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Clinical Effectiveness of Nursing Care Delivery Models for Patients Following Hip Elective Surgery: Comparative Study

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ABSTRACT

Background and Objective: A shortage of health workers significantly impacts nurse staffing, nursing care and patients' clinical outcomes. The study aimed to compare two clinical nursing care delivery models by investigating patients' perceptions of nurse caring behaviors and patient satisfaction. **Materials and Methods:** Clinical data of patients admitted for elective hip surgery in the orthopedics trauma and microsurgery department between January and September, 2019 and 2022 were prospectively collected and retrospectively analyzed. The sample was composed of 64 and 49 patients for the pre and peri-pandemic periods, respectively. In each period, patients were randomized into primary nursing care (PNC) and team nursing care (TNC) groups. Various tools were used including Caring Behaviors Inventory-24 (CBI-24) and patient satisfaction index (PSI) for data collection. All patients were followed up for three months. **Results:** Before the pandemic, the overall mean score on CBI-24 patients was 4.97 and 4.84 for PNC and TNC, respectively. Their corresponding values PSI scores were 4.29 and 4.30, respectively. During the peri-pandemic period, PNC patients recorded 4.71 and 4.23, on CBI-24 patients and PSI, respectively and TNC patients recorded 4.96 and 4.05 on CBI-24 and PSI, respectively. Findings suggested significant correlation between CBI-24 and PSI within each group and at a specific study period. Better satisfaction is associated with the quality of caring behaviors and technical caring behaviors for patients in the PNC and TNC groups, respectively. **Conclusion:** However, in consideration of patients' diverse expectations and perceptions of care, nurse managers are called to take into consideration different factors (nurse, patient and institution-related factors) provide satisfied and high-quality care.

KEYWORDS

Clinical nursing care delivery model, hip elective surgery, patient satisfaction, caring behavior inventory, quality of care, COVID-19

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INTRODUCTION

The nursing staff is an integral part of the healthcare workforce and constitutes its largest portion, worldwide. Nursing care is well recognized for its holistic approach in shaping patient safety culture and stressing its safe and quality values[1]. At the core of the profession, care remains the key component stressing the difference between nursing and other health-related professions[2,3]. The global phenomenon of health worker shortage impacts seriously the delivery of health care quality[4]. Accessibility, acceptability, quality and cost-effectiveness of health care with staffing of nurses based on population needs summarize the core component and values of the health care vision advocated by the World Health Organization (WHO)[5].

Registered nurses (RNs) (accounting for much more than half of the nursing workforce), licensed practical nurses (LPNs)/nursing associates and unregistered nursing carers comprise the entire professional nursing workforce[6,7]. Although RNs and LPNs are both well self-regulated, they indeed differ in their level of education, competencies and subsequently in their scopes of practice[8]. According to different organizational structures and years of experience, the professional titles/positions of nursing staff range from primary nurse to head nurse[9,10]. Furthermore, based on their clinical specialities, licensed clinical nurses can be subsequently grouped into different types such as RNs, RNs with a subsequent license (for example midwifery license), certified nurses (CNs) and certified nurse specialists (CNSs, for instance, orthopaedic RNs or oncology RNs).

The shortage of healthcare workers is a reality shared across many countries, despite the robustness of their healthcare systems. The nursing profession is usually quite demanding on staff's physical and psychological level[11]. This reality has been further exacerbated worldwide by the tremendous burden of the COVID-19 pandemic on the healthcare system. Reports from the World Health Organization (WHO) estimate that, by 2030, there will be a net shortage of 15 million physicians, nursing staff and other health workers, of which nursing staff shortfall will account for 5.7 million worldwide[12,13].

Adequate nurse staffing is essential to provide safe and qualified nurse care, especially if patients receive care without failure[1]. To secure a sufficient number of nurses in hospitals and subsequently to maintain a high quality of delivered nursing care, several nations have put in place policies, which are still challenging to meet due to various reasons[1]. Several countries have put in practice, through legislation, a mandatory minimum nurse-to-patient (NTP) ratio to provide sufficient quality care in order to improve patient's quality of health care[14,15]. This means nurses should not attend to more patients than the fixed NTP ratio.

In 2012, the Chinese National Health Committee through the Guidelines on the Management of Staffing Hospital Nursing Workforce 2012, strongly recommended that NTP in the general ward, Intensive Care Unit (ICU) and Neonatal Intensive Care Unit (NICU) should not exceed 1:8.0, 1:2.5-3.0 and 1:1.5-1.8.0, respectively[16]. According to the National Nursing Development Plan (2016-2020), the overall average NPT ratio at Chinese large hospitals improved from 1:11.2 to 1:10.4 between 2014 and 2016[16]. In a large observatory study conducted by Shen and colleagues, the average NTP ratio was found to be 1:8.0 and 1:23.0 respectively during the day/shift and during the night in general wards[17]. In ICU and surgery departments, the average NTP ratio was 1:2.0 (during the day/shift) and 1:2.9 (during the night) and 1:7-8 (during the day/shift) and 1:18-25 (during the night), respectively[17].

