Review Article

Hand hygiene adherence among Iranian nurses: A systematic review and meta-analysis

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ARTICLE INFO	ABSTRACT
	Background & Aim: Adherence of nurses to hand hygiene is important for the prevention of healthcare-associated infections. This study aims to systematically review the existing studies that assess Iranian nurses' adherence to hand hygiene and estimate their amount with meta-analysis. **Methods & Materials:** We performed a systematic search for peer-reviewed journals published from 2005 to 2018. The systematic search was conducted using both international (Google Scholar, PubMed, SCOPUS, and Web of Sciences) and Iranian databases (Scientific Information Database, IranMedex, Magiran, and MedLib). The search was carried out using a combination of the following terms: "adherence", "compliance", "hand hygiene", "nurse", "Iran", "nursing practice", "nursing", and "guidelines". The combinations of these words with Boolean operators like 'AND', 'OR' and 'NOT' were used. **Results:** A total of 22 articles were used in the final analyses. The pooled proportion of hand hygiene adherence was 40.5 percent [95% confidence interval [CI]: 31.1–49.8]. Sensitivity analysis confirmed that the overall estimated pooled proportion of hand hygiene adherence did not vary significantly with the elimination of any of the 22 studies, observer or self-reported hand hygiene, instrument of measurement, unit of measurements, sample size, and time. **Conclusion:** The level of adherence of Iranian nurses to hand hygiene can potentially increase the chance of healthcare-associated infections and put patients and nurses at risk. Hospital and nursing managers should take practical steps to investigate factors contributing to the failure of hand hygiene adherence among nursing staff. They should ensure the continuous implementation of hand hygiene improvement strategy.

Introduction

Hospital-acquired infection (HAI), also known as the nosocomial infection, is an infection that occurs within 24 to 72 hours of hospital admission (1). The nosocomial infection is associated with increased mortality and healthcare costs in all health systems. In the US, for example, approximately one out of every 25 patients acquires HAI in the acute care hospitals in 2011, accounting for a total of 721,800 healthcare-associated infections cases (2). The annual cost of HAI is estimated to be between 8.3 and 11.5 billion dollars in the US (2, 3).

The high prevalence of HAI imposes major challenges in developing countries (3). The rate of HAI in low- and middle-income countries (LMICs) is more than 25%, which causes a significant economic burden on their health systems (3, 4). The rate of HAI in Iran, as an upper-middle-income country, was reported as high as 30% (5). Thus, the prevention of HAI is pivotal to providing high quality and safe healthcare, especially in developing countries (6).

Due to exposure risks inherent in the profession, healthcare workers are 3 to 5 more times more likely than the general population to acquire infections such as tuberculosis, hepatitis B, and AIDS (7, 8).

Thus, standard precautions are recommended to prevent the onset of HAIs. Standard precautions including hand hygiene and personal protective equipment (e.g., masks, gloves, glasses to prevent contact with infectious substances) have been developed to protect the healthcare professional and prevent the transmission of infection in hospitals (9).

Hand hygiene is one of the most important methods of standard precautions, which is known as a vital component in protecting patient safety and preventing HAI (10). It is estimated that adherence to hand hygiene reduces at least 20% of HAI (11). The adherence to hand hygiene is varied among different healthcare staff. Since nurses are at the forefront of patient care and have the most contact with patients (12), their adherence to standard precautions has a significant impact on the reduction of HAI, cross-infection among nurses and patients, and among patients (13). Nevertheless, adherence to hand hygiene among nurses is reported with a wide range so it cannot be citable for future programming (14, 15). Adherence of nurses to hand hygiene provides safety for themselves, patients, and their relatives; it is vital to understand the level of hand hygiene adherence among nurses. This systematic review and meta-analysis study aims to estimate the overall adherence of nurses to hand hygiene in Iran.

Methods

The present study was systematic reviews and meta-analyses. Systematic reviews and meta-analyses present findings by gathering, merging, and analyzing results from different studies published on a similar research topic (16).

Databases and search terms

The Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guideline was used to perform a systematic review and meta-analysis of the peer-reviewed studies on hand hygiene adherence among nursing staff in Iran. The MOOSE guideline provides a checklist of items for writing a standard form of systematic reviews and meta-analyses of observational studies in (reporting of background, reporting of search strategy, reporting of methods, reporting criteria, reporting of results, reporting of discussion, reporting of conclusions) health research and medicine (17). We restricted our studies to reporting hand hygiene adherence among Iranian nurses published in Persian or English language. Both international (Google Scholar, PubMed, SCOPUS, and Web of Sciences) and Iranian databases (Scientific Information Database, IranMedex, Magiran, and MedLib) were searched to find relevant studies in January 2019. The search terms included medical subject headings (MeSH) and their synonyms associated with 'hand hygiene', 'nurse(s)', 'nursing staff', 'hospital(s)', 'Iran', 'Iranian'. It was completed by searching free-text terms. The corresponding Persian equivalent of these terms was used to search for Iranian databases. The combinations of these words with Boolean operators like 'AND', 'OR' and 'NOT' were used. For example, in PubMed, we searched hand hygiene AND nurse AND Iran. Search go on by the different combinations of search terms and Boolean operators to combine or exclude keywords in a search. The reference lists of the final articles were also searched to identify other relevant studies.

