

Original Research



COVID-19 vaccine uptake among nursing officers: a cross-sectional study in a tertiary care hospital in Sri Lanka

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Abstract

Introduction: Vaccination against COVID-19 was considered an important public health intervention to control the pandemic. However, the vaccine uptake was not satisfactory among Asian nurses and less explored in Sri Lankan setting.

Objectives: To describe the compliance with the COVID-19 vaccine among nurses in a tertiary care hospital in Sri Lanka with its associated factors

Methods: This cross-sectional study was conducted in January 2022, one year after the introduction of the COVID-19 vaccination to Sri Lanka. Stratified sampling method was used to select 415 nurses from District General Hospital Matara. Data collected using a pre-tested, self-administered questionnaire were summarized with descriptive statistics. Uptake of two primary doses and one booster dose was considered full compliance. The associations were evaluated with the Chi-squared test at $p < 0.05$ significance level and adjusted for confounders using multiple logistic regression.

Results: With a 91.1% response rate ($n=378$), full compliance with the COVID-19 vaccine was noted among 51.8% ($n=196$). There had been an active demand for the first dose among 84.7% which declined to 70.9% and 26.7% by the second and booster doses, respectively. Only 107 (28.3%) were willing to accept another dose if recommended in the future. The most influential reason for vaccine uptake as reported by a majority was to prevent complications of COVID-19 disease. The most reported reason for reluctance was the vaccine's inability to protect against new strains of the virus. Age, nursing qualifications, nursing grade and knowledge on COVID-19 vaccine showed a significant association with vaccine uptake in bivariate analysis. However, only knowledge retained significant with vaccine uptake (adjusted odds ratio (aOR)=1.9; 95% CI=1.2, 2.9; $p=0.003$) after adjusted for confounding effects using multiple logistic regression.

Conclusions & Recommendations: There exists a gap in compliance with COVID-19 vaccine among study participants. Targeted interventions should aim to empower and improve vaccine related knowledge among nurses in future vaccination programs.

Keywords: COVID-19, vaccine, compliance, nursing officers, Sri Lanka

Introduction

Coronavirus disease 2019 (COVID-19) was declared a pandemic by the World Health Organization (WHO) on 11 March 2020. At the 73rd World Health Assembly, the role of extensive immunization against COVID-19 as a global public good for health was recognized (1). The first COVID-19 case reported in Sri Lanka on 27 January 2020 was a Chinese tourist. The vaccination campaign for COVID-19 was initiated in Sri Lanka on 29 January 2021 starting from priority groups which included healthcare staff and other frontline workers from defence, police and services at ports of entry (2). Adopting WHO recommendations, booster dose vaccination was later introduced for citizens who have completed two doses of any COVID-19 vaccine type after three months from the 2nd dose (3).

Getting vaccinated involves psychological and behavioural processes. Vaccine uptake, coverage, compliance, and hesitancy are different terms used to describe this complex process. Vaccine uptake is defined as “the number of people vaccinated with a certain dose in a certain period”. Vaccination coverage indicates the vaccinated proportion of a target population (4). Vaccine compliance is to complete the immunization series by uptake of the full course of vaccination according to the recommended dose interval appropriate for age (5). The Strategic Advisory Group of Experts on Immunization (SAGE) defines vaccine hesitancy as “delay in acceptance or refusal of vaccine despite the availability of vaccine services” (6).

Nursing is considered the largest occupation category in the health sector accounting for nearly 59% of the total health care personnel globally. Nurses were the most infected group of health care workers due to COVID-19 (7). Out of 276 categories of health personnel employed in the state sector in Sri Lanka, nurses constitute the single largest category of the healthcare workforce (8). Nurses were at increased risk of COVID-19 due to occupational exposure as they delivered care to patients with

longer contact times (9-10). Healthcare workers including nurses had a decisive role in combating the pandemic as they were regarded as one of the most reliable sources of information by the public (11). A study in India stated that more than half of the nurses in a tertiary care hospital were found to be COVID-19 vaccine-hesitant (12). Our study aimed to describe the compliance with the COVID-19 vaccine among nurses in a tertiary care hospital in Sri Lanka with its associated factors.