During the Coronavirus Disease (COVID-19) pandemic, the entire healthcare system around the world was suddenly under so much stress, struggling to cope with an increasing number of patients, leading to an increase in nurses' workloads and physical and mental exhaustion from the frontlines. Thus, a tremendous necessity of nurses was urgently needed, sometimes even relocating nurses from general wards to ICUs,

thereby reducing the nurse staffing level in general wards[18]. In the nursing literature, traditionally four types of nursing care delivery models (NCDM) are identified and used to organize and provide patients' care, mainly in hospital settings[19]. They are total patient care (TPC), functional nursing care (FNC), team nursing care (TNC) and primary nursing care (PNC). In order to accommodate the changing roles of nurses and different levels of nursing skill mix and to cope with the shortage of nursing workforce[20], contemporary care delivery models such as patient allocation (PA), partnership nursing systems® (PNS®), fixed-team nursing model and shared-care nursing model have been gaining popularity worldwide[20,21].

Taking into consideration diverse complex factors such as the health care system, nurse staff and patients' demands, nursing managers have a challenging responsibility to choose a model or a combination of models to provide and sustain highly reliable, cost-saving and safe quality patient care. Moreover, the choice of the NCDM should contribute to leading the healthcare institution into excellence and enhance patient and family satisfaction[8]. This study aimed to assess the clinical effectiveness of delivering nursing patient care in an orthopaedic surgical ward, of a primary nursing care model compared with a team nursing care model, before and during the COVID-19 pandemic.

MATERIALS AND METHODS

Study design and setting: The study used a retrospective qualitative comparative design and was conducted in the orthopaedics trauma and microsurgery department of a 3000-bed Chinese tertiary referral teaching hospital. The current study was approved by the local ethics and review board (20180145).

Definition of the study period: The current study was carried out in two distinct periods (pre and peri-pandemic period) several months apart as a transition and stable period from various waves of COVID-19. By the end of 2018, the department's nursing leadership staff brought into action to conduct a study on nursing care delivery models. However, the outbreak of COVID-19 within our city quickly spread across countries and was declared a worldwide pandemic on March 11, 2020, by the WHO[22]. In order to significantly avoid or minimize the evident impact of COVID-19 as a confounding factor, January to September, 2019 and January to September, 2022 (matched time) were, respectively set as pre and peri-pandemic periods.

Study population: All cases that underwent elective hip surgery in the Department of Orthopedics Trauma and Microsurgery of Zhongnan Hospital of Wuhan University between January and September, 2019 (pre-pandemic period) and from January to September, 2022 (peri-pandemic matched-period) were prospectively collected and retrospectively reviewed and assessed. In an attempt for robust analysis, patients with complete medical records were only included that contain surgery records (patient demographic data, type of surgery, comorbidities, etc.), nursing care data (nursing care delivery model, patient satisfaction index (PSI) and caring behaviours inventory-24 patient (CBI-24 patient)) and preoperative, postoperative and follow-up scoring (numeric rating score for pain (NRS pain), haris hip score (HHS) and Hospital Anxiety and Depression Scale (HADS)). Inclusion criteria included the following: (i) Scheduled for elective hip surgery, (ii) 18 years or older of age, (iii) First admission during the study period and (iv) Patient and/or their primary family caregiver agreed to participate by giving informed consent. The exclusion criteria included: (i) Pregnancy, (ii) Scheduled for hip surgery due to traumatic or urgent condition, (iii) Patients using antidepressants or being treated by a psychologist for relevant diagnosed symptoms or (iv) Patient in any ongoing clinical trial. The patients in the PNC group and the TNC group were randomly assigned. The randomization was done by alternating assignment method.

Variables and measurement: Patients were measured preoperatively on the day of hospital admission (while on the waiting list), one week after hospital discharge and one and three months following hip surgery. However, HHS and HADS were filled at three-assessment time points (pre-surgery, one and three months post-surgery). The NRS pain was used at all assessment points. The CBI-24 patient and PSI were assessed at one and three months post-surgery fixed team of two nurse's assistants was specifically assigned to administer the instrument during each follow-up visit. The preoperative and three months post-surgery collected data were used in the final analysis.

