories were left without any determinants, which can be considered significant when viewed from the perspective of BCD theory, as finding suggests these categories may hold less importance. The categories without determinants were the physical and biological environment, and within the behavioural settings stage, roles and routines did not play any role.

Table 7: The data found categorized to the BCD framework (Aunger et al. 2017)

Behavioural categories by the BCD		Determinants that had a statistically significant positive connection to hand hygiene in reviewed studies. Number behind the determinant tells how many times it was mentioned in initial studies if it was mentioned more than only in one study.
Environment	Physical	
	Biological	
	Social	Social influence
Brains	Executive	Training (n=4), feedback (n=2), risk perception, advantages, risk of contamination, disease severity and susceptibility, intention to maintain hand hygiene,
	Motivated	Feeling good to follow procedure, feeling good doing the right thing, protecting others (n=2), protection of people important to them, beliefs about consequences, protecting oneself, being role model
	Reactive	Habit (n=2), signs encouraging hand washing (n=3), attitude (n=2)
Body	Characteristics	Higher level of education, female gender (n=3), male gender (n=1)
	Senses	
	Capabilities	hand hygiene self-efficacy (n=2), self-regulation, belief about time used to hand hygiene
Settings	Stage	
	Roles	
	Routine	
	Norms	Supervision, personal obligation, guidelines
	Props and Infrastructure	Well-equipped facilities (n=3), clean sink (n=2), morning time (n=2)

6.4 Brain related categories

Looking at table 9, it is clear that the majority of the determinants are concentrated in the brain category, particularly in its subcategories: executive and motivated behaviour, which contain the largest number of determinants, followed by reactive behaviour as the third largest. According to BCD, the executive brain, or executive control, is responsible for producing planned behaviour related to short- and medium-term behaviour goals (Aunger & Curtis 2016). Determinants identified in the executive category included training (n=4) and feedback (n=2), which were the most frequently mentioned, along with risk perception and awareness of disease severity and susceptibility (Altın & Gök 2022; Brown et al. 2022; Bülbül Maraş & Kocaçal 2024; Madden et al. 2022; Nickell & Hinsz 2023).

The motivated brain category refers to behaviour driven by the desire to achieve short-term goals, which may sometimes occur subconsciously (Aunger & Curtis 2016). Determinants identified in this category included protecting others (n=2), particularly those important to the individual. Other factors in this category were feeling good about doing the right thing, following procedures, and serving as a role model. (Brown et al. 2022; Burusnukul & Broz 2013; Nickell & Hinsz 2023.)

The reactive brain, or reactive behaviour, is considered the oldest behavioural control system in evolutionary terms. It reflects environmental stimulus with instant response sometimes without a conscious choice (Aunger & Curtis 2016). Determinants identified in this category included habits (n=2) (Barrett & Cheung 2021; Brown et al. 2022), signs encouraging handwashing (n=3) (Borchgrevink et al. 2013; Burusnukul & Broz 2013; Huis et al. 2012), and attitude (n=2) (Barrett & Cheung 2021; Brown et al. 2022).

6.5 Environment related categories

The body subcategory of characteristics includes determinants such as higher educational level and gender, which are factors we have little control over (Altın & Gök 2022; Barrett & Cheung 2021; Borchgrevink, Cha & Kim 2013; Nickell & Hinsz 2023). However, these aspects should be considered and studied within the target group when designing real-life health education. The Body subcategory of capabilities according by definition, includes determinants such as hygiene self-efficacy (n=2), self-regulation, belief about time used to hand hygiene (Barrett & Cheung 2021; Daniel et al. 2022). This category is related to beliefs about behaviour.

Categories and determinants not previously mentioned include social influence (Huis et al. 2012) within the social environment and the settings where behaviour takes place. The setting subcategory of norms includes determinants such as supervision, personal obligation, and guidelines (Nickell & Hinsz 2023; Daniel et al. 2022; Madden et al. 2022). The infrastructure subcategory includes determinants like well-equipped handwashing facilities (n=3), clean sinks (n=2), and morning time (n=2) (Altın & Gök 2022; Borchgrevink, Cha & Kim 2013; Bülbül Maraş & Kocaçal 2024; Madden et al. 2022; Nickell & Hinsz 2023).