Methods

A cross-sectional study with an analytical component was carried out among nursing officers in Matara District General Hospital (DGH), a tertiary care institute in Sri Lanka. It is a referral centre for specialized care and one of the sentinel sites of Severe Acute Respiratory Infections (SARI) and Influenza-like Illness (ILI) Surveillance in the country (13). Data collection was done during 3-23 January 2022. The participants were nursing officers employed in the DGH Matara for a minimum of three months. Nursing officers on maternity leave, any other long-term leave and on temporary attachment during the period of data collection were excluded. Special grade nursing officers were also excluded as they were considered as a separate category of health care workers having an advanced level of clinical nursing experience, skills, and knowledge with minimum direct supervision.

The sample size was calculated using the single population proportion formula for cross-sectional studies (14). The estimated proportion of nurses compliant with the COVID-19 vaccine was taken as 58.8%, as per the COVID-19 vaccine uptake among South Asian healthcare workers in a study done among the multi-ethnic UK healthcare workforce (15). With a type 1 error set at 0.05 and a desired precision of 5%, the sample size adjusted for a non-response rate of 10% was 415. Stratified random sampling with proportional allocation (16) was used to recruit nursing officers representing all the wards

and units. Eligible nursing officers were stratified into five strata based on the similarities of work performed and the type of patient care given, namely medical, surgical, gynaecology and obstetrics, theatre and ICU, and others. For each stratum, a list including all the nursing officers in alphabetical order of their name was used as the sampling frame. Required numbers of nursing officers proportionate to the size of the stratum were selected using random integers generated through the Microsoft Excel command.

A pre-tested, structured, self-administered questionnaire was used for data collection from selected participants. It was developed by the principal investigator after reviewing previous comparable research. The WHO 28 BeSD-Behavioral and Social Drivers of COVID-19 Vaccination Survey Guide assessing COVID-19 vaccine-intention of health care workers was referred to and modified to assess vaccine uptake (17). It included questions on socio-demographic factors, occupation related factors, knowledge regarding COVID-19 vaccine and vaccination related factors. Depending on the answers to ten true/false statements, knowledge score was determined. Based on an operational definition as per the recommended schedule during the study period, the uptake of two primary doses and one booster dose was considered full compliance with COVID-19 vaccines. Self-reported level of demand for uptake of each dose was assessed based on an operational definition. Active demand was self-motivated uptake of vaccine while passive acceptance was to receive the vaccine in a neutral manner neither willingly nor with resistance. In contrast to determined refusal group, delayed or postponed group included those who have not received the vaccine at the time of data collection yet considering the uptake of vaccine in the future. Two retired nursing sisters ensured face validity while three experts in the field of vaccination including a consultant epidemiologist were consulted to improve the content validity of the questionnaire. It was pre-tested among 20 nurses from Base

Hospital Walasmulla, following which necessary adaptations were made.

The selected nurses were identified from duty rosters of relevant wards with the help of immediate administrative authority. They were invited to participate in the study with informed written consent. A maximum of five nurses per shift from a given ward were approached to minimize the disturbance to ward work as well as cross-contamination of data. Repeated visits were required to collect the completed questionnaires from each unit. The questionnaire was designed to maintain anonymity with no information on individual identification such as name, address, or telephone number. Non-duplicating serial numbers were used for participants.

Data analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) Software version 21. An individualized knowledge score was obtained for each participant with the sum of correctly answered items out of ten true/false statements. Equal weight on scoring was offered with one point for each correct answer and zero point for each incorrect or do not know answers. The participants were categorized into two groups (good knowledge and poor knowledge) using the total sample mean as the cut-off mark. Vaccine uptake status was assessed by the time of data collection; one year after the introduction of the COVID vaccines to Sri Lanka. This was interpreted as those who accept the vaccine must have already vaccinated. Vaccine compliance with the demand for each dose and reasons for acceptance or refusal were also summarized with percentages. Associations were determined through Chi-squared test at $p < 0.05$. The strength of association was further described with the OR and 95% confidence interval (CI). These ORs were adjusted for confounders by carrying out a multiple logistic regression analysis.

Results

The study included 378 nurses (response rate 91.1%) with a female predominance (93.9%). The median

age of the study sample was 41 years (IQR=37-48 years). Mean years of work experience was 17.2 years (SD=7.8) and half of the sample was in grade II.

