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Health care organization

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Knowledge, attitudes and practices towards standard precautions among nurses in Southern Tunisia

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ABSTRACT

Introduction. Standard precautions (SP) are the pillar of hospital-associated infections prevention. Nurses as caregivers must be aware and apply those precautions in order to do their work in complete safety.

The purpose of the study. To determine the prevalence and the determinants of good knowledge, positive attitudes and good practices towards SP among nurses in Southern Tunisia.

Materials and methods. This was a cross-sectional study using an anonymous self-administered questionnaire, including a representative sample of nurses working at Hedi Chaker and Habib Bourguiba University Hospitals in Southern Tunisia, from March, 1st to April, 30th, 2022.

Results. The scores' mean values of SP knowledge, attitudes and practices among nurses were 62.5 ± 13.5, 59.6 ± 12.6 and 61.1 ± 13.9 out of 100, respectively. We noted that 55 nurses (42.3%) had good knowledge, 56 participants (43.1%) had positive attitudes and 62 subjects (47.7%) had good practices towards SP. Multivariate analysis showed that good knowledge was independently associated with age > 30 years (adjusted odds ratio (AOR) = 0.2; $p = 0.009$) and continuous training about SP (AOR = 3.1; $p = 0.012$).

Positive attitudes were independently associated with the presence of initial academic training about SP (AOR = 3.02; $p = 0.013$) and continuous training about SP (AOR = 6.6; $p < 0.001$), age > 30 years (AOR = 0.3; $p = 0.034$) and the presence of chronic diseases (AOR = 2.8; $p = 0.027$). Good practices were independently associated with positive attitudes (AOR = 3.42; $p < 0.001$), however they were not associated with good knowledge.

Research limitations. It included the cross-sectional design, through which it was possible to assess only the association between facts, but not to confirm causal relationships and temporality.

Conclusions. A relatively low rates of good knowledge, positive attitudes and good practices regarding SP were observed among nurses in Southern Tunisia. Tunisian policymakers in the health sectors should plan continuous training sessions about SP in order to promote health security in our country.

Keywords*: *knowledge; attitudes; practices; standard precautions; nurses

Compliance with ethical standards. The study does not require submission of the opinion of the biomedical ethics committee or other documents.

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Знания, отношение и практика стандартных мер профилактики у медицинских сестёр в Южном Тунисе

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РЕЗЮМЕ

Введение. Стандартные меры профилактики (СМП) являются основой профилактики внутрибольничных инфекций. Настоящее исследование направлено на обеспечение безопасности путём введения мер профилактики, которые обязаны знать и соблюдать медсёстры, осуществляющие уход за больными.

Цель исследования — определить распространённость и факторы, определяющие наличие надёжных знаний, позитивного отношения и передовой практики соблюдения СМП медсёстрами в Южном Тунисе.

Материалы и методы. Проведено перекрёстное исследование посредством самостоятельного заполнения анонимной анкеты включённых в репрезентативную выборку медсестёр, работавших в университетских больницах Хеди Чакера и Хабиба Бургибы на Юге Туниса с 01.03.2022 по 30.04.2022.

Результаты. Средние значения балльной оценки знаний, отношения и практики СМП среди медсестёр составили 62,5 ± 13,5; 59,6 ± 12,6 и 61,1 ± 13,9 из 100 соответственно. Мы отметили хорошие знания у 55 (42,3%) медсестёр, положительное отношение — у 56 (43,1%), передовой опыт в соблюдении СМП — у 62 (47,7%). Многофакторный анализ показал независимую связь хороших знаний с возрастом > 30 лет (скорректированное отношение шансов (СОШ) = 0,2; p = 0,009) и постоянным обучением СМП (СОШ = 3,1; p = 0,012).
Отмечена независимая связь положительного отношения с наличием начальной академической подготовки по СМП (СОШ = 3,02; p = 0,013) и непрерывного обучения СМП (СОШ = 6,6; p < 0,001), возрастом > 30 лет (СОШ = 0,3; p = 0,034) и наличием хронических заболеваний (СОШ = 2,8; p = 0,027).
Установлена независимая связь передовой практики с позитивным отношением (СОШ = 3,42; p < 0,001), но не с хорошими знаниями.
Ограничения исследования обусловлены перекрёстным типом исследования, позволяющего оценить только связь между фактами, но не подтвердить причинно-следственные связи и временные характеристики.
Заключение. У медсестёр в Южном Тунисе обнаружен довольно низкий уровень хороших знаний, позитивного отношения и передовой практики соблюдения СМП. Тунисским политикам в секторе здравоохранения следует планировать постоянные учебные занятия по СМП, чтобы повысить безопасность здравоохранения в стране.

