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Factors influencing the occurrence of infectious diseases among crew members onboard cruise ships: a systematic review

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Abstract

Infectious diseases have been reported to adversely affect industries including tourism. Understanding the knowledge, attitudes, and practices of at-risk populations is crucial to implementing successful preventive and mitigation measures. This systematic review aimed to identify factors that affect the spread of infectious diseases among crew members onboard cruise ships. A systematic search of Scopus, Web of Science, and Google Scholar was conducted, and nine studies were included in the final analysis. Findings revealed good knowledge levels, but misconceptions about transmission were common. Discriminatory attitudes and risky behaviors were also reported. Primary sources of information included the media, participatory educative sessions, healthcare providers, and family/friends. There is a need to prioritize the initiation of participatory-focused health literacy interventions to enhance knowledge, and attitudes and modify the behavior of seafarers in relation to infectious diseases.

Keywords: Knowledge, attitudes, practices, , HIV/AIDS, COVID, STIs

1. Introduction

The emergence and spread of infectious diseases with pandemic potential have had a significant impact on global public health [1], [2]. These diseases have been associated with substantial morbidity and mortality and remain a threat to human health and social stability [3]. In addition, they continue to burden populations around the world and account for a large proportion of death and disability [2]. In the past decades, the world has witnessed the onset and spread of different infectious diseases, most notably, Severe Acute Respiratory Syndrome (SARS), Middle Eastern Respiratory Syndrome, and COVID-19 [4]–[6]. The latter affected millions of people and negatively impacted the daily lives of different population groups across the globe [7], [8]. The effects of the disease itself and restrictions implemented to counteract its spread affected all areas of society [7]–[9]. In addition, a report by the World Health Organization revealed that more than 100 outbreaks of gastroenteritis occurred on cruise ships between the years 1970 and 2000. An estimated 16,000 people were affected by these outbreaks, caused mostly by noroviruses [10]. Additionally, the Center for Disease Control (CDC) reported over 60 outbreaks of gastroenteritis between 2010 and 2015, suggesting that this remains an ongoing problem despite the decrease in outbreaks [11].

Despite the unprecedented policies and measures to mitigate and combat infectious diseases, effective pandemic prevention and management measures require support from at-risk population groups [12], [13]. Improvement in population health depends on understanding the social and cultural behaviors of the target population [12]–[14]. The knowledge, attitude, and practice (KAP) model is a commonly used method to gather information on factors that influence the attitudes, values, beliefs, interactions, and behaviors of a given population group [15], [16]. The KAP model suggests that individual practices are determined by attitudes and knowledge about a particular behavior [17], and understanding these elements is considered critical to changing behavior [18].

The KAP model gauges what people know about a certain problem, how they look at it, and how they deal with it. Using the KAP model can aid in planning and strengthening preventative health efforts by identifying factors that influence the adoption of healthy practices and responsive behavior. [16]. This systematic review aimed to identify factors that affect the spread of infectious diseases and the facilitators and barriers to compliance with preventive measures among crew members on cruise ships. This was done by investigating and synthesizing available evidence on crew members' knowledge, attitudes, and practices regarding infectious contamination and compliance with prevention policies. The review was guided by the following questions:

i. What behavioral factors have influenced the outbreaks of infectious diseases including COVID-19 among cruise ship crew members?
ii. What social, behavioral, and cultural factors influence compliance with prevention, mitigation, and management measures of infectious diseases including COVID-19 among cruise ship crew members?

2. Methods

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [19]. A review protocol was registered in PROSPERO (CRD42023393140).

2.1 Data sources and search strategy

A systematic search of peer-reviewed articles addressing infectious disease among crew members in the cruise industry was conducted in the Scopus and Web of Science databases. A manual search in Google Scholar was also performed to expand the scope of the search. The search was conducted using relevant keywords and their associated terms, including "crew," "beliefs," "infection," "cruise," and their related terms. The formulated search terms were combined using the Boolean operators "AND" and "OR" and truncations to broaden the search scope. Refer to File 1 for a detailed list of keyword

combinations and File 2 for the search strategies. To broaden the scope of the search, the snowballing technique was used by manually checking the references from the bibliographies of selected articles.