Nursing care models related outcomes

Patients self-evaluated nurse caring behaviours: Developed by Wolf *et al*.[23], revised by Wu *et al*.[24] and translated, evaluated and validated by He *et al*.[25] and Shen *et al*.[26], the Chinese version of CBI-24 (CBI-24-C) was used to assess the quality of nursing caring behaviours perceived by patients. The instrument consists of 24 items, grouped in four subscales covering, (i) Assurance of human presence, (ii) Professional knowledge and skill, (iii) Patient respectfulness and (iv) Positive connectedness[24,26]. All items were scored on a 6-point Likert-type rating scale from 1 (never) to 6 (always). Higher the score highly present the caring behaviours in the nurse-patient relationship and vice versa. The Chinese version of CBI-24 has been reported to have adequate internal consistency reliability ranging from 0.96 to 0.98[10,25,26]. The current study had a Cronbach's α value of 0.96.

Patients satisfaction index: Patient satisfaction instrument (PSI) was used to assess patient satisfaction with nursing care according to the technical professionalism, the interpersonal-education and the trusting relationship of nurses regarding their profession and towards the patients[27]. The instrument is composed of 25 items and each item is scored on a five-point Likert scale ranging from one (strongly disagree) to five (strongly agree). The mean score of all 25 items was computed and defined as a total score range of one to five. The higher the score, the greater the patient satisfaction with nursing care. Moreover, the computed score of each subscale is determined by the mean score of the associated items.

Patients health-reported outcomes

Harris hip score: Hip function was evaluated using the harris hip score (HHS) for each patient on the day of hospital admission and during each follow-up visit. The HHS enables variables such as the range of motion of the joint, deformity, function and pain using a total score ranging from 0 to 100[28]. The higher the score better is the hip function (excellent ≥90, good 80-89, satisfactory 70-79 and poor <70).

Hospital anxiety and depression scale: The HADS is a self-screening instrument, composed of 14 items incorporating anxiety and depression subscales. Designed and developed by Zigmond and Snaith[29], the screening tool has been translated and validated in several languages, including Chinese[30] and it is widely used to assess anxiety and depression status in medical patients across various specialties[31-36]. Each item is scored on a 4-point response scale ranging from 0 (absence of symptoms) to 3 (representing highest symptomatology). Each subscale score could range from 0 to 21 and the higher the score higher is the level of the disorder. A score of 0-7 is "normal", 8-10 "mild", 11-14 "moderate" and 15-21 "severe". The instrument takes 2 to 5 min to complete.

Numeric rating scale for pain and hospital length of stay: The numeric rating scale for pain (NRS for pain) to quantity pain intensity was used to assess its interference with quality of life. The instrument is a segmented numeric tool functionally similar to the visual analogue scale (VAS) by which individual patients can easily identify the intensity of their pain by choosing a number from 0 to 10[37]. It is an 11-point numeric scale with scores ranging from 0 (no pain) to 10 (worst pain). The higher the score, significant is the pain intensity and subsequent impact on quality of life.

A hospital length of stay (LOS) was recorded, the mean was assessed in each group and the values were compared between the two groups.

Follow-up and post-operative complications: For the current study, a follow-up period of three months after surgery was set. Patients were highly recommended to come to the outpatient or/and rehabilitation unit for follow-up visits. Follow-up time-points were scheduled at one week after hospital discharge, 1 and 3 month after surgery. During each follow-up visit, postoperative outcomes were assessed and then recorded them. The occurrence of major complications during nursing care and the follow-up period was recorded and compared among the two groups and according to the pre-and peri-pandemic period.

Statistical endpoints: The primary endpoints were the nurse caring behaviour and patient satisfaction scores between both groups. The secondary endpoints were mean scores of HHS, HADS, NRS pain, hospital length of stay and complication rates between the two groups.

Statistical analysis: The SPSS version 24 (IBM, New York, USA) was used to conduct statistical analysis. Categorical variables were compared and the odds ratio was calculated using the Mann-Whitney U Test or Person's chi-squared analysis where appropriate. Student's t-test or analysis of variance test (followed by *post hoc* Test if necessary) was used to compare continuous variables for two groups (before or/and during the pandemic). The level of significance was set at a $p<0.05$.

Ethical consideration: The study was reviewed and approved by the local ethics committee board. The patients and/or their primary family caregivers were informed of the voluntary nature of their participation and the confidentiality of their responses as they provided their written informed consent.