Ключевые слова: *знания; отношение; практика; стандартные меры профилактики; медицинские сёстры*

Соблюдение этических норм. Исследование не требует предоставления заключения комитета по биомедицинской этике или других документов.

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Introduction

Healthcare-associated infections (HAI) are responsible of an important growth in morbidity and mortality rates and high costs for hospitals worldwide [1]. Across the world, the prevalence of HAI was about 3 to 5% with an estimated number of 470,000 cases per year [2, 3]. In Tunisia, the prevalence of this infection was ranged between 9.1%, 10.9% and 14.5% [4–6]. HAI lead to a prolonged hospital stay and 3,000 to 4,000 deaths/year [3]. Although their gravity, 55 to 70% of HAI are preventable [7]. The prevention remained the effective solution for avoiding HAI and standard precautions (SP) are at the top of the list of this preventive approach. SP were introduced by the Center for disease control and prevention (CDC) in 1988, as 'universal precautions' with the aim of preventing occupational exposure of healthcare professionals to bloodborne viruses [8]. The World Health Organization defines SP as an action meant to reduce the risk of transmission of pathogens from both recognized and unrecognized sources [9]. SP are the basic level of infection control precautions and the first infection prevention strategy which must be used, as a minimum preventive measure, at hospital era. The 7 recommendations included in the SP are essentially appropriate hand hygiene, use of gowns and personal protective equipment, appropriate cleaning and disinfection of equipment and surfaces, needlestick and sharps injury prevention, management of clinical waste, respiratory hygiene (cough etiquette) transport of biological samples, and prevent blood exposure accident by safe injection practices [10]. Despite their justified interest and real contribution at improving quality and security care, SP were poorly known and respected at hospital establishments [11]. They should be applied when tacking care of all patients independently of their infectious risk, in all healthcare settings and regardless of the suspicion or the confirmation of the presence of infection. The SP principe is that any blood product or other biological fluid, secretion and excreta, could contain transmissible infectious agents. Consequently, it could be responsible of HAI. The SP application, cannot succeed only if we have exhaustive information about them. Furthermore, SP practice will raise if healthcare professionals (HCP) had good knowledge and adopted positive attitudes about SP continuously [12]. A previous study evaluated the level of knowledge attitudes and practices among HCP in Cyprus revealed that the majority of HCP had an unsatisfactory level of knowledge, inadequate practice, and negative attitude toward SP at the workplace with a mean scores about 5.73 ± 1.72 (range: 0–8), 2.84 ± 1.68 (0–5) and 2.52 ± 1.76 (range 0–7), respectively [1]. Another similar study in Iran showed that the mean scores assessed those determinants were respectively about 5.30 ± 2.17 (range 0–8), 3.17 ± 1.32 (range 1–5) and 1.53 ± 1.92 (range 0–8) [13]. Moreover, nurses were one of the most concerned HCP category about SP application because of the close contact they had while providing care to their patients. A Moroccan previous study showed that the percentage of sufficient knowledge attitudes and practices towards SP among nurses was nearly about 60 to 80% [12]. In our region, there were a missing data about knowledge, attitudes and practices among nurses towards SP.

In this perspective, studying nurses' knowledge, attitudes and practices towards SP was considered as an important step of their application path. Our study aimed to evaluate knowledge, positive attitudes and practices towards SP among nurses in Sfax, Southern Tunisia and to identify the main independent factors of these determinants.

Methods

Study design and settings. This was a cross-sectional bicentric study conducted during the period from March, 1 to April 30, 2022. It was performed using an anonymous self-administered questionnaire, including a representative sample of nurses working at Hedi Chaker University Hospital (HCUH) and Habib Bourguiba University Hospital (HBUH), in Sfax.