Table 1: Socio-demographic, work related characteristics and vaccination status of the nursing officers in Matara District General Hospital (N=378)

Socio-demographic characteristics	No.	%
Sex		
Male	23	6.1
Female	355	93.9
Age (In completed years)		
21 - 30	5	1.3
31 - 40	182	48.1
41 - 50	112	29.6
51 - 60	78	20.6
> 60 years	1	0.3
Marital status		
Single	44	11.6
Currently married	333	88.1
Divorced/ separated	0	0.0
Widowed	1	0.3
Nursing-related highest educational qualification		
Three years nursing course	294	77.8
Nursing degree	65	17.2
Post graduate diploma	19	5.0
Current grade		
Supra grade	12	3.2
Grade I	146	38.6
Grade II	189	50.0
Grade III	31	8.2
Work experience		
≤ 10 years	75	19.8
> 10 years	303	80.2
Average working hours per a week		
< 50 hours/week	257	68.0
50 - 70 hours/week	98	25.9
> 70 hours/week	23	6.1
COVID-19 vaccination status		
Only the 1 st dose	4	1.1
Only the two doses of the primary series	173	45.8
Initial two doses and the booster	196	51.8
None of the doses	5	1.3

Five participants (1.3%) had not taken any of the COVID -19 doses, while 51.8% (n=196) had taken all three recommended doses (Table 1). Only 28.3% stated that they would accept another booster dose of the COVID-19 vaccine in the future. Self-reported level of demand for each dose of COVID-19 vaccine, from acceptance to refusal with in between vaccine-hesitant levels among study participants is displayed in Figure1. From initial dose to booster dose, the level of demand had been reducing reflecting an increasing trend towards vaccine hesitancy. The knowledge score ranged from 20 to 100 with a mean score of 62.3 (SD=15.9). The proportion of nursing officers with good knowledge was 46.3% (n=175). The most influential reason for vaccine uptake as reported by a majority (87.3%) was to prevent complications of COVID-19 disease. Among those who missed at least one of the recommended doses, the most reported reason for reluctance was the vaccine's inability to protect against new variants of the virus (42.7%) (Table 2).

Higher educational level related to nursing (OR=1.8; 95% CI=1.1, 3.0; p=0.02), upper grades (OR=2.1; 95% CI=1.4, 3.2; p<0.05) and good knowledge regarding the vaccine (OR=2.0; 95% CI=1.3, 3.0; p=0.001) showed a statistically significant positive association with vaccine compliance in bivariate analysis, while the age was negatively associated (OR=0.5; 95% CI=0.4, 0.8; p<0.05). However, when these factors were adjusted for confounders using multiple logistic regression, except for the knowledge regarding COVID -19 vaccine (aOR=1.9; 95% CI=1.2, 2.9; p=0.003), other factors lost their significance (Table 3).

Discussion

A key finding of the study was vaccine uptake status among nursing officers. In the sample, 51.9% were fully compliant with the three-dose COVID-19 vaccine regimen and 98.7% had received at least one dose. The results align closely with national level population coverage data, where 97% of the eligible

population over 12 years had received at least one dose (18). The first study on COVID-19 booster dose compliance, conducted in Israel, found that 60% had received the booster. In comparison, 51.9% of participants in our study had received it (19). However, 18% of participants in our study refused the booster, compared to 8.7% in the Israeli study, reflecting a rising trend in vaccine hesitancy towards booster dose in Sri Lanka. Two studies focusing on COVID-19 vaccine uptake solely among nurses conducted in the USA and Kenya reported 83.3% and 56.1% uptake, respectively (20-21). A cross-sectional survey conducted in a single centre in UK, 58.5% of South Asian healthcare workers had received at least one dose compared to 70% of White healthcare workers (15). An Indian mixed-method study stated 50.7% of nurses were vaccine-hesitant. Its qualitative analysis revealed fear of side effects and doubt about vaccine efficacy as the most frequently reported reasons for hesitancy (12). Most of these studies have focused mainly on compliance with primary series, while this study assessed compliance with all three doses of the COVID-19 vaccine and associated factors. The findings indicate a high initial uptake during the early active vaccine rollout, followed by increased hesitancy.

Remarkable achievements in reaching elimination targets have been made through high coverage of immunization in Sri Lanka (22). This highlights the effectiveness of having satisfactory coverage as well as the importance of adhering to the recommended dosing schedule. This study addresses a gap in evidence regarding how vaccine demand evolved over the multi-dose vaccination process in Sri Lanka. Participants were given the option of selecting reasons that led them to be compliant or not. To fully understand the reasons behind varying vaccine uptake, a qualitative analysis would be beneficial.