The influence of social determinants was surprisingly found to be significant in only one study (Huis et al. 2012). In the study by Brown et al. (2022), the model behaviour of others was not found to support hand hygiene behaviour (Brown et al. 2022). This diverge from the findings of Laine et al. (2013), where social pressure was reported to have a greater impact on handwashing behaviour among Finnish conscripts (Huis et al. 2012; Laine et al. 2013).

7 Discussion

Rather than focusing on individual determinants, it may be more effective to consider entire categories, prioritizing those that clearly highlight significant areas. The determinants identified in the original studies are presented in a sunburst chart in figure 4, providing the reader a clearer perspective on the significance of the different BCD categories. This chart offers a visual representation of how determinants are concentrated within certain categories.



Figure 4: Sunburst chart of categorized determinants

The brain category accounts for the largest portion of all determinants, indicating a strong emphasis on cognitive and motivational factors influencing behaviour. The body and behavioural settings categories follow, each being approximately the same size. Lastly, the environment category highlights only the influence of social factors, which were surprisingly found to be significant in only one study.

Next, this finding will be examined from the perspective of the BCD theory of change, which is essential if this framework is to be used for designing a complete intervention. Here, it is

utilised to provide the reader with a more holistic perspective on the findings and to clarify why BCD was chosen as the framework for this work. The behavioural setting component of the BCD theory of change is presented in figure 5.

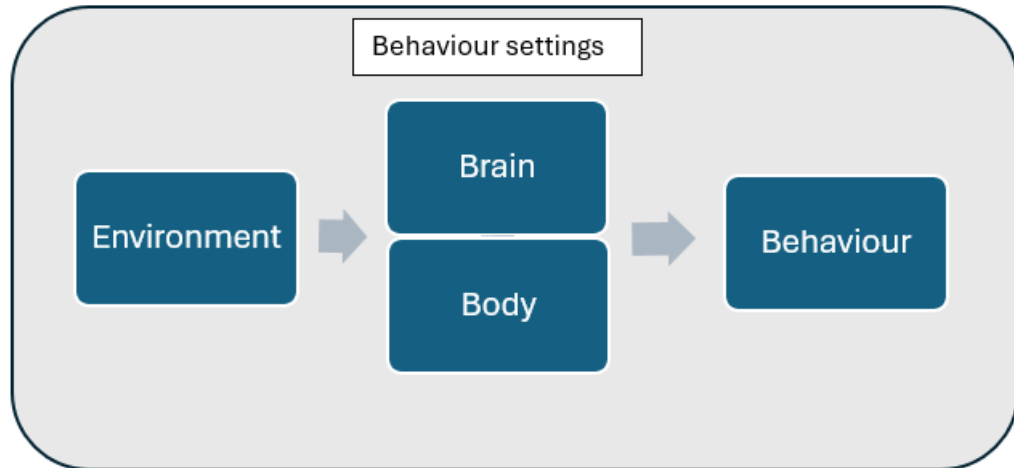


Figure 5: BCD behavioural setting (Aunger & Curtis 2016)

7.1 Behaviour health problem link

In the BCD framework, this connection is referred to as the “state-of-the-world link,” highlighting the importance of designing interventions that encourage initial health problem related behaviours. It also stresses the need to ensure that feedback from other links is clear, positive, and designed to reinforce the desired behaviour over time (Aunger & Curtis 2016).

In light of this link, it is interesting to compare the determinants that were found to have no effect or a negative effect on behaviour, such as worry about getting sick (n=2) or knowledge related to handwashing or diseases (n=3) (Barrett & Cheung 2021; Brown et al. 2022; Daniel et al. 2022; Madden et al. 2022). Despite high levels of awareness about the importance of hand hygiene, these studies found that this knowledge did not translate into action. This finding aligns with the concept of the intention-behaviour gap, where individuals may understand the benefits of a behaviour but fail to act accordingly (Sheeran & Webb 2016). It also supports the idea of psychological mismatch described by Aunger et al. (2017), where people choose unhealthy behaviours even when they are aware of their negative consequences (Aunger et al. 2017).

To achieve the goal of this link, it is essential to identify the specific behaviour to target, which can be challenging in more complex health problems. In the case of infection prevention, the target behaviour was relatively straightforward to identify, and the BCD approach emphasises the importance of focusing directly on behaviour.

7.2 Brain behaviour link

The next connection in the theory of change is between behaviour and the brain. These two are deeply linked, as the brain has evolved to produce adaptive behaviours. As shown in figure 5, the brain is situated within the body, which carries out the actual behaviour. The body provides sensory and perceptual feedback to the brain, which must also account for the body's physiological and metabolic demands. From the evolutionary perspective of BCD, the human brain regulates behaviour through three distinct mechanisms: reactive, motivated, and executive control systems, which have already been discussed in the category lists. (Aunger & Curtis 2016.)