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Study population. All eligible nurses working at HCUH and HBUH who accepted to respond to the questionnaire were enrolled. All nurses who were absent or on leave on the day of the survey were not included in the study. Nurses worked at outpatient consultation and administrative tasks, archives and COVID-19 units were non included given the difficulty of access. Others HCP' categories were also not included in the survey. All participants who did not complete or who refused to take the questionnaire were excluded from the survey.

Sampling

Sample size calculation. In order to obtain a representative sample of the participants we proceeded first by the calculation of the minimum sample size required. It was made according to the following formula:

$$N = \frac{Z \cdot p0 \cdot (1 - p0)}{i^2}$$

N = sample size, Z = 1.96 for a 95% confidence level, i = precision 5%, p0 = 9.8%: this is the prevalence of good knowledge about SP published in a previous similar study. It was a study for M. Askarian et al. about knowledge, attitude, and practices related to standard precautions of surgeons and physicians in university-affiliated hospitals of Shiraz, Iran [14]. $\rightarrow N = (1.96)^2 \cdot p0\,(1 - p0)/i^2 = (1.96)^2 \cdot 0.098\,(1 - 0.098)/0.0025 = 135$. We increased the sample by 10% to take into account non-response so the final number was 148.

Sampling procedure. This selection was done in each hospital to obtain a representative sample of nurses. The participants were selected, using a one-step sampling from an exhaustive and update list of departments in HBUH and in HCUH. A grape selection of some departments from both Hospitals. Finally, all nurses affected in each department selected were invited for the study.

Data collection

Survey instrument. The survey instrument was an 89 self-administered and anonymous questionnaire. The instrument was drawn up from the study of the literature. We conducted a pilot survey on a small sample to test the intelligibility and clarity of the questionnaire. It was written in French and was composed of four major parts. The first one described personal and sociodemographic characteristics of nurses such as age, gender, marital status, department, working seniority and history of chronic or professional diseases. In this part also nurses were asked about previous participation in training session about SP at work.

Knowledge, attitudes and practices were assessed in the 3 other parts of data collection tool. The second part consisted of 24 items to assess knowledge about SP. Such as 'Hand hygiene is the most effective measure to limit the transmission of infectious agents in a healthcare establishment' and 'Can wearing gloves replace hand washing?'. The third part comprised nurses' attitudes, including 12 items to consider their obstacles (7 items) as well as their motivators (5 items) towards SP. Obstacles assessed the reasons about the non-adherence for SP among nurses such as 'I don't have enough time to apply the PS for each patient and before each act' and 'lack of hygiene material'. Motivators were such as 'Technical sheets displayed in the service that must describe the technique of SP to be used in each case' and 'Daily audit carried out by the care director'. The last part, with 37 items, included practices towards SP. Examples: 'Do you practice hand washing between patients?' 'Do you wear gloves if there is a risk of contact with blood or biological fluids?' 'Do you dispose of the used needle in the special sharps container?' and 'Do you recap the used needle after use?'.

Case definitions. We used the CDC definition for SP [15]. They were defined as the minimum infection prevention practices that apply to all patient care, regardless of suspected or confirmed infection status of the patient, in any setting where health care is delivered. These practices are designed to both protect and prevent healthcare professionals from spreading infections among patients. Standard precautions include: hand hygiene, use of personal protective equipment (e.g., gloves, masks, eyewear), respiratory hygiene/cough etiquette, Sharps safety (injury prevention) and waste management, safe injection practices, sterile instruments and devices and cleaning and disinfection.

Data collection procedure. Data collection was carried out from March, 1 to April, 30 2022, in the nurses' meeting room, during their break or after finishing their work by distributing the data sheet to the nurses giving their consent to participate in the survey. Data were collected by a team of two previously well-educated investigators. We made a single visit per service and we questioned all the nurses present on the day of the survey agreeing to answer before. The content and the objective of the questions was firstly explicated to the participants by the investigators. All questions were anonymously responded to guarantee the participant confidentiality.