Only 46.3% (n=175) of participants were categorized as having good knowledge. This result is consistent with a previous finding of 34% Sri Lankan nurses having a good level of knowledge about Influenza

(25). Our study also found a significant positive association (aOR=1.9) between COVID-19 vaccine compliance and knowledge on COVID-19 vaccine. Baniak et al. has also identified a significant association between knowledge of the vaccine development process and vaccine uptake (20). A study among Kenyan nurses found a 1.79 times positive association between vaccine uptake and subjectively assessed knowledge (21). Unlike self-categorization by participants, our study used ten questions to assess knowledge objectively, enhancing the accuracy of the evaluation. Taken together, these results reveal that there is a place for awareness programs or other interventions to improve health literacy on vaccines to achieve an increase in the COVID-19 vaccine uptake.

Except for age, higher educational qualifications related to nursing, being in a higher grade and other demographic or occupation related factors did not show statistical significance in the bivariate analysis. None of them showed a significance following logistic regression analysis. In a multi-ethnic study conducted in the UK, younger health care workers (≤ 30 years) had an aOR of 0.48 (95% CI=0.4, 0.5; $p < 0.05$) for vaccine uptake (12). Consistent with this, another study among nurses in Kenya also found a negative association between age and COVID-19 vaccine uptake (21). The SIREN cohort study adhered to these findings, showing that health care workers under 35 years had only 0.78 times the likelihood of being vaccinated compared to their older colleagues (23). Although nurses under 41 years in this study were initially less likely to be fully compliant (OR=0.5; 95% CI=0.4, 0.8; $p < 0.05$), this association did not remain significant after adjusting for potential confounders (aOR=0.8; 95% CI=0.5, 1.4; $p = 0.5$).

Among the factors related to the nursing profession, higher educational qualifications and being in a higher grade were positively associated with vaccine compliance in the Chi-squared analysis. However, these associations lost significance after logistic

regression analysis. This finding aligns with the Kenyan study, which also initially found a positive association between higher nursing education and years of experience with vaccine uptake but lost this significance after multivariate analysis (21). Conversely, longitudinal assessments of health care workers in California showed that higher educational attainment was positively associated with vaccination intention and resulted in a significantly higher uptake ($p < 0.05$) in the final assessment (24). In this study, work experience did not show a significant association with vaccine compliance (OR=0.9; 95% CI=0.6, 1.6; $p = 0.82$).

Despite the challenges of the pandemic leading many studies to use non-probability sampling methods like convenience and snowball sampling, this study employed a probability sampling method, specifically stratified sampling, which enhances the validity of its findings. The majority (93.9%) of participants were females and this correlates with a recent Sri Lankan study reporting 92.8% of females, which is consistent with the disproportionate sex distribution in this study (25).

An important constraint that was highlighted by the majority of authors is the use of online questionnaires for data collection with comparatively low response rate. This invariably limits the generalizability of the findings, making the participants only those who have online access with added selection bias. Given the fact this study was carried out at a late stage of the pandemic when the country has adopted a new normalcy with fewer movement restrictions, reaching the participants for paper-based data collection was not a challenging concern.

Based on the WHO BeSD model with its survey and guide applicable to healthcare workers a semi-structured questionnaire was prepared (17). The validity of the questionnaire was confirmed through expert opinion, face validation, and pre-testing. The primary outcome was verified at three different