2.2 Selection criteria

Potential articles were limited to randomized controlled trials, cohort studies, and crosssectional and case-control studies, published from 2010 to 2022. The review included all articles reporting on factors such as knowledge, attitudes, behaviors, beliefs, perceptions, and practices about infectious diseases among seafarers on ships, ferries, or expedition vessels. Articles that contained insufficient information or were missing the outcome of interest, as well as editorial reports, systematic reviews, and case reports were excluded from the review. The full inclusion and exclusion criteria are presented in File 3.

2.3 Study selection

All articles retrieved from each database were uploaded onto the EndNote-20 reference manager where duplicates were removed. The articles were later exported to Rayyan software where two reviewers (SS and DAB) independently screened the title and abstract of eligible studies for inclusion in the review. Three categories were used during the selection process: include, maybe, and exclude. Full texts were then evaluated by the reviewers against the inclusion and exclusion criteria. Any disagreements that arose were resolved through consensus discussion and cross-checking of articles by the two reviewers.

2.4 Data extraction

The two reviewers developed a data extraction form to identify significant information and characteristics. Relevant information was extracted, including study characteristics including author, year of publication, study title, study objective, location, study design, participant characteristics,

sample size, data collection tool, and main outcome measure File 4. To increase accuracy, the extracted data was reviewed again by both reviewers.

2.5 Quality appraisal

The included studies were assessed independently by the two reviewers using the Joanna Briggs Institute (JBI) standardized critical appraisal tool for cross-sectional studies [20], as the methodological approach for all included articles was cross-sectional. This tool covers eight questions addressing topics such as inclusion criteria, study subjects, and setting, reliability, and validity, criteria for measurement of the condition, confounding factors, strategies to deal with confounding factors, and statistical analysis. The answer to each question was either yes, no, unclear, or not applicable. Studies for which the response was “yes” to fewer than five of the addressed topics were considered to have a high risk of bias and low quality. Potential discrepancies were resolved through discussion by the two reviewers. Refer to File 5 for a list of appraised articles.