Scoring method

For knowledge, each correct answer was given 1 point and 0 point for incorrect answers. The higher the points, the more knowledgeable the nurse was. For attitudes, items of obstacles to applicate SP responses were recorded on a 5-point-Likert modality from 1 to 5 (5 = strongly disagree, 4 = disagree, 3 = uncertain, 2 = agree, 1 = strongly agree). For motivators, the response for each item was noted on the same scale but inversely coted (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree). The more the score was high the more nurses' attitude was positive. As for practices, the assessment of the participant's response was composed of 5 behaviors according to the practice frequency from "never" to "always". Answers reflected practice were given 0 to 5 points. while zero was given for "never". For each section, a score was calculated by summing up the answers of each item. Then, these scores were adjusted out of 100 points. Subsequently, according to the median of each score, respondents were categorized according to their scores into having: good (≥ mean value of knowledge score) or bad knowledge, positive (≥ mean value of attitudes score) or negative attitudes and good (≥ mean value of practices score) or bad practices towards SP.

Statistical analysis

Data were analyzed using the SPSS.26 version. Descriptive statistics were carried out to describe the participants. Continuous variables were first plotted, the Kolmogorov–Smirnov test was performed to verify the normal distribution. The results of continuous variables were presented according to the normality of the variable distribution as mean ± standard deviation or median and interquartile range (IQR). Binary and categorical variables were presented as numbers and frequencies within the group.

Univariate logistic regression was performed to compare and to measure the association between two categorical variables in independent samples [crude odds ratio (COR); 95% confidence interval (95% CI), *p*)]. In the case of more than two groups, binary regression was performed. Associated

Table 1. Description of the study population
Таблица 1. Характеристика обследованной группы

Variables | Показатели	Total (*n*, %) | Всего (*n*, %)
Gender: | Пол:	
females | женщины	88 (67.7)
males | мужчины	42 (32.3)
Education level: | Образование:	
secondary school | среднее	54 (41.5)
post-graduated | последипломное	76 (58.4)
Hospital: | Больница:	
Habib Bourguiba University Hospital | Университетская больница Хабиба Бургибы	87 (66.9)
Hedi Chaker University Hospital | Больница Университета Хеди Чакера	43 (33.1)
Occupation department: | Место работы:	
medical | медицинские учреждения	53 (40.8)
surgical | хирургические отделения	47 (36.2)
intensive care units | палаты интенсивной терапии	30 (23.1)
Age groups, years: | Возрастные группы, годы:	
≤ 30	20 (15.4)
> 30	110 (84.6)
Chronic diseases | Хронические заболевания	28 (21.5)
Professional diseases | Профессиональные заболевания	12 (9.2)
Previous training about standard precautions during the last 3 years Предшествующая специализация по стандартам мер профилактики не менее 3 лет	42 (32.3)
Sources of information about Standard precautions: | Источники информации о мерах профилактики:	
academic initial training | начальная академическая подготовка	71 (54.6)
Internet | Интернет	49 (37.7)
post university training | последипломное университетское обучение	14 (10.8)
continuous training | непрерывное обучение	30 (22.5)
others sources | другие источники	4 (3.0)

N o t e. *n* — number; % — percentage.
П р и м е ч а н и е. *n* — число; % — проценты.

factors of good knowledge, attitudes and practices with p value < 0.2 in univariate analysis were entered into three multivariate models using logistic binary regression [adjusted odds ratio (AOR); 95% CI, p] in order to identify the independent factors of good knowledge, positive attitudes and good practices towards SP. Calibration was assessed using the Hosmer–Lemeshow test for goodness of fit, which evaluated expected and observed probabilities in population deciles. The discriminatory power of the prediction model was expressed as the area under the receiver operating characteristic curve. The sensitivity and the specificity of the prediction model were calculated. The p values lower than 0.05 were considered statistically significant.

Results

Overall, 130 subjects responded to the questionnaire out of 148 enrolled nurses, giving a response rate of 87.8%.

Descriptive analysis

Description of the study population. The participants were working in HBUH (87 nurses; 66.9%) and in HCUH (48 nurses (33.1%)). There were 88 (67.7%) females, with a sex-ratio (male/female) of 0.47. The median age was 40 years with IQR = [32.00–48.25] years. Fifty-three nurses (40.8%) worked at medical departments and 39 (30%) participants had more than 20 years of work experience. History of chronic diseases and professional diseases were noted among 28 (21.5%) nurses. We found that 42 subjects (32.3%) had participated in previous training about SP during the last three years (**Table 1**).