Table 2: Reasons for uptake or refusal of at least one dose of COVID-19 Vaccine

Reasons	No.	%
For being vaccinated (n=371)		
1. To prevent myself getting complications of COVID-19 disease	330	88.9
2. To prevent myself being quarantined due to COVID-19 contact history	116	31.3
3. Because I have the disease and I realized the impact of the disease	67	18.1
4. Because my family members got the disease and I realized the impact of the disease	43	11.6
5. I am scared to transmit the disease to family members	274	73.8
6. Because I do not like to go to a COVID-19 treatment centre	82	22.1
7. Because I have a family member who is at high risk of getting the severe disease	128	34.5
8. To prevent transmission to others in society from me	280	75.5
9. To contribute to societal responsibility of herd immunity	233	62.8
10. Experienced stigma and discrimination for being a member of a health care team	96	25.9
11. As COVID-19 vaccine was recommended for health care workers by WHO	157	42.3
12. As COVID-19 vaccine was widely accepted by developed countries	104	28.0
13. As Health Ministry offered the vaccine and my working institute advised me to get it	101	27.2
14. I trust the National COVID-19 vaccination program for providing us with safe vaccines	108	29.1
15. I did not have to pay for COVID-19 vaccine	48	12.9
16. I had easy access to vaccination within the institute	120	32.3
17. Because the benefits of getting the COVID-19 vaccine outweigh the associated risks	150	40.4
18. Senior health care professionals have received the vaccine and recommended it	74	19.9
19. Most of my colleagues have taken the COVID-19 vaccine	60	16.2
20. I had to work as a frontline health care worker in COVID-19 disease control activities	196	52.8
For missing vaccination (n=164)		
1. I do not have adequate information on the COVID-19 vaccine	64	39.0
2. Most of the vaccine recipients had experienced side effects	49	29.9
3. I am concerned about the efficacy of the vaccine and protection after receiving	50	30.5
4. Serious unwanted side effects following vaccination were reported in other countries	44	26.8
5. I do not want to wait in a long queue to get the vaccine	10	6.1
6. Because more than one dose is required to develop immunity	19	11.6
7. Because the vaccine was developed via a fast-track approach	25	15.2
8. I do not trust the vaccine manufacturing country	10	6.1
9. The vaccine will not prevent from getting the infection	59	36.0
10. I prefer natural immunity against COVID-19	12	7.3
11. I am concerned about the late effects of vaccination which are yet to be studied	38	23.2
12. I believe the COVID-19 vaccine is being promoted for commercial benefits	27	16.5
13. The vaccination time schedule was not convenient with my duty roster	5	3.0
14. I believe the COVID-19 vaccine is still in the trial phase	38	23.2
15. The vaccine offered is not my choice of the vaccine	8	4.9
16. Not eligible for the vaccine due to hypersensitivity to active substances of the vaccine	7	4.3
17. I do not consider COVID-19 as a severe disease	13	7.9
18. I believe in traditional and other remedies over vaccination for COVID-19	7	4.3
19. Even though I got vaccinated it will not protect me from variants of COVID-19	70	42.7
20. I had concerns on fertility wishes/ breast feeding/ pregnancy/subfertility	9	5.5

points within the questionnaire. To minimize information bias, a high level of anonymity was maintained, and participants were given ample time to complete the self-administered questionnaires despite their busy schedules. However, relying on

self-reported vaccine uptake status, even with cross-checks, poses a limitation. As vaccine hesitancy among health care workers could be an issue of concern, social desirability bias must be acknowledged.

Table 3: Factors associated with vaccine compliance among nursing officers

Variable	Fully compliant (n=196)		Not fully compliant (n=182)		Total No.	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
	No.	(%)	No.	(%)			
Sex							
Male	14	(60.9)	9	(39.1)	23	1.5	NS*
Female**	182	(51.3)	173	(48.7)	355	(0.6, 3.5)	
Age in complete years							
≤ 41 years	96	(45.3)	116	(54.7)	212	0.5	0.8
> 41 years**	100	(60.2)	66	(39.8)	166	(0.4, 0.8)	(0.4, 1.4)
Marital status							
Single/ Widowed	29	(64.4)	16	(35.6)	45	1.8	NS*
Currently married**	167	(50.2)	166	(49.8)	333	(0.9, 3.4)	
Highest education							
Nursing degree or PG diploma	53	(63.1)	31	(36.9)	84	1.8	1.6
Three years nursing course**	143	(48.6)	151	(51.4)	294	(1.1, 3.0)	(0.9, 2.7)
Current grade							
Supra grade and grade I	99	(62.7)	59	(37.3)	158	2.1	1.7
Grade II and grade III**	97	(44.1)	123	(55.9)	220	(1.4, 3.2)	(0.9, 3.1)
Work experience							
≤ 10 years	38	(50.7)	37	(49.3)	75	0.9	NS*
>10 years**	158	(52.1)	145	(47.9)	303	(0.6, 1.6)	
Average working hours							
< 50 hours/week	125	(48.6)	132	(51.4)	257	0.7	NS*
≥ 50 hours/week**	71	(58.7)	50	(41.3)	121	(0.4, 1.0)	
Knowledge on COVID-19 vaccine							
Good knowledge	107	(61.1)	68	(38.9)	175	2.0	1.9
Poor knowledge**	89	(43.8)	114	(56.2)	203	(1.3, 3.0)	(1.2, 2.9) [#]