Numerically, the largest number of factors positively influencing hand hygiene behaviour were found in the executive brain category. This aligns with the previously mentioned finding that simply providing information or instructions is often insufficient to drive sustained behaviour change. Instead, training programmes that include practical demonstrations and real-time feedback create opportunities for individuals to reflect on their actions and improve their behaviour (Aunger & Curtis 2016). For conscripts, regular handwashing feedback during their basic training period, integrated into daily activities, could be particularly effective in ensuring compliance with hand hygiene protocols.

An interesting finding related to this link was the significance of emotions, which fall under the motivated brain category. The desire to protect others and the positive reinforcement associated with following orders were key motivators identified in multiple studies (Brown et al. 2022; Burusnukul & Broz 2013; Bülbül Maraş & Kocaçal 2024; Huis et al. 2012; Nickell & Hinsz 2023). The well-being of others appears to act as a strong positive factor influencing behaviour, even when one's own well-being does not. This may be particularly relevant in a military context, where personnel often operate in close-knit units, and the group's well-being takes precedence over individual preferences. Health education that emphasises collective responsibility could be effective in promoting proper hand hygiene, not only for personal protection but also for the safety of comrades. This focus on group responsibility could be further emphasized during military crisis management operations.

Reactive, unconscious behaviour can be influenced through the use of visual posters placed in hand washing areas. Motivated behaviour can be addressed by designing training programmes that foster a positive attitude towards hand hygiene, familiarise individuals with instructions and regulations, and emphasise the importance of everyone serving as a role model.

7.3 Environment behaviour link

This link means external environment influencing to behaviour. Environment includes physical, biological, and social factors and behavioural settings which affects the target

population like infrastructure, norms, roles, and routines. Most often, people adapt their behaviour to their environment. Settings create a great way to directly influence behaviour without having to examine contextual motivators so closely. (Aunger & Curtis 2016.)

Looking at the results, good practical solutions emerge from the infrastructural related determinants alone, that could be used to influence hand hygiene behaviour directly. When resources are directed to easily accessible, well-equipped hand washing facilities that are kept clean, this alone can improve handwashing behaviour (Borchgrevink et al. 2013; Madden et al. 2022; Nickell & Hinsz 2023). In addition, when encouraging and informative posters are added to those spaces to remind people of the importance of hand washing (Brown et al. 2022; Burusnukul & Broz 2013), according to studies, it also has the effect of encouraging behaviour.

7.4 Limitations and strengths identified

The biggest limitation of this study relates to the unavailability of studies in the desired context. In this review, all included studies were from different settings, none of which were in a military context. While these studies share similarities in structured, hierarchical settings, their direct generalisability to the military context, particularly within the Finnish Defence Forces, may be limited. Further research focusing exclusively on Finnish military environments would be needed to fully validate these findings in that specific context.

Despite the lack of proper context, the finding of determinants related to hand hygiene behaviour itself was strong. Using a literature review, this research contributes to future health behaviour research by identifying determinants that are potentially generalisable to other high-risk environments, such as healthcare settings.

The use of a relatively new BCD theory as a framework proved its usability. The framework analysis approach worked well and enabled clear and organised data management, allowing for the systematic categorisation of determinants. This methodological strength ensures transparency and replicability, as readers can clearly see how findings are organised within the BCD framework.

7.5 Ethical considerations

Due to the research method, there was no need for ethical evaluation. The guidelines of the Finnish National Board on Research Integrity (TENK 2023) provided recommendations for good research practices throughout the research process. Which includes All European Academies ALLEA's integrity values; reliability, honesty, respect, and accountability were followed throughout the research process (ALLEA 2023). To maintain reliability study followed systematic and transparent research process, including clearly defined steps of integrative

literature review research. Findings, challenges and limitations were reported truthfully. Respect of original authors and their contribution was maintained by giving credit to all cited articles and avoiding plagiarism through paraphrasing and referencing. The entire research process was documented transparently allowing reader to evaluate accountability and if needed to replicate the review process. The thesis agreement, including storage, ownership, and user rights of the material produced, was signed with the required partner using Laurea's guidelines (Arena 2019).