Knowledge, attitudes and practices towards Standard precautions. The score's mean value of SP knowledge among nurses was about 62.5 ± 13.5 out of 100. We noted that 55 (42.3%) nurses had good knowledge towards SP. The mean score of attitudes towards SP among nurses was about 59.6 ± 12.6 out of 100. We noted that 56 (43.1%) nurses had positive attitudes towards SP. The mean score of practices towards SP among nurses was about 61.1 ± 13.9 out of 100. We noted that 62 (47.7%) nurses had good practices towards SP.

Analytic analysis

Factors associated with good knowledge, positive attitudes and good practices: Results of Univariate analysis. Univariate analysis showed that good knowledge was statistically associated with age > 30 (odds ratio (OR) = 0.27; p = 0.018). Besides, there is no significant association between good knowledge and gender.As for professional factors, univariate analysis showed that good knowledge was statistically associated with initial academic training about SP (OR = 2.43; p = 0.015) and continuous training

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about SP (OR = 2.7; p = 0.026). Positive attitudes were statistically associated with chronic diseases (OR = 2.94; p = 0.010). There were none other statistically associated factors revealed. Professionally, positive attitudes were statistically associated with initial academic training about SP (OR = 2.43; p = 0.01), continuous training about SP (OR = 4; p = 0.002), and working at intensive care units (OR = 3.16; p = 0.01). There were no significant association between good practices and sociodemographic and personal factors in our study results. Continuous training about SP (OR = 3.12; p = 0.012) and working at intensive care units (OR = 2.9; p = 0.029) were a statistically associated factors with good practices among nurses. Positive attitudes towards SP among nurses were statistically associated with good knowledge and good practices were statistically associated with Good knowledge and positive attitudes towards SP among nurses (**Table 2**).

Factors associated with good knowledge, positive attitudes and good practices: results of multivariate analysis. Multivariate analysis showed that good knowledge was independently associated with age > 30 years (AOR = 0.2; p = 0.009) and continuous training about SP (AOR = 3.1; p = 0.012).

Table 2. Factors associated with good knowledge, positive attitudes and good practices regarding standard precautions among nurses: results of univariate analysis

Таблица 2. Факторы, связанные с хорошими знаниями, положительным отношением и хорошей практикой стандартной профилактики у медицинских сестер: результаты одномерного анализа

Variables Показатели	Good knowledge Хорошие знания			Positive attitudes Положительное отношение			Good practices Хорошая практика		
	n (%)	COR [95% ДИ | CI]	*p*	*n* (%)	COR [95% ДИ | CI]	*p*	*n* (%)	COR [95% ДИ | CI]	*p*
Gender: | Пол:									
males | мужчины	16 (42.1%)	1	0.490	17 (40.5%)	1	0.600	22 (56.4%)	1	0.255
females | женщины	39 (48.8%)	1.3 [0.6–2.8]	–	39 (45.3%)	1.22 [0.57–2.5]	–	40 (45.5%)	0.64 [0.3–1.37]	–
Age groups: | Возрастные группы:									
≤ 30	13 (72.2%)	1	**0.018**	12 (63.2%)	1	0.065	10 (50%)	1	0.908
> 30	42 (42%)	0.27 [0.09–0.8]	–	44 (40.4%)	0.39 [0.14–1.08]	–	52 (48.6%)	0.94 [0.3–2.4]	–
Hospital: | Больница:									
Habib Bourguiba University Hospital Университетская больница Хабиба Бургибы	36 (43.9%)	1	0.200	43 (50%)	1	**0.041**	43 (50.6%)	1	0.570
Hedi Chaker University Hospital Больница Университета Хеди Чакера	19 (52.8%)	1.42 [0.65–3.13]	–	13 (31%)	0.44 [0.2–0.9]	–	19 (45.2%)	0.8 [0.38–1.69]	–
Chronic diseases: Хронические заболевания:									
no | нет	39 (43.3%)	1	0.200	38 (38%)	1	**0.010**	50 (50%)	1	0.608
yes | есть	16 (57.1%)	1.75 [0.74–4.16]	–	18 (64.3%)	2.94 [1.23–7.14]	–	12 (44.4%)	0.77 [0.41–1.46]	–
Professional diseases: Производственные заболевания:									
no | нет	49 (46.2%)	1	0.860	48 (41.4%)	1	0.090	54 (46.6%)	1	0.097
yes | есть	6 (50%)	1.16 [0.35–3.83]	–	8 (66.7%)	2.85 [0.81–10.00]	–	8 (72.7%)	3.12 [0.7–12.5]	–
Educational level: | Образование:									
secondary school | среднее	11 (39.3%)	1	0.370	15 (51.7%)	1	0.325	15 (55.2%)	1	0.436
post-graduated | последипломное	44 (48.9%)	1.47 [0.62–3.5]	–	41 (41.4%)	0.66 [0.28–1.51]	–	46 (46.9%)	0.71 [0.13–1.6]	–
Occupation department: Место работы:									
medical медицинские учреждения	25 (55.6%)	1	0.270	18 (53.3%)	1	**0.047**	22 (43.1%)	1	0.054
surgical хирургические отделения	17 (38.6%)	0.5 [0.39–1.21	0.110	19 (40.4%)	1.24 [0.55–2.82]	0.601	20 (42.6%)	0.9 [0.43–2.17]	0.953
intensive care units палаты интенсивной терапии	13 (44.8%)	0.6 [0.2–1.2]	0.370	19 (63.3%)	3.16 [1.24–8.09]	**0.016**	20 (69%)	2.92 [1.11–7.66]	**0.029**