2.6 Outcome measurement and data analysis

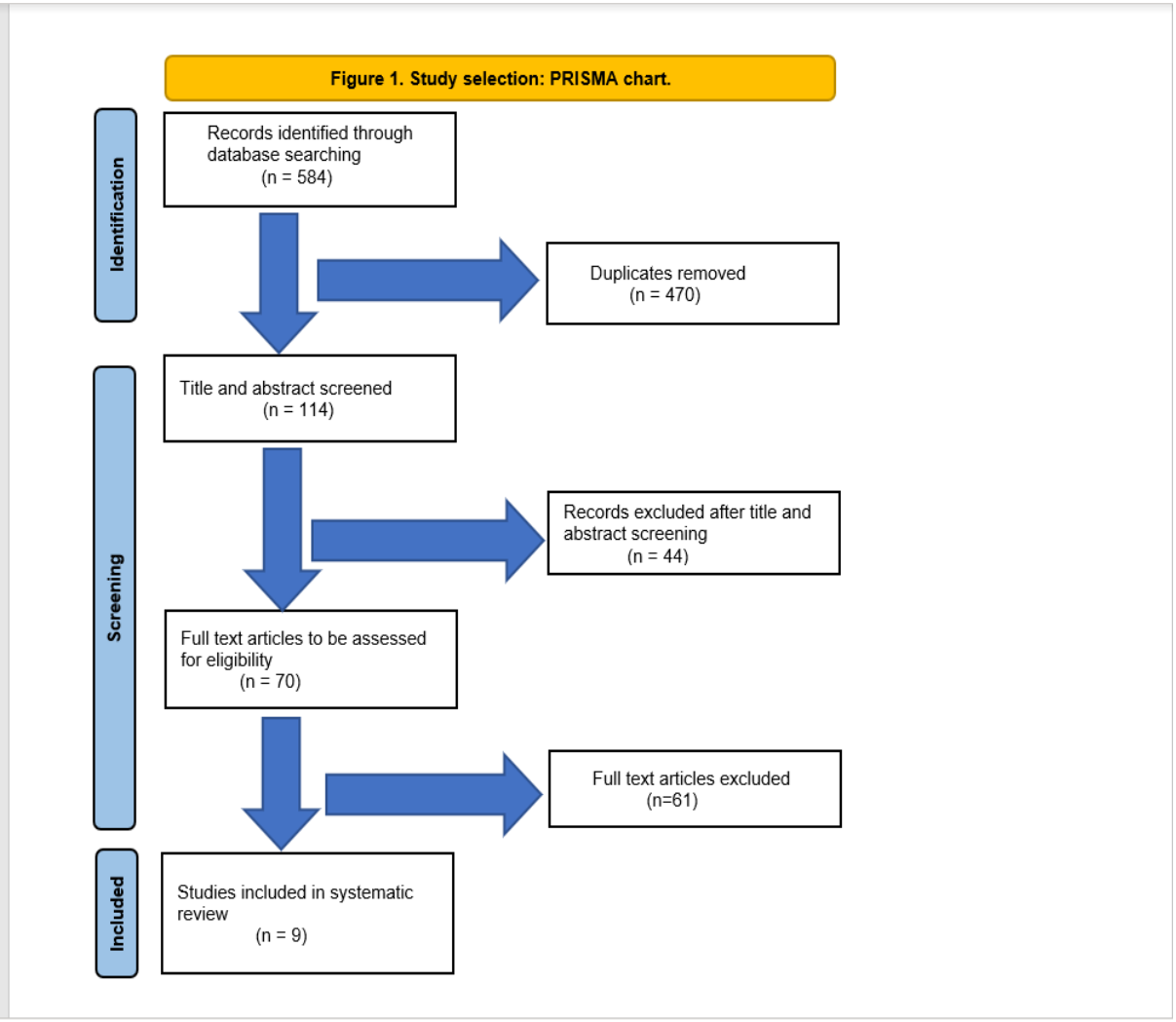
To enable analysis and interpretation, the outcome measurements of this systematic review were reported in terms of percentages of crew members knowledge, attitudes, and practices toward infectious diseases. In addition, a narrative synthesis was performed for each of the variables described, and facilitators and barriers were identified and summarized.

3. Results

3.1 Search outcome and study selection

The initial database search yielded 584 articles, of which 470 duplicates were excluded. The remaining 114 articles were screened against the title and abstract, of which 44 articles were disqualified because they were not addressing the topic of interest. The remaining 70 full articles were then evaluated against the predetermined eligibility criteria. Sixty articles were excluded due to the wrong population

group and/or outcome. One additional article was excluded after failing the methodological assessment stage. Only 9 studies were included in the final assessment (Figure 1).



3.2. Study characteristics

Nine studies [21]–[29] comprising 5,208 participants were included (see File 6 for study characteristics). Included studies were conducted in the Philippines [23], [26], Italy [21], [28], Senegal [24], Morocco [29], Montenegro [22], and Kiribati [27]. One was a combined study from Nigeria and the United Kingdom [25]. All studies employed a cross-sectional study design. Five articles reported on all three components of KAP [21], [23], [24], [26], [29], and four articles reported on at least two components of KAP [22], [25], [27], [28]. All articles examined and reported on knowledge.

3.3. Quality assessment of included studies

Overall, most of the studies (n=7) answered “yes” to six of the questions, one answered “yes” to seven, and the other “yes” to five of the questions. Eight of the studies failed to score on questions 5 and 6, which were addressing confounding factors during the research process.

4. Main Findings

4.1 Knowledge

Knowledge was assessed using four sub-themes: General knowledge about the disease, mode of transmission, symptoms, and preventive measures.