8 Conclusion and recommendations

The aim of this thesis was to identify potential determinants that could promote hand hygiene behaviour in a military context. While studies specifically focused on military settings were lacking, factors associated with communal environments were explored. Although the sample size was relatively small, it aligned well with the framework used, which demonstrated its applicability. Key determinants included training, feedback, and well-equipped facilities, highlighting the critical role of cognitive and environmental support in fostering effective hygiene practices.

Secondly, the purpose of this thesis was to provide guidance for the planning of real-life health education projects. Although based on a small sample, the study offers insights into how determinants may influence actual behaviour and identifies key considerations for designing effective health education. The findings indicate that, despite high awareness of hand hygiene, the gap between knowledge and behaviour persists, underscoring the importance of developing education that goes beyond merely sharing information. An intervention in the form of an interactive face-to-face or online training programme, tailored to the determinants identified in this study, could help bridge this gap.

Well-planned practical training that integrates all elements of the BCD framework should focus on the target behaviour. Combining training with encouraging feedback engages the executive brain while supporting self-efficacy. Education should emphasise how hand hygiene protects others, foster positive attitudes, familiarise individuals with instructions and regulations, and highlight the critical role of role modelling in promoting consistent behaviour.

Recommendations arising from this research could be implemented through structural solutions. According to the BCD framework, people adapt their behaviour to their environment, meaning that improvements to infrastructure alone can help guide behavioural change. Well-equipped handwashing facilities placed in high-traffic areas, such as dining facilities, can encourage frequent use. Additionally, the reactive brain can be influenced by

strategically placed signs or posters that reinforce the importance of hand hygiene. These should be visually appealing and contextually relevant to the military environment, further promoting positive behavioural change.

Future research should prioritise exploring, environmental structures, organisational policies and practices, and attitudes associated with hygienic behaviour. Structural issues, if present, may reduce health education efforts alone insufficient. Emphasising the involvement of stakeholders is crucial to ensure the success and sustainability of interventions.

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Appendix 1: Adapted qualitative Mixed Methods Appraisal Tool

QUANTITATIVE DESCRIPTIVE STUDIES					
Ref	1. Is the sampling strategy relevant to address the research question?	2. Is the sample representative of the target population?	3. Are the measurements appropriate?	4. Is the risk of nonresponse bias low?	5. Is the statistical analysis appropriate to answer the research question?
Altın, N. & Gök, Ş.E. 2022	Yes	Yes	Yes	Yes	Yes
Barrett & Cheung 2021	Yes	No	Yes	Can't tell	Yes
Borchgrevink, Cha & Kim 2013	Yes	Yes	Yes	Yes	Yes
Brown et al. 2022	Yes	Can't tell	Yes	Can't tell	Yes
Burusnukul & Broz 2013	Yes	Can't tell	Yes	Can't tell	Yes
Bülbul Maraş & Kocaçal 2024	Yes	Yes	Yes	Can't tell	Yes
Daniel et al. 2022	Yes	Can't tell	Yes	Can't tell	Yes
Nickell & Hinsz 2023	Can't tell	Can't tell	Yes	Can't tell	Yes
MIXED METHODS STUDIES					
	1. Is there an adequate rationale for using a mixed methods design to address the research question?	2. Are the different components of the study effectively integrated to answer the research question?	3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?
Huis et al. 2012	Yes	Yes	Yes	Can't tell	Yes
Madden et al 2022	Yes	Yes	Yes	Can't tell	Yes

Appendix 2: Included studies

Ref. and country	Purpose and aim of the study	Design	Data and method	Result	Qualitative contribution to this study and other remarks
Altın & + Gök 2022, Turkey	To study the impact of a training program to hand hygiene behaviour.	A prospective and observational study that investigated hand hygiene compliance among healthcare professionals working in the intensive care unit.	74 workers 37% doctors, 39% nurses, 24% auxiliary staff from 3 different units were observed during 2072 patient hours which included 13263 patient contacts.	With the training, implementation of hand hygiene increased from 8% to 42%, and when direct feedback was added to hand hygiene, it increased to 76%. (p-value <0,001). Education, gender and risk of contamination also influenced behaviour.	Good quality. The study supports the assumption of the usefulness of education. The execution of the observation or feedback they perform, or the protocol used, or the training of the observers had not been reported in any way. Founding is in line with previous studies though.
Barrett & Cheung 2021, United Kingdom	To examine how knowledge, socio-cognitive perceptions, and demographic factors influence infection preventive behaviour like hand hygiene.	A cross-sectional online survey study in which applicants were recruited from UK university students by a commercial partner.	293 participants, 73.4% age 18-25 answered the online survey questionnaire on 13 May 2020. The questionnaire was adapted from existing surveys, mainly a WHO longitudinal survey on COVID-19 behavioural insights.	Participants reported high compliance (88.9%) with social distancing, but only 42.0% did the same for hand hygiene. Knowledge of the effectiveness of practices was high. Habit ($\beta = 0.39$) and time constraints ($\beta = 0.28$) were the strongest predictors of hand hygiene behaviour, followed by ethnicity ($\beta = -0.13$) and risk perception ($\beta = 0.13$). Regression models explained 40% of the variance in hand hygiene.	Good quality. The age group of the study and community environment fits well with the searched context. Determinants are clearly defined and amount of determinant good.