Continuation of Table 2 on page 287. | Продолжение Таблицы 2 на стр. 287.

End of Table 2. Beginning on page 286. | Окончание Таблицы 2. Начало на стр. 286.

Variables Показатели	Good knowledge Хорошие знания			Positive attitudes Положительное отношение			Good practices Хорошая практика		
	n (%)	COR [95% ДИ | CI]	*p*	*n* (%)	COR [95% ДИ | CI]	*p*	*n* (%)	COR [95% ДИ | CI]	*p*
Time of work: | Время работы:									
day work работа в дневное время	37 (52.9%)	1	0.257	32 (43.2%)	1	0.498	36 (48.6%)	1	0.470
night shift work работа в ночную смену	2 (33.3%)	2.27 [0.4–1.2]	0.369	2 (25%)	0.4 [0.08–2.3]	0.331	5 (71.4%)	2.6 [0.4–14.4]	0.264
both of them | Оба варианта	16 (38.1%)	0.54 [0.2–1.1]	0.132	22 (47.8%)	1.2 [0.5–2.5]	0.624	21 (45.7%)	0.8 [0.4–1.8]	0.749
Previous training about standard precautions during the last 3 years: Предшествующая специализация по стандартам мер профилактики не менее 3 лет:									
no | Не было	36 (46.2%)	1	0.890	35 (40.7%)	1	0.319	41 (47.7%)	1	0.709
yes | Была	19 (47.5%)	1.06 [0.5–2.27]	–	21 (50%)	1.4 [0.68–3.1]	–	21 (51.2%)	0.868 [0.4–1.8]	–
Continuous training about standard precautions: Непрерывное образование по стандартам мер профилактики:									
no | не было	37 (40.7%)	1	**0.026**	35 (35.7%)	1	**0.002**	41 (42.3%)	1	**0.012**
ye | была	17 (65.4%)	2.7 [1.11–7.14]	–	20 (69%)	4 [1.64–9.7]	–	20 (69%)	3.12 [1.2–7.3]	–
Initial academic training about Standard precautions: Начальная академическая подготовка по стандартам профилактики:									
no | не было	19 (32.2%)	1	**0.015**	19 (32.2%)	1	**0.015**	26 (44.8%)	1	0.409
yes | была	37 (53.6%)	2.43 [1.19–5.26]	–	37 (53.6%)	2.43 [1.19–5.26]	–	36 (52.2%)	1.35 [0.66–2.7]	–
Post university training about standard precautions: Последипломная академическая подготовка по стандартам профилактики:									
no | не было	46 (44.7%)	1	0.266	49 (43.4%)	1	0.809	56 (50%)	1	0.467
yes | была	9 (60%)	1.85 [0.61–1.62]	–	7 (46.7%)	1.14 [0.38–3.44]	–	6 (40%)	0.66 [0.22–2]	–
Committee for fight against healthcare associated infections: Комитет по борьбе с больничными инфекциями:									
no | нет	33 (41.3%)	1	0.090	34 (42%)	1	0.595	39 (47.6%)	1	0.702
yes | есть	22 (57.9%)	2 [0.9–4.34]	–	22 (46.8%)	1.21 [0.59–2.5]	–	23 (51.1%)	1.15 [0.5–2.38]	–
Knowledge: | Знания:									
bad | плохие	–	–	–	22 (35.5%)	1	**0.010**	21 (36.2%)	1	**0.026**
good | хорошие	–	–	–	32 (59.3%)	2.64 [1.24–5.6]	–	33 (56.9%)	2.32 [1.1–4.9]	–
Attitudes: | Отношение:									
negative | негативное	22 (35.5%)	1	**0.010**	–	–	–	19 (30.2%)	1	**0.001**
positive | позитивное	32 (59.3%)	2.64 [1.24–5.6]	–	–	–	–	37 (59.7%)	3.4 [1.6–7.18]	–
Practices: | Практика:									
bad | плохая	21 (36.2%)	1	**0.026**	19 (30.2%)	1	**0.001**	–	–	–
good | хорошая	33 (56.9%)	2.32 [1.1–4.9]	–	37 (59.7%)	3.4 [1.6–7.18]	–	–	–	–