4.1.1 General knowledge about the infectious disease

Seven articles reported that crew members had appropriate general knowledge about the infectious diseases being studied [21], [23]–[26], [28], [29]. The majority of participants were familiar and aware of the existence and spread of the infectious disease of interest. Levels of knowledge **on familiarity** ranged from 78.6 to 100%. Only one study [22] reported unsatisfactory familiarity (47.9%) with the disease. One article [27] did not provide any information on **general knowledge** about the infectious disease in question.

4.1.2 Mode of transmission

The studies revealed satisfactory levels of knowledge about the mode of transmission among most of the study participants, ranging from 54.2% for Sexually Transmitted Infections (STIs) to 97.3% for COVID-19 . Of the two articles investigating COVID-19 [21], [25], both revealed good levels of knowledge on modes of transmission. In the Italian study, the majority of the participants (97.3%) understood that COVID-19 can be transmitted via droplets by an infected person when they cough or sneeze [21]. The majority of HIV/AIDs and STI-related articles indicated similar findings. A study

conducted in Senegal reported that 96.5% of the participants were aware that HIV could be transmitted through sexual intercourse [24]. Additional articles from Italy (85.3%), Morocco (98%), and Kiribati (72.5%) revealed comparable knowledge levels [27]–[29]. This contrasted with a study conducted in Montenegro, which reported that only 35.5% of the participants acknowledged unprotected sex as one way of transmitting HIV [22]. Studies also reported satisfactory knowledge of the mode of transmission through the blood, such as mother-to-child transmission, blood transfusion with infected blood, and use of contaminated sharp objects such as blades and needles [24], [28], [29]. While knowledge levels in this area were generally satisfactory, some participants identified incorrect modes of transmission [22], [24], [26], [28], [29]. A study conducted in Morocco indicated that 81.1% of the participants believed that exposure to cold weather was a contributing factor to HIV transmission [29]. In addition, meal sharing with infected people, (13.8%, 18%, 42.2%, 62%) and mosquito bites (41.3%, 53.9%, 47%) were some of the cited wrong modes of HIV transmission reported by the participants [22], [24], [26], [28], [29].

4.1.3. Symptoms

Only four of the nine included articles reported knowledge levels related to disease symptoms. Three of these four studies indicated adequate levels of knowledge [21], [23], [24]. The Italian study on COVID-19 indicated good knowledge levels (99.4%) of COVID-19 symptoms [21]. In a study from the Philippines, more than 70% of the participants were aware of the symptoms of STIs [22]. However, a study from Morocco, reported that only 53.2% of the participants had full knowledge about the symptoms related to HIV/AIDs and other STIs [29].

4.1.4 Preventive Measures

Participants had reasonable knowledge of how to prevent getting infected with the reported disease [21], [25], [27], [29]. This was higher when it came to COVID-19. The Italian study reported that 92% of the respondents recognized that the spread of COVID-19 could be prevented through wearing face

masks [21], and 99% were aware that isolation and treatment of COVID-19 patients was a promising way to reduce transmission of the disease. Knowledge levels of HIV/AIDS and STI preventive measures such as **abstinence, and use of condoms varied across studies.** In the studies from Kiribati, Morocco, and one study from the Philippines, participants **indicated that condom use was an effective method of preventing HIV/AIDs and other STIs** [23], [27], [29]. This is in contrast to participants in another study from the Philippines and Montenegro who reported low levels of knowledge on condom use for the prevention of HIV and STIs; 57.4% and 42% respectively [22], [26]. Furthermore, two-thirds (67.8%) of respondents from the study in Montenegro cited **abstinence as a preventive measure**, while over a third (35.5%) did so in the study from Senegal [22], [25].

4.1.4. Information Sources

The most common sources of information were from educational courses, the media, family members, and healthcare providers [22], [24]–[26], [28], [29].