Inclusion and exclusion/ criteria

We used the following six inclusion criteria: 1) articles published before December 2018; 2) the original articles that were published in either English or Persian; 3) cross-sectional articles that reported the prevalence of hand hygiene adherence; 4) articles were available in full texts; 5) studies that were conducted in hospital settings; and 6) quality scores of studies ranged between 8 and 12, as described below. The following studies were excluded from the analysis: 1) qualitative studies, brief reports, review articles, case reports, letter to editors, editorial comments, working papers, and studies with duplicate data (i.e., if a study published in both Persian

and English with similar results, the Persian report study was excluded from the review); and 2) studies that reported hand hygiene adherence among other healthcare workers including among nursing students. Two authors (BN and SV) evaluated all the articles independently, and discrepancies were resolved through discussion and, if required, by consultation with a third author (KB). The primary evaluation of the articles was based on the title of articles using the checklist.

The quality of each study was evaluated by a quality checklist, which has been used in previous studies (18-20). The checklist contained 12 questions about the methodology of the retrieved studies (e.g., the aim of the study, the method of the study, the tool of data collection, the sample size of the study, the method of data analysis, and the study population). One point was assigned for each question if a study met the quality requirement; zero was assigned otherwise. The overall quality of each study was calculated by summing all the points of the twelve questions. The quality scores ranged from zero to 12. Studies with the quality scores between 8 and 12 were retained in the meta-analysis, and their relevant information was extracted for data analysis.

Data extraction

We used a checklist to extract the required information from each article. The following data were included in the checklist for each article: first author of the study; year of publication; year of data collection; the language of the study; the province of the study; sample size; type of assessment (self-report or direct observation); the number of hand hygiene opportunities; and a measurement instrument (World Health Organization [WHO] five-moment questionnaire or other) and the proportion of hand hygiene adherence among nurse staffs. The quality of each study was evaluated by a quality checklist (Table 1); the checklist contained 12 questions about the methodology of the retrieved studies (e.g., the aim of the study, the method of the study, the tool of data collection, the sample size of the study, the method of data analysis and study population). One point was assigned for each question if a study met the quality requirement; zero was assigned otherwise. The overall quality of each study was calculated by summing all the points of the twelve questions. The quality scores ranged from zero to 12. Studies with the quality scores between 8 and 12 were retained in the meta-analysis, and their relevant information was extracted for data analysis.

Table 1. Checklist for assessment of the quality of primary studies

Number	Question	Score	
		Yes=1	No=0
1	Are the research questions clearly stated?		
2	Is the approach appropriate for the research question?		
3	Is the study context clearly described?		
4	Is the role of the researcher clearly described?		
5	Is the sampling method clearly described?		
6	Is the sampling strategy appropriate for the research question?		
7	Is the data collection method clearly described?		
8	Is the data collection method appropriate to answer the research question?		
9	Is the method of analysis clearly described?		
10	Are the main characteristics of the population well described?		
11	Is the analysis appropriate for the research question?		
12	Are the claims made supported by sufficient evidence?		

The checklist questions were obtained from Moosazadeh et al. (2014).

Data analysis

The hand hygiene adherence rate among nurses was identified for each study. Based on the binomial distribution formula, the standard deviation of the proportion of hand hygiene adherence for each study was computed. Heterogeneity among final studies included in the meta-analysis was evaluated using chi-square based Q test, I^2 test, and τ^2.

The significant result of the Q and τ^2 tests, or I^2 more than 50%, indicate heterogeneity among the included studies (21). To adjust for heterogeneity among the studies, a random effect model should measure the pooled proportion of hand hygiene adherence (22). Point estimation of the pooled proportion of hand hygiene adherence was calculated using a forest plot and a 95% confidence interval (CI). Meta-regression and subgroup analyses were conducted to identify the potential sources of between-study heterogeneity among selected studies (23). To evaluate the extreme effect of each study on the pooled proportion of hand hygiene adherence, a sensitivity analysis was performed by sequentially excluding one study at a time from the meta-analysis(24). All the statistical analyses were computed using the R statistical software package. The statistical significance was decided at p<0.05.

Results

The results of the systematic review process are presented in Figure 1. From the initial 207 studies, 22 eligible articles that provided information about hand hygiene adherence among nursing staff were included in our review [13-34]. The main characteristics of the studies included in this review were summarized in Table 2.

Table 2. Main characteristics of the studies on hand hygiene adherence in nurse staffs in Iran