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Positive attitudes were independently associated with the presence of initial academic training about SP (AOR = 3.02; $p = 0.013$) and continuous training about SP (AOR = 6.6; $p < 0.001$), age > 30 years (AOR = 0.3; $p = 0.034$) and the presence of chronic diseases (AOR = 2.8; $p = 0.027$). Good practices were independently associated with positive attitudes (AOR = 3.42; $p < 0.001$), however they were not associated with good knowledge. The results of Hosmer–Lemshow chi-square testing for the 3 models of good knowledge, positive attitudes and good practices (($\chi^2 = 0.143$; $p = 0.7$), ($\chi^2 = 1.63$; $p = 0.897$) and ($\chi^2 = 0.001$; $p = 0.99$), respectively) were indicatives of good calibration. The AUROC of the predictive logistic regression models were 0.67 ($p = 0.001$), 0.67 ($p < 0.001$); and 0.35 ($p = 0.003$), respectively) indicating good predictive power in discriminating, with a sensitivity and specificity of (0.55; 0.79), (0.60; 0.651) and (0.3; 0.5), respectively.

Discussion

The majority of our study population were women. This seemed consistent with the results in the public establishments of Saudi Arabia and of Cyprus but different from other similar previous study in Saudi Arabia and this could be explained by the natural demographic differences between participants between populations. This study showed that the median age was equal to 40 years. This result was different from two other studies in a recent published study from Cyprus where the average age was about 32 years [13] and it was about 25 years in Iran [16]. This fact which could be explained by recruitment at advanced age in public service in our country. According to work department, there were 53 (40.8%) worked at medical departments and 36% worked in surgical units. By comparing these results by a previous similar study we found that 44.4% of participants practiced in surgical disciplines and 16.7% in medical disciplines [12]. The important frequency of medical nurses responding to our questionnaire could be explained by the relatively more availability of HCP in these departments compared to nurses in surgical units. In fact, care activity was always greater in surgical department and HCP were sometimes overloaded. We found that 32.3% of participants had participated in previous training about SP during the last three years. This percentage was more than a similar study conducted in Maroc [12]. This difference come probably from the lack of experience of the compared study. In fact, professional caregivers practicing in Maroc establishment, characterized by a young and newly recruited HCP (79.7% < 30 years old). On the other hand, our study population had a relatively more professional experience (39 participants (30%) had > 20 years of work experience and 84.6% were aged more than 30 years old). Consequently, they had more chance to had training session at work. The rate of good knowledge in our study was about 42.3%. It was relatively poor than other findings from Saudi Arabia (73.6%) [17], Iran 66.3% [18] and Cyprus 57.5% [13]. These discrepancies between good knowledge frequencies among nurses from different countries, could be explained by the differences in sample size, sampling methods, and compositions of the study populations between the studies. For attitudes we found that less than the half of participants had a positive attitude towards SP. Our results were higher than those reported by another study in Cyprus (37.7%) [13] and more less than others data from China (93.2%) [19] and from Pakistan 80% [20]. The reason for low agreement of Tunisian nurses may be related to the un-pragmatic approach to policymaking of health authorities and irregular assessment of the guidelines by HCP about the necessity of the application of SP at hospital. Good practices towards SP among nurses was nearly about the half of participants. This frequency was about 20% in previous similar Iranian study [14] and about 65% in Jordan [21]. This fact could be explained by the lack of necessary equipment for applicate SP in our hospitals [1]. It could be also related to the insufficient knowledge and to the inadequate attitudes of nurses towards SP because of the lack of continuous training sessions. Our study was conducted in two largest university hospitals in southern Tunisia witch received an important number of patients from all the south of the country, so the heavy workload that HCP had, could also explain their non-compliance with the SP. Good practices could also be affected by the variances in perceiving the risk of infection transmission and the differences of physicians' personality.