**Reference level; *Not significant at the bivariate analysis; [#]p=0.015

The study was conducted one year after the introduction of COVID-19 vaccines, and it was interpreted that those who were willing to get vaccinated had already done so. A key limitation is that the study could not account for individuals who

might have chosen to get vaccinated later, including with booster doses. Being a cross-sectional study some of these factors were unavoidable without a longitudinal assessment.

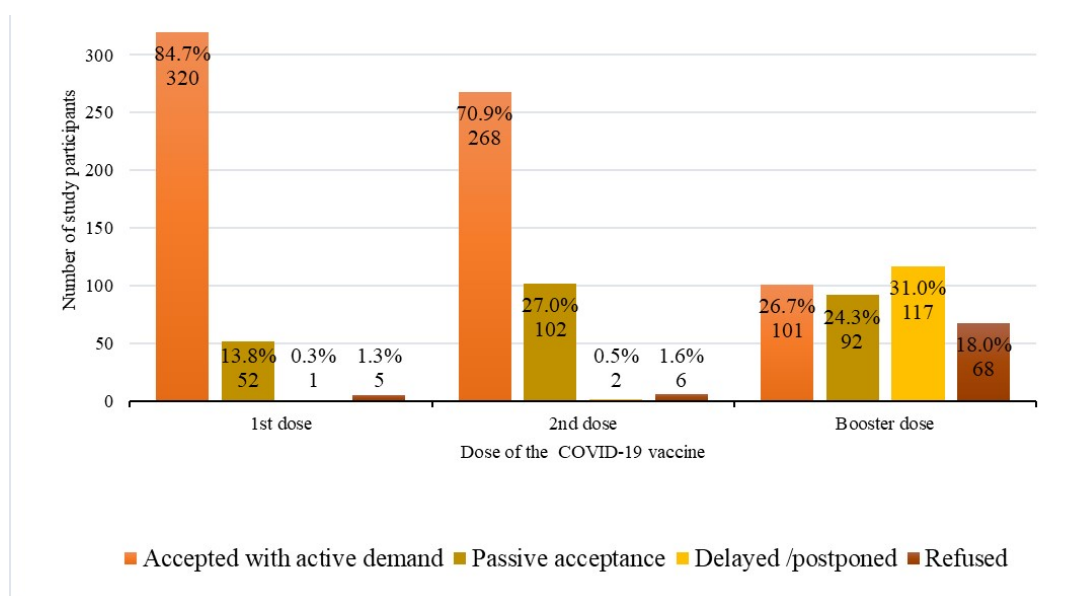


Figure 1: Demand on the COVID-19 vaccine among participants by dose

Conclusions & Recommendations

The current study described COVID-19 vaccine compliance among nurses in Matara DGH with the factors associated. Reflecting vaccine hesitancy observed for the booster dose, only 51.8% of the participants were fully compliant with the three doses. Good knowledge on the COVID-19 vaccine was found to have a significance that doubled the likelihood of being fully compliant. The majority were vaccinated to prevent disease complications while most of the refusals were due to a lack of trust against protection from new variants. There is room for improvement and optimization of COVID-19 vaccine uptake. This is the first study to report the demand for the COVID-19 vaccine among Sri Lankan nursing officers. The aforementioned data-related limitations should be acknowledged, and the findings should be treated with caution in applying them to a different setting. Qualitative studies would be recommended to describe the actual reasons for the differences observed in the uptake of each dose.

Author Declarations

Ethics approval and consent to participate: Ethical clearance was obtained from the Ethics Review Committee of the Postgraduate Institute of Medicine, University of

Colombo (ERC/PGIM/2021/083). Informed written consent was obtained from study participants before data collection.

Competing interests: The authors declare that there are no conflicts of interest.

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Author contributions: LK did the literature search, data collection and performed the statistical analysis, and drafted the manuscript; MS contributed to the methodological development of the study and both authors approved the final manuscript.

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