| First Author (reference number)	Publication year	Place	Sample size	Number of occasions	Hand hygiene proportion	Questionnaire
Tabrizi J.S. (37)	2015	Tabriz	NA	126	71.10%	WHO five moment
Tabrizi J.S. (38)	2015	Tabriz	NA	252	59.94%	WHO five moment
Seyed Nematin S.S. (39)	2017	Shiraz	NA	1155	39.16%	Other questionnaires
Mostafazadeh Bora M. (40)	2018	Esfehan	94	500	12.80%	WHO five moment
Albughbish M. (41)	2016	Ahvaz	NA	369	57.18%	Other questionnaires
Askarian M. (42)	2006	Fars	8986	NA	32.20%	Other questionnaires
Kavakebi N. (43)	2016	Tabriz	150	1465	42.80%	WHO five moment
Najafi Ghezeljeh T. (44)	2015	Lorestan	282	282	69.75%	Other questionnaires
Toulabi T. (45)	2006	Khoram Abad	NA	190	10.00%	Other questionnaires
Gholami Fesharaki M. (46)	2014	Tehran	140	NA	36.00%	Other questionnaires
Zandiyeh M. (47)	2012	Hamedan	74	296	61.30%	Other questionnaires
Hazavehei S.M.M. (48)	2015	Tehran	154	NA	21.10%	WHO five moment
Nazari R. (49)	2015	Amol	153	NA	52.29%	Other questionnaires
Samadipour E. (50)	2008	Sabzevar	100	1356	22.60%	Other questionnaires
Hosseinialhashemi M. (51)	2015	Shiraz	377	NA	8.20%	Other questionnaires
Sharif A. (52)	2016	Kerman	200	NA	87.50%	Other questionnaires
Ataei B. (53)	2013	Esfehan	NA	2653	6.40%	WHO five moment
Nazari R. (54)	2011	Amol	NA	159	16.98%	Other questionnaires
Naderi H.R. (55)	2012	Mashhad	22	913	47.90%	Other questionnaires
Farbakhsh F. (56)	2013	Theran	NA	2194	21.70%	WHO five moment
Sadeghi Moghaddam P. (57)	2015	Ghom	20	NA	29.40%	WHO five moment
Shiva F. (58)	2014	Tehran	NA	510	59.20%	Other questionnaires
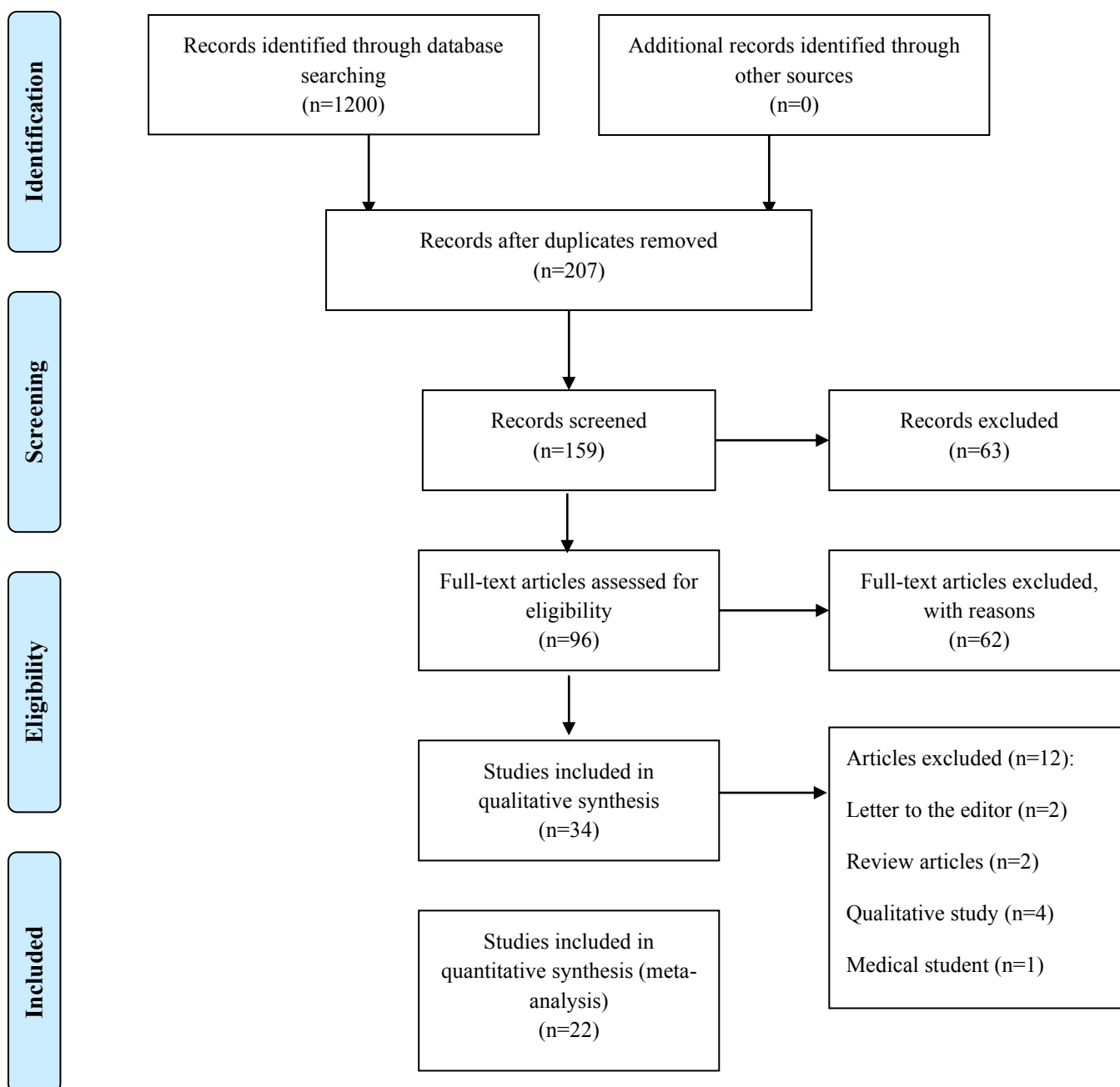
Figure 1. *PRISMA flow diagram*