Age > 30 years was an independent factor of good knowledge and positive attitude towards SP among nurses. In fact, our study showed that nurses with more than 30 years were more likely to had bad knowledge and negative attitude. This could be related to the motivation of young nurses as recently recruited and still remember the notions of academic training recently acquired. The years of experience and traditions may be a factor in favor with resistance to change behaviors, attitudes and practices. In this sense, a Chinese study reported that SP good knowledge was statistically associated with younguest HCP [22]. The presence of chronic diseases among nurses was independently associated with positive attitude towards SP. This result was in line with a previous study conducted in Bangladesh which demonstrated that increasing age, and having non-communicable diseases were an independent factors of good compliance with SP [23]. This could be allied to the willingness of HCP to protect themselves at work. Indeed, chronic diseases were universally known as factors of immune fragility and of defense-capacity decrease against infections. As an evident result, those at risk nurses, would adopt and respected these preventive precautions as much as possible [23, 24].

Initial academic training about SP was independently associated with positive attitude towards SP. This finding was supported by other studies in Morocco and a large scale audit about 4500 HCP in France [12, 25]. This audit demonstrated the contribution of initial training on HCP knowledge about SP. An interesting finding in this study was that continuous training about SP was independently associated with good knowledge and positive attitude towards SP among nurses. This fact was in line with several previous data concluded that providing periodic training sessions on safety and precautionary practice, significantly affect the level of knowledge of HCP and nurses particularly [13, 26–28]. This could be explained by the efficacy of the training sessions to keep nurses regularly aware and to make them more knowledgeable about the benefits and the necessity of SP as preventive barrier to protect them as well as their patients. Our study showed no association between good practices and good knowledge. This result was similar to another study [14]. This fact may be related to the resistance of nurses to change habits at work despite of their knowledge about SP. Moreover, the lack of control and supervision of the nurses and all HCP while working about the application of SP could be another explication. However, some other data reported a statistically association between the two indicators [29]. It was not surprising to find that good practices were independently associated with positive attitudes. In fact, this relation was reported also by literature [1, 14, 29]. As a whole, it could be an evidence that better attitude towards SP could positively affect practice and behaviors [30].

To the best of our knowledge, this original study was the first one enlightening the levels and the determinants of knowledge, attitudes and practices towards SP among HCP in southern Tunisia. Because it was carried out on a representative sample, this survey would be a useful tool to estimate afterwards the SP knowledge attitudes and practices among all nurses at our region. Additionally, knowledge attitudes and practices assessment was done with a study tool that was prepared based on a large review of literature from published similar previous studies. Moreover, the detailed and clear methodology of our work gave an added value because it provided clarity and reproducibility to our study. Besides, there were some limitations. Specifically, it included the cross-sectional design, through which it was possible to assess only the association between facts, but not to confirm causal relationships and temporality. Furthermore, regardless of the considerable number of the participants and the sample representability, a single-city and reduced-time study form could bias the representability of our findings to other populations.

Conclusions

A relatively low rates of good knowledge, positive attitudes and good practices towards SP were observed among nurses in Southern Tunisia. The main determinants of these indicators were potentially related to professional factors. Therefore, the Tunisian government and policymakers in the health sectors should plan continuous training sessions to rise nurses' awareness about those preventive measures necessity at hospitals, their effectiveness and benefits in order to promote health security in our country.

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