Educational courses offered by employers [22], [26], [28], [29] and the media [22], [24], [28], [29], were the most common sources of information about COVID and other infectious diseases. Educative sessions were mainly conducted through lectures and discussions. One study reported that before embarking on a new contract, crew members were required to attend training that included a 45-minute module on HIV transmission and prevention and a follow-up discussion on common myths [26]. However, despite educational courses being one of the most cited sources of information, findings from studies indicated that optional sessions had fewer participants as compared to compulsory sessions.

Participants specified radio, newspapers, and television as the main media bodies through which they accessed health information [22], [24], [29]. For instance, participants indicated that targeted television and radio programs were very useful avenues in gaining in-depth knowledge on HIV/AIDs and STIs [29]. Other reported information sources included healthcare providers, family members,

friends, and partners [22], [28], [29]. The majority of studies with respondents accessing information through these sources exhibited good general knowledge about COVID-19, HIV, and STIs [25], [28], [29].

4.2. Attitudes

Across the reviewed articles, two themes were identified about the attitudes of the participants: attitudes toward specific groups of people and toward adherence to preventive measures.

4.2.1. Attitudes towards specified groups of people

Overall, all the relevant reviewed articles for this theme indicated a negative attitude towards a specified group of people [24], [26], [29]. Despite participants having adequate levels of knowledge of HIV/AIDS in the Moroccan study, they exhibited high levels of stigma and discrimination towards **People Infected with the Human Immunodeficiency Virus (HIV), or People Living with HIV (PLHIV)** [20]. Forty-five percent (45%) reported that they would not share a meal with PLHIV. Similar findings were obtained from a study in the Philippines, where only 4% of the respondents had a positive attitude toward PLHIV [26]. The majority of participants had negative responses to questions related to meal sharing, purchasing food, employing, and working with PLHIV [26], [29]. In one study, participants indicated that an HIV positive but asymptomatic colleague should not be allowed to work [29].

During the COVID pandemic, negative attitudes towards people of Asian origin were reported by participants of a study conducted in Nigeria and the UK [25], with 50% of participants indicating they would not eat a meal from a Chinese-owned restaurant. In addition, participants reported that they would not work on a cruise ship occupied by people with 'Asian-sounding' names.

4.2.2. Adherence to Preventive Measures

Many participants had negative attitudes toward adherence to suggested preventive measures. Over a third (38%) of participants in the Morocco study did not like the use of condoms during sexual intercourse [29], while nearly a third (32.5%) indicated that condoms were not necessary because they were married [29]. Similar results were obtained from the studies in Senegal and the Philippines, where participants gave negative responses towards safe sex [24], [26]. A third (33%) of the Senegalese participants claimed that condoms reduced pleasure. The study from the Philippines indicated similar findings, despite participants having a generally positive attitude toward safe sex [26]. Additionally, 12% of the participants from the Philippines believed that condoms were not effective due to the presence of holes and factory defects [26], which may indicate questionable quality of condoms in some markets.

The Italian study on COVID-19 revealed that participants had a positive approach toward mitigating the spread of the disease [21]. The majority (92.5%) anticipated covering their face whenever they coughed or sneezed, while more than two-thirds (68%) reported willingness to use disinfectants in the absence of hand soap.

4.3. Practices

Regarding practices, two themes were identified during the review process: seeking health services and behavioral practices.

4.3.1. Seeking Health Services

Study participants in the Philippines were reported to have good practices regarding seeking health services [23], [26]. The majority of respondents stated that they voluntarily sought medical evaluation of STIs [23]. In addition, 91% of participants reported to have been routinely screened before embarkation. In the other Filipino study, 70% of participants reported to have been tested for HIV [26], which the majority indicated was mandatory for employment.

In contrast, the Montenegro study reported that only 22.3% of respondents tested for HIV, 8.1% for hepatitis B, and 6.8% for hepatitis C [22]. Poor practices were also reported in the Moroccan study, where only 10.2% had tested for HIV [29].