Hand hygiene adherence

The pooled proportion of hand hygiene adherence was 40.5 percent [95% CI: 31.1–49.8] (Figure 2). In studies where the result was not reported as a percentage of adherence, the adherence ratio (*P*) and sample number (*n*) or sample number (*n*) and adherence number (*x*) were reported. In both cases, the standard deviation and confidence interval were calculated based on the reported results. In the first cases

$$sd = \sqrt{\frac{p(1-p)}{n}}$$

$$\left(p - 1.96\sqrt{\frac{p(1-p)}{n}}, \; p + 1.96\sqrt{\frac{p(1-p)}{n}} \right)$$

and second cases $p = \frac{x}{n}$ $\quad sd = \sqrt{\frac{p(1-p)}{n}}$,

$$\left(p - 1.96\sqrt{\frac{p(1-p)}{n}}, \; p + 1.96\sqrt{\frac{p(1-p)}{n}} \right)$$

the formula used. A random-effects model was used because of a high heterogeneity rate among the studies included in the final quantitative analysis (I^2=99.6%, Q [df.=21]=4231.9595, p-value<0.0001). Sensitivity analysis confirmed that the overall pooled proportion of hand hygiene adherence did not vary extremely with the elimination of any study (95%CI of the re-estimated proportion by sequentially excluding one study at a time from the analysis ranged from 38.2% to 42.1%, correspondingly) (Figure 3). The Quantile-Quantile (QQ) plot showed that the random effect model fitted the studies perfectly (Figure 4).
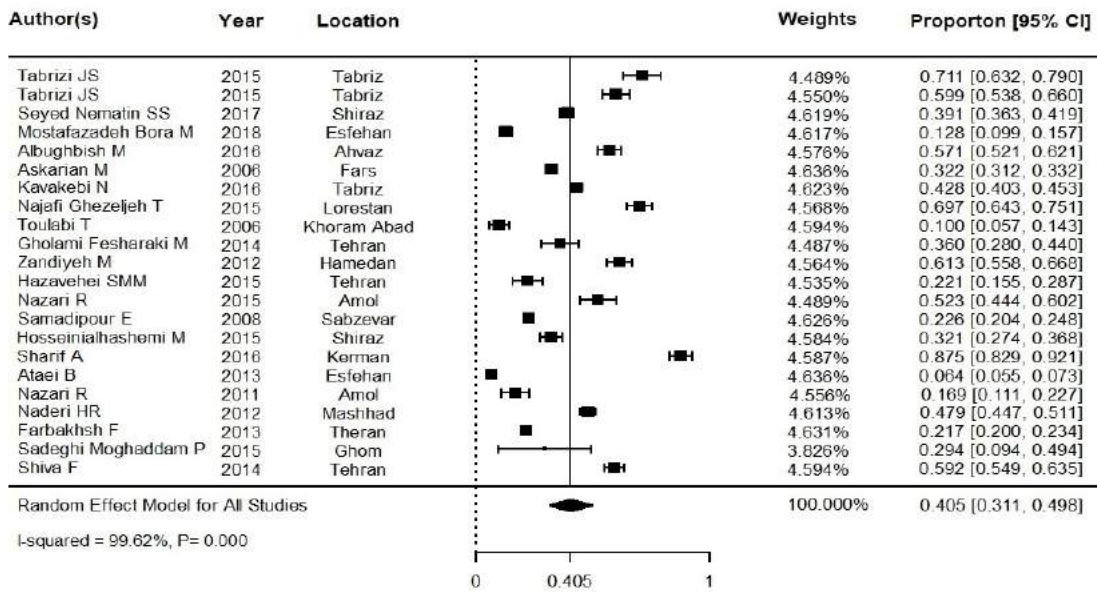
Note: CI: confidence interval; results are based on meta-analysis with a random effect model.

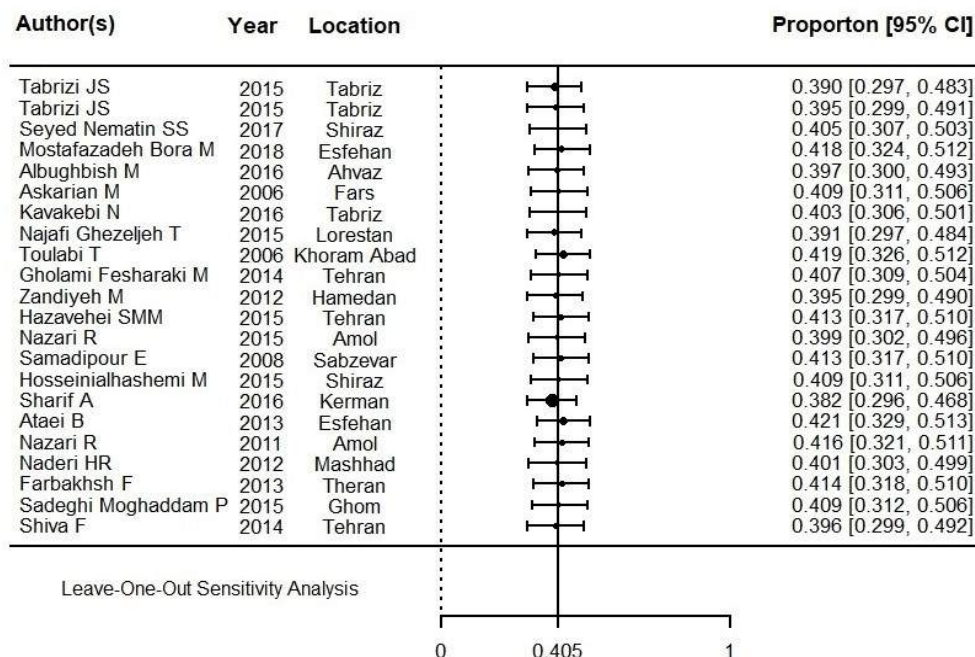**Figure 2**. Forest plot of the total proportion of hand hygiene adherence