Borchgrevink, Cha & Kim 2013 USA	To determine potential environmental and demographic factors that influence handwashing compliance.	An observational study using 12 individually trained research assistants to document hand washing behaviours in restrooms across a college town.	Data was collected from four different restrooms observing 3746 subjects. Observation data included date, age group, time, gender, hand washing behaviours, drying mechanism type, restroom location, faucet type, sink cleanliness, and hand washing signage. Collected data was further analysed using Chi-square tests and ANOVA	Subjects washed their hands with soap more in the mornings (70.6%) than in the afternoons (66.4%). Women used soap and practiced proper hand washing more (77.9%) than men (50.3%). Subjects used soap more (68.5%) in restrooms with hand washing signs. Sink cleanliness increased hand washing (73.9%) compared to dirty ones (59,4%).	Good quality. Low number of behavioural determinants, some of them were found during observing subject. Although environmental factors are difficult to exploit in health education, but knowledge about them benefits people who are responsible for instructions and regulations.
Brown et al. 2022 USA	To assess U.S. adults' perceptions of the COM-B model's components in relation to hand hygiene behaviour and to identify links between these components and the behaviours.	Online survey study in which applicants were randomly recruited by Porter Novelli using ConsumerStyle methodology from U.S. adults.	Survey was completed by 3,625 U.S. adults in fall 2020, included items on capability, opportunity, motivation, and hand hygiene behaviours. Multiple logistic regressions were then conducted to identify predictors of handwashing and hand sanitizer use.	Over 90% felt these behaviours didn't require much effort, but fewer knew when (67%) or how (74%) to properly wash hands or use sanitizer (62%; 64%). Time wasn't a barrier (95%), few were reminded by visual cues (handwashing: 30%; sanitizer: 48%). Most believed hand hygiene prevent illness (handwashing: 76%; sanitizer: 59%). Regressions showed that capability, opportunity, and especially motivation were linked to behaviour.	Low quality. About 70 % of the age group fits well for this research context. The veracity of self-reporting can always be questioned, and the research is strongly connected to the pandemic situation, which can be assumed to be different from ordinary life. Clear definition and good number of determinants, but community influence was lacking.

Burusnukul & Broz 2013 USA	The study aimed to evaluate the effectiveness of a four-year university campaign, which involved placing hand-washing reminder signs in campus restrooms.	An online survey study performed 2012 with participants recruited using a university weekly newsletter, recruitment considered both students and employees.	Data were collected during February and May of 2012 using SurveyMonkey webpage online self-reported survey. The hand washing posters related to the study were placed into public toilets in 2008.	186 participants completed the survey, 62.8 % female and 37.2 % male. Ages ranged from 19 to 80 (M = 37.49). Participants believed mainly positive outcome, not getting sick (M = 4.41) encouraging others to same behaviour (M = 3.54) and feeling good as doing the right thing (M = 3.96).	Low quality. The age groups were not clearly specified, but 49% being students and mean 37.9 it can be assumed that more than 60% belong to the age group 18-60. Community environment fits well with the searched context. Determinants are clearly defined, and number of determinants is not good but adequate.
Bülbül Maraş & Kocaçal 2024 Turkey	The study aimed to assess nursing students to identify the factors influencing hand washing behaviour using the Theory of Planned Behaviour.	A descriptive, cross-sectional study was conducted at the nursing departments of a university in İzmir, Turkey, between 2021 and 2022	Data was collected from 240 nursing students using student identification form and the Scale for Assessment Hand Washing Behaviour. The data was analysed with the Chi-square test, and correlation analysis with the SPSS 21.0 program (p < .05).	The sub-dimension "intention" worked as key factor in predicting behaviour, beliefs about the consequences of hand hygiene 45.5 ± 4.5 (min-max: 31-56), subjective norm 3.3 ± 0.6 (min-max: 1-4), normative beliefs 20.8 ± 3.0 (min-max:12-24), perceived control 5.9± 1.0 (min-max: 2-8), attitude 20.0 ± 2.6 (min-max: 13-24), "intention" 12.1 ± 2.5 (min-max: 4-16), and knowledge 23.4 ± 1.9 (min-max: 11-24).	Good quality. Study included only one professional group, even though age group was good. Study did not really present determinants but behavioural intentions and although the results were presented in many graphs, the actual result for this study was very lean.