4.3.2. Behavioral Practices

Risky behavior was prevalent in the studies that investigated STI/HIV, but less so in those that investigated COVID-19. [23], [24], [26]–[29].

The study done in Senegal reported that 23.7% of the participants engaged in unprotected sex [24]. Similarly, the study conducted in Morocco indicated that 42.8% of participants had never used a condom and 29.8% rarely used a condom [29]. In the Italian STI study, 56.4% of seafarers reported regular use of condoms during sexual intercourse and 13.7% reported always using protection with their wives and girlfriends [28]. Findings from the study in the Philippines indicated that of the participants who engaged in commercial sex, only 20% of them used condoms [23]. Similar findings were reported in the Moroccan study, where 60% of participants who engaged in transactional sex did not use condoms [29].

High numbers of sexual partners was another risky behavior reported across studies [23], [26], [29]. One of the Filipino studies reported that 59% of participants engaged in sexual intercourse outside their current stable relationships [23]. Likewise, the Moroccan and Kiribati studies indicated that 32% and 55% of respondents had more than one sexual partner [27], [29]. The Kiribati study further reported that of the 35% who engaged in transactional sex, 78% had multiple transactional partners. In contrast, 83.6% of respondents reported having one regular sexual partner in one of the studies from the Philippines [26].

Regarding COVID-19, a study in Italy reported satisfactory practices toward COVID-19 [21]. Ninety-seven percent (97%) of respondents reported that they avoided touching their faces, 93.7% washed their hands at least for the recommended 20 seconds, 84% adhered to social distancing and 77.3% wore face masks while on board.

5 Discussion

In this systematic review, we aimed to identify factors that affect the spread of infectious diseases and facilitators and barriers to compliance with preventive measures among crew members on cruise ships. This was done by synthesizing and evaluating available evidence on crew members' knowledge, attitudes, and practices on infectious contamination and compliance with prevention policies.

In general, infectious diseases have serious long-term effects while also often negatively affecting aspects of daily life. Understanding the knowledge, attitudes, and practices of seafarers can be crucial in implementing interventions aimed at shaping behaviors and subsequently reducing the spread of infectious diseases.

The findings of this systematic review demonstrated that most crew members had good knowledge about the disease of interest [21], [23]–[26], [28], [29]. Findings from the study conducted in Italy reported having the best-informed respondents on COVID -19. This could be due to high publicity by the media and experiences encountered by the general population, especially considering Italy was once the epicenter of Covid-19 in Europe.

Age was not significantly associated with the level of knowledge exhibited by the participants. This could be because all the participants were adult seafarers and hence, had general knowledge about the specified disease. Furthermore, education levels were equally not a predictor of knowledge. This could have been because of the similar educational background of the majority of the participants who had acquired a high school diploma or higher education [21]–[23], [26]–[28]. However, one study

found that a statistically significant difference existed regarding knowledge of transmission in connection with levels of education [22]. The article from Montenegro indicated that participants with only primary education were cited to be the ones having misconceptions about the specified infectious disease, hence countering prevention efforts, and maintaining the spread of the diseases. These findings indicate that there is a need to introduce and intensify evidence-based and audience tailor-made health education, training opportunities, and awareness campaigns.

Despite high levels of knowledge, poor attitudes reflected pessimistic beliefs and perceptions [21], [23]–[26], [29]. The Nigerian/UK study indicated that participants had a discriminatory attitude toward people of Asian origin during the COVID-19 epidemic [25]. This is supported by another study that found xenophobic attitudes toward China and other Asian countries in relation to COVID-19 [30]. This demonstrates respondents' prejudice toward China, where COVID-19 infection was first detected.

Unwillingness to share a meal with PLHIV [21], [29] was highlighted in some studies, despite reporting high percentages of educated crew members with satisfactory levels of knowledge of HIV and existing initiatives of international stakeholders, including the International Federation of Transport Workers, the International Seafarers' Welfare and Assistance Network and the International Chamber of Shipping. This could be explained by the frequency of misconceptions about HIV transmission reported in these studies.