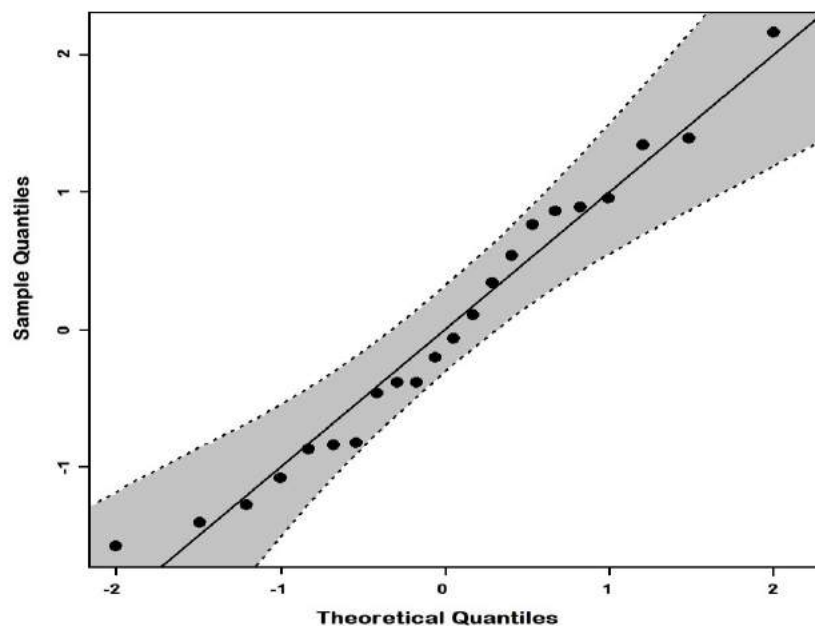**Figure 3.** Leave-one-out study plot to assess the sensitivity of pooled proportion to any of the studies

Figure 4. Quantile-Quantile (QQ) plot of the residuals of the random effect model

Sources of heterogeneity among studies

There was a high degree of heterogeneity in studies included in the meta-analysis (I^2=99.6%). To evaluate the possible sources of this heterogeneity, we conducted the following four subgroup analyses.

Observation vs. self-reporting

We examined the effect of assessment type on the differences between studies in which an observer collected their data with studies that analyzed self-reported hand hygiene adherence data. In 18 out of 22 studies, hand hygiene adherence was evaluated by an observer, while the hand hygiene adherence in the remaining 4 studies was self-reported by the participants. The combined proportion of hand hygiene adherence for those which was evaluated by an observer was 42.3 percent (95% CI: 31.4–53.2). The combined proportion from self-reported studies was 32.0 percent (95% CI: 18.5–45.5). There was, however, not any significant difference between these two subgroups (QM [df.=1]=0.66, P-value=0.41) (Figure 5).

Instrument of measurement

Thirty-six percent (8/22) of studies assessed the hand hygiene adherence using the WHO five moments approach, and the other studies applied a variety of different questionnaires and checklists (observation checklist, CDC recommendations based questionnaire, infection control guideline-based checklist, the theory of planned behavior-based checklist, organizational instruction-based checklist, and researcher-made questionnaire). The combined proportion of hand hygiene adherence for studies that used the WHO five moment approach and other questionnaires were 32.2 (95% CI: 17.2–49.2]) and 44.5 percent (95% CI: 33.2–55.9), respectively. The proportions from these two measurement tools were not significantly different (QM [df.=1]=1.33, P-value=0.24) (Figure 6).

Unit of measurements (person vs. opportunity)

In sixty-eight percent (15/22) of the studies, opportunities for hand hygiene were considered as experimental units to compute the hand hygiene adherence rate, and in the remaining studies, each person considered as a unit of estimation for hand hygiene adherence rate. The pooled proportion from the random effect models for studies which opportunities had taken as experimental units was 39.8 percent (95% CI: 28.2–51.4), whereas the corresponding proportion for

studies that used nurses as the experimental unit was 42.0 percent (95% CI: 25.2–58.8). The difference in the pooled hand hygiene adherence rates between the latter groups was not statistically significant (QM [df.=1] = 0.04, P-value=0.83) (Figure 7).