Daniel, Kurniawan, Pinawati, Morrin & Annaduzzaman 2022 Indonesia	To explore the differences in health protocols and practices among university students during covid-19 pandemic.	A cross-sectional, self-reported online study was conducted among university students from July 2021 to February 2022.	Data was collected from 292 participants using online Google form questionnaire created by researchers. Age range of participants was 17-43 years, 74% of them were female. RANAS psychological framework was used to design the questionnaire and to evaluate the results.	Three key factors were found to influence student's adherence to health protocols: belief about time (attitude) ($p \leq 0.05$), personal norms ($p \leq 0.01$), and action control (self-regulation) ($p \leq 0.05$). Personal norms had the strongest association with health protocol practices.	Low quality. The age group of the study and community environment fits well with the searched context. Even though hand washing was just one part of study, determinants are clearly defined and number of determinants good.
Huis et al. 2012 Netherlands	This study aims to outline commonly used improvement strategies and behavioural determinants that promote effective hand hygiene practices, to offer a better understanding of such strategies.	A systematic review of experimental and quasi-experimental studies on strategies to improve hand hygiene data search was carried out using Medline, Embase, CINAHL, and Cochrane databases, covering research from January 2000 to November 2009.	First, the characteristics of 41 reviewed studies were extracted using the EPOC Data Collection Checklist, including study objectives, settings, design, target population, outcome measures, intervention descriptions, analysis, and results. Then, the Taxonomy of Behavioural Change Techniques was applied to identify targeted determinants.	The most addressed determinants were knowledge, awareness, action control, and behaviour facilitation, while fewer studies focused on social influence, attitude, self-efficacy, and intention. Of the 13 controlled studies, most showed positive effects on hand hygiene behaviour, with the effectiveness increasing from a 17.6% improvement when addressing one determinant to 49.5% when addressing five determinants.	Good quality. The age groups were not clearly specified but can be assumed that more than 60% belong to the age group 18-60, because studies included were hospital work related. Community environment fits well with the searched context. Determinants are clearly defined, and number of determinants is great.
Madden, Rutter, Stones & Ai	To examine how workers and	A quantitative and qualitative online	Data concerning hand hygiene, impact of covid-	Attitudes toward implementing the	Good quality. Age group and working life context

2022 United Kingdom	managers in non-clinical settings respond to the opportunities presented by a smart technology hand sanitizer, both during the COVID-19 pandemic and in general contexts.	survey study where online interviews were used to collect the additional qualitative data. The survey was done between July and August 2021 during the COVID-19 pandemic lockdown in UK.	19, and monitoring hand hygiene using online questionnaire was gathered from 314 respondents, age 21-55 years (77,1%) with wide variety of working sectors biggest education and public service (43.3% and 20.7%).	technology varied widely among the sample, with age being a particularly significant factor in these differences. Finding of study did not include behavioural determinants, but those can be found from the text	fits well into this study. From the data presented can be found good number of behavioural determinants even though those have not been considered in the study as such.
Nickell & Hinsz 2023 USA	The study aims to evaluate how effectively the Theory of Planned Behavior predicts self-reported food safety behaviours among workers in turkey processing.	A quantitative survey which was done using a paper questionnaire distributed at the workplace, which was later returned when completed	The 140 (54%) of 261 employees of the company returned the 188-question survey form. Participants mean age was 39,32, and 67,8% of them were male. The event time of the survey has not been announced.	This study supports the TPB by showing that attitudes, norms, perceived control, and intentions are key in preventing food contamination, with gender also playing a role in applying TPB in certain workplaces.	Low quality. Age group and working life context fits well into this study. Determinants are clearly defined, and number of determinants is great. But the overall quality was not so good