These findings indicate that more needs to be done to reduce stigma and discrimination through workplace community education and awareness.

Studies also indicated negative attitudes toward the use of condoms during sexual intercourse. Despite being knowledgeable on the mode of transmission, condom use was thought to reduce pleasure and unnecessary in marriage [26], [29]. These attitudes may result from prevalent religion and/or cultural

norms [24], [29] in some countries. There is a need for relevant health authorities to ensure that crew members can easily access culturally-tailored, clear, and consistent information.

COVID-19-related studies reported good attitudes [19], [21]. This could have been because the general population had first-hand experience with the negative effects of the diseases on loved ones such as high admissions and mortalities that were being reported [21].

Poor practices were found among most of the crew members across all studies' [22], [24], [26]–[29]. Unprotected sex was reported among 'among most of the crew members in the studies that investigated HIV/STIs' [24], [26], [28], [29]. This is validated by the crew members' attitudes toward the use of condoms, where they indicated that condoms reduce pleasure [24]. Even though the results were not statistically significant, 20-year-old seafarers (60%) were more likely to use condoms as compared to people aged between 31 and 40 years [28]. This could be because the majority of the older seafarers were married and believed that condoms were not necessary for married people [24], [29].

Additionally, studies indicated that participants were in the habit of engaging in transactional sex [23], [26], [27] and having multiple sexual partners [27], [29]. Participants with a history of alcohol use were three times more likely to have multiple sexual partners as compared to those who did not. Younger seafarers were two times more likely to have multiple sexual partners than their older counterparts. A considerable number of participants reported not to have used any condoms during sexual intercourse with sex workers [26], [27], [29]. Positive practices were also noted by several studies [21], [23], [26], including adhering to recommended health practices [21] and medical evaluation [23], [26] especially when requested by the shipping company as a compulsory measure.

Generally, the findings indicate that there is a weak relationship between knowledge, attitudes, and practices concerning specified infectious diseases. Knowledge alone cannot result in behavior change. In the case of HIV/AIDs, the asymptomatic nature of the disease during the early stages and the introduction of antiretroviral drugs can be responsible for the weak link. In addition, seafarers have pointed out the need for evidence-based information regarding HIV/AIDS [31].

Investigating the knowledge, attitudes and practices provides valuable information regarding insufficiencies and obstacles to reducing the spread of infectious diseases. The present study provides impetus for tailored education and training sessions conducted regularly among crew members on cruise ships. This will facilitate the retention of knowledge which will subsequently instill a positive attitude towards the prevention of infectious diseases. In addition, this will also contribute to improved practices that will in turn reduce the incidence of contagious diseases.

Strengths and Limitations

The search for relevant articles was performed in multiple databases following the inclusion/exclusion criteria. Two researchers (SS and DAB) were involved at all stages of the review process which reduced bias and error in study selection. JBI appraisal assessment indicated that the studies included were high quality.

Only a few articles were available for inclusion in the review showing the very limited research in this field. In addition, most of the studies were from low- and middle-income countries. Furthermore, despite the intentions of the authors to investigate the knowledge, attitudes and practices of crew members regarding various infectious diseases, seven of nine studies reported on HIV/AIDs and other STIs. Hence, generalization of results to high-income countries and other infectious diseases respectively should be done with caution. All the articles included in the review were cross-sectional studies, which have intrinsic weaknesses.

6 Conclusion

Generally, there is limited research on the topic that prevents generalization of the findings. Despite good general knowledge of the diseases in question, there is a great need to improve attitudes and modify behaviors. The findings from this review indicate that programs put in place to improve knowledge have not been effective in changing attitudes and practices. There is a need to prioritize new participatory-focused health literacy interventions to change attitudes and modify behavior of crew members with relation to the different infectious diseases. There is also a need for more studies on other airborne-related and respiratory diseases among crew members on cruise ships.

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