Sample size and time

The result of the meta-regression analysis showed that the proportion of hand hygiene adherence was not related to the sample size of the studies (P-value = 0.29, Figure 8). The results also indicated that the hand hygiene adherence rate did not change significantly between 2005 and 2016 (P-value=0.07, Figure 9).
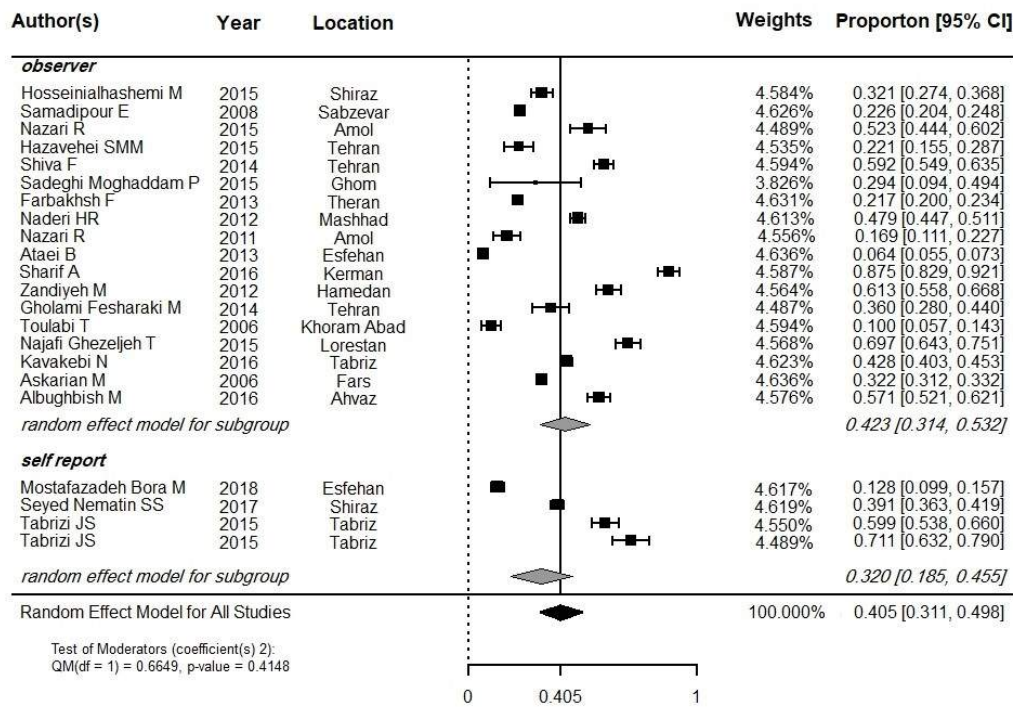

Figure 5. Forest plot of the proportion of hand hygiene adherence in terms of the assessment types
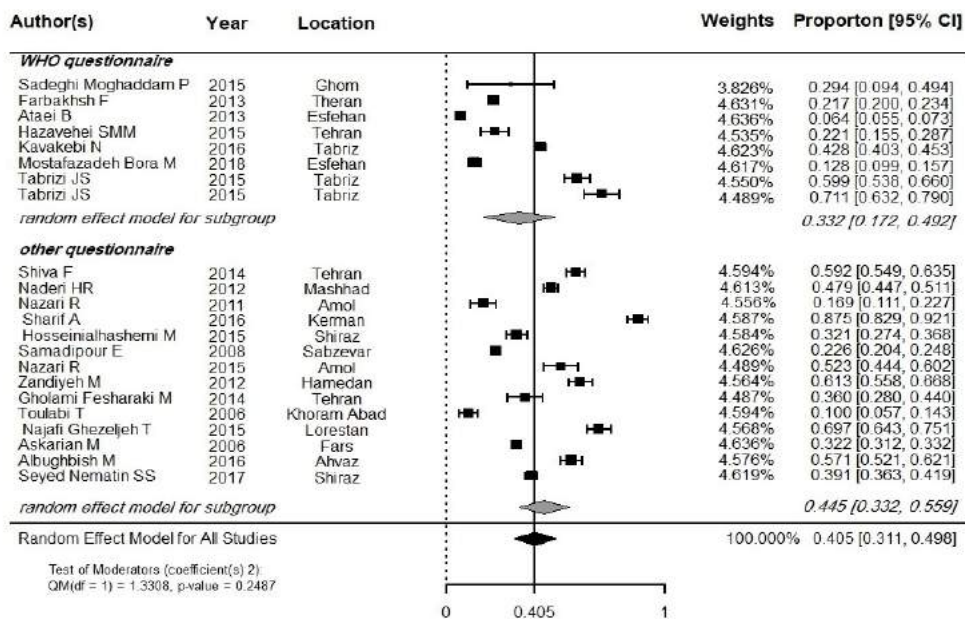

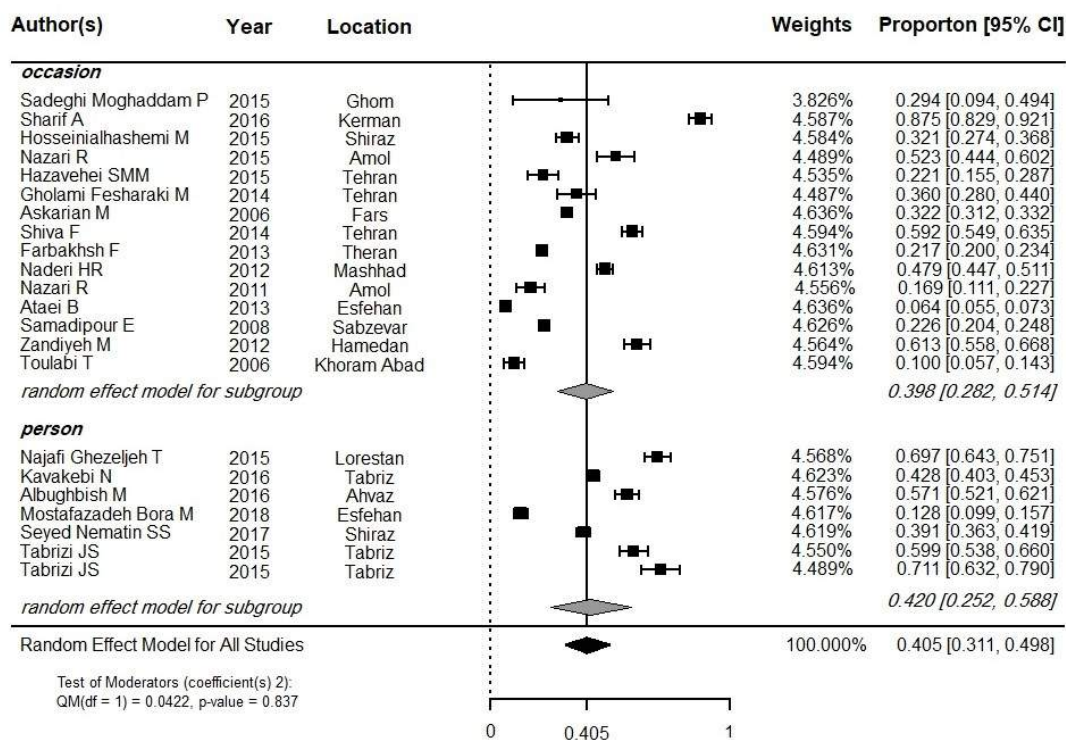**Figure 6.** Forest plot of the proportion of hand hygiene adherence in term of measurement tools

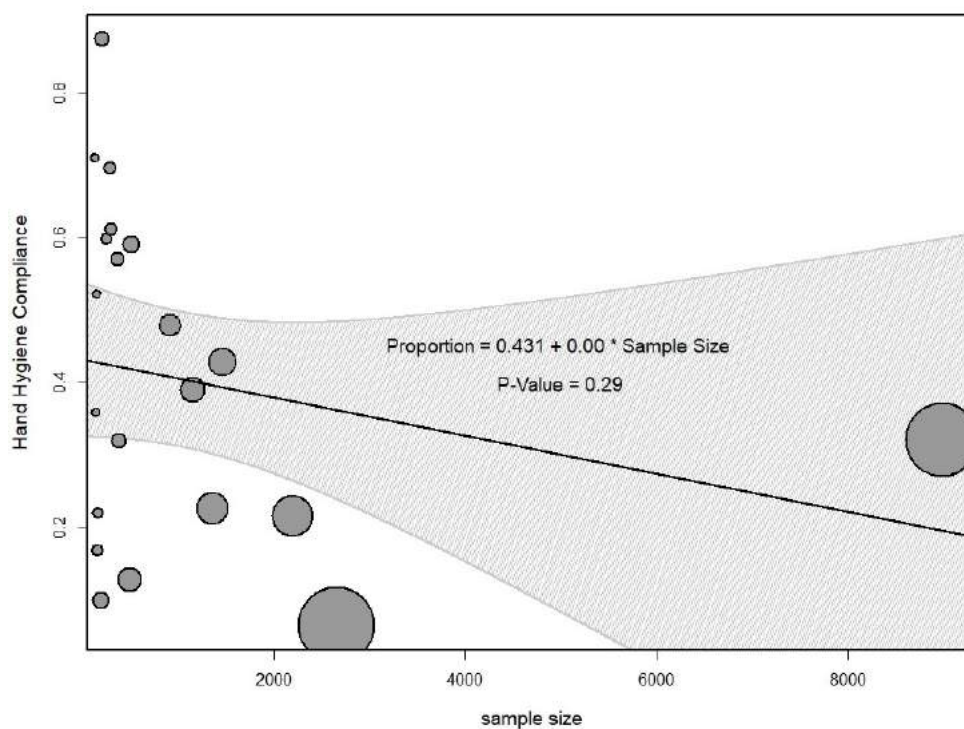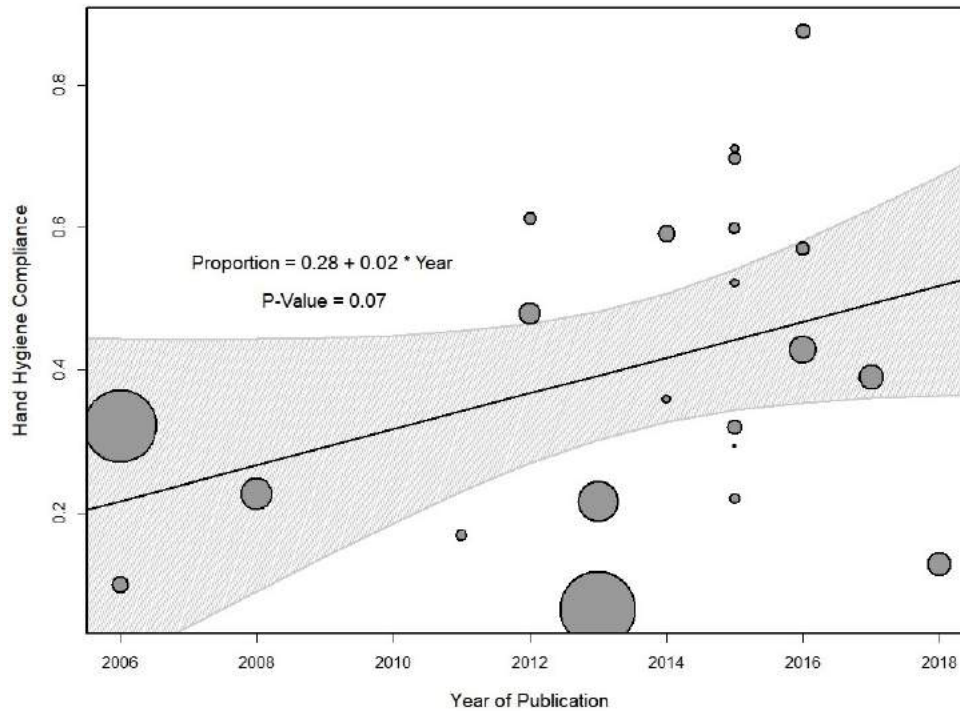**Figure 7.** Forest plot of the proportion of hand hygiene adherence in term of the experimental units

Figure 8. Meta-Regression plot of the change in the proportion of hand hygiene adherence against the sample size of studies.

Figure 9. Meta-regression plot of change in the proportion of hand hygiene adherence against publication year of studies

Discussion

The hand hygiene adherence rate in Iranian nurses was found to be 40.5 percent. A systematic review of studies on adherence with hand hygiene guidelines in industrialized countries in 2010 showed that the overall adherence rate of 40 percent in hospitals, with 48 percent of hand hygiene adherence among nurses (25).

Hand hygiene is an important way to prevent HAI and reduce the spread of antimicrobial resistance (26). It is described as the most critical tool in preventing the spread of HAI between patients. Specifically, washing hands before and after patient contact is a simple solution to prevent the spread of infection between patients (27). Several factors such as personal (age, gender, knowledge) (28, 29), psychological (e.g., risk personality and sensitivity perception), and organizational factors (e.g., safety culture) (30) are related to the adherence of nurses to hand hygiene. A large number of patients, a lack of towels and soap, forgetfulness, lack of time, skin problems, lack of knowledge, and the

absence of positive role-model have been reported as the most common barriers to the adherence of hand hygiene practices (31, 32).

Continuous education and monitoring on standard precautions are necessary because adherence to hand hygiene at the right time and with appropriate technique can save lives (33, 34). A systematic qualitative literature review investigating the healthcare workers' hand hygiene adherence revealed the motivational factors (acuity of patient care, self-protection, and use of cues) and perceptions of the work environment (resources, knowledge, information, organizational culture) as the main factors affecting the adherence to hand hygiene (35).

The low rate of hand hygiene adherence among nurses in Iran warrants further attention, and healthcare managers should investigate the reasons for nonadherence to hand hygiene among nursing staff to implement relevant interventions to increase hand hygiene adherence among nurses. Also, most nurses have direct contact with

patients with high vulnerability to infectious diseases like COVID-19 (36). Therefore, considering the importance of hand hygiene, especially during the outbreak of infectious diseases, the study of adherence to hand hygiene during the COVID-19 epidemic and emphasized hand hygiene by nurses during this period recommended.

The main limitation of this study was that in the studies, there was not a unique definition of measurement of hand hygiene as handwashing with soap and water, hand rubbing with alcohol-based hand rubs, or both. In this study, we conducted a first systematic review and meta-analysis to assess hand hygiene adherence among Iranian nurses. We should highlight heterogeneity among studies included in the final analysis in terms of the measurement instrument (the WHO instrument and others), the source of reporting the adherence (observation vs. self-reporting), and the unit of measurement (person vs. opportunity). Although we could not find significant effects of these factors on the reported hand hygiene adherence rate, it would be ideal to have studies that used similar methods to measure the hand hygiene adherence rate to avoid any potential bias. Another limitation of the present study was the lack of review of gray literature and dissertations.

Conclusion

The overall adherence of Iranian nurses to hand hygiene adherence was 40.5 percent. The low adherence of Iranian nurses to hand hygiene requires further investigations. Nursing managers in Iran should take practical steps to investigate factors contributing to the failure of hand hygiene adherence among nursing staff. Hospitals and nursing managers should ensure continuous implementing and implementation of hand hygiene improvement strategies.

It is vital to understand the level of hand hygiene adherence among nurses, as it provides safety for themselves, patients, and their relatives. The overall adherence of Iranian nurses to hand hygiene adherence was lower than half and did not vary significantly with effective factors, especially time-lapse. Therefore, practical steps to investigate and remove factors contributing to the failure of hand hygiene adherence among nursing staff is necessary. Implementation of hand hygiene improvement strategy and intervention especially to change the attitude about hand hygiene required.

Acknowledgment

Conflict of Interest

The authors declare that there is no conflict of interest.

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