RESULTS

Patient demographic and clinical baseline characteristics: As shown in Table 1, a total of 64 patients (30 males and 34 females) and 49 patients (21 males and 28 females) completed the study, respectively for the period before and during the pandemic. During the pre-covid period, the mean age of the patients years, 57.93±5.5 and 73.25±6.3 years (<65 vs ≥65) and 53.94±8.0 and 72.0±6.4 years (<65 vs ≥65), in PNC group and TNC group, respectively. In the peri-covid period, the corresponding mean age of the patients within the different age groups and between both nursing groups was slightly lower than during the pre-pandemic period. Before the pandemic, osteoarthritis (diagnosis), total hip arthroplasty (type of surgery) and primary surgery accounted, respectively 50, 78.12 and 81.25% of all cases provided in PNC. Their corresponding percentages were 50, 62.5 and 93.73% in the TNC group.

During the pandemic, diagnosis of osteoarthritis (OA), total hip arthroplasty (THA) and primary surgery accounted, respectively for 56, 72 and 72% in the PNC group, compared to their corresponding percentages of 62.5, 79.16 and 87.5% in the TNC group. Although there was no statistically significant difference in age, gender, diagnosis, surgery type and rank, between the two groups during each study period, significant differences were noted in age group, surgery type and rank of each group during both study periods ($p<0.05$, Table 1).

Comparison of caring behaviour inventory between the two groups and study periods: The total mean score for the CBI-24 was 4.97±0.7 and 4.84±0.7 in PNC and TNC, respectively before the pandemic. During the pandemic, the corresponding CBI-24 values were 4.77±0.5 and 4.96±0.5 in PNC and TNC, respectively (Table 2). Before the pandemic, patients in the PNC group rated the quality of caring behaviour (positive connectedness) higher than other subscales, while technical caring behaviours (professional knowledge and skills) received the highest mean score by patients of the TNC group (5.34±0.8 and 5.30±0.7, respectively). During the pandemic, the patient respectfulness subscale received the highest mean score (5.24±0.5) for patients in the PNC group, while patients in the TNC group still rated the professional knowledge and skills subscale (5.30±0.5) with the highest score.

Table 1: Patients' demographic and clinical characteristics

	Primary nursing care		Team nursing care		
Variable	Data	p-value	Data	p-value	p-value
Before COVID-19	N = 32		N = 32		
Age (years), X̄±SD					
<65	57.93±5.5	**<0.001***	53.94±8.0	**<0.001***	0.097*
≥65	73.25±6.3		72.0± 6.4		0.596*
Gender (n)					
Male/female	13/19	0.295♂	17/15	0.726♂	0.316‡
BMI (kg m^{-2}), X̄±SD	24.42±1.7	**<0.001***	24.75±1.9	**<0.001***	0.475*
Diagnosis (n)					
OA	16		16		0.760‡
ON	10		7		
FAI	3		5		
LT	3		4		
ASA status (n)					
I	15		15		0.721‡
II	12		14		
III	5		3		
CCI status (n (%))					
0	2 (6.25)		6 (18.75)		0.371‡
1	6 (18.75)		6 (18.75)		
2	10 (31.25)		11 (34.37)		
≥3	14 (43.75)		9 (28.13)		
Surgery (n)					
THA/SCOPE	25/7	**0.005***	20/12	0.170♂	0.171‡
Surgery side (n)					
Right/left	13/19	0.295♂	16/16	1.000♂	0.451‡
Type of surgery (n)					
Primary (n)	26	**0.002***	30	**<0.001***	
Revision (n)	6		2		0.130‡
During the COVID-19	N = 25		N = 24		
Age (years), X̄±SD					
<65	55.6±7.2	**<0.001***	51.0±11.0	**<0.001***	0.228*
≥65	72.3±7.1		71.6± 4.3		0.784*
Gender (n)					
Male/female	10/15	0.326♂	11/13	0.681♂	0.320‡
BMI (kg m^{-2}), X̄±SD	24.45±3.0	**0.019***	24.00±2.6	**0.066***	0.582*
Diagnosis (n)					
OA	14		15		0.877‡
ON	4		4		
FAI	3		3		
LT	4		2		
ASA status (n)					
I	7		6		0.499‡
II	12		15		
III	6		3		
CCI status (n (%))					
0	-		-		0.501‡
1	6 (24.00%)		5 (20.83%)		
2	3 (12.00%)		6 (25.00%)		
≥3	16 (64.00%)		13 (54.17%)		
Surgery (n)					
THA/SCOPE	18/7	**0.044***	19/5	**0.013***	0.560‡
Surgery side (n)					
Right/left	10/15	0.327♂	13/11	0.684♂	0.320‡
Type of surgery (n)					
Primary/revision	18/7	**0.002***	21/3	**<0.001***	0.178‡

X̄: Mean, SD: Standard deviation, BMI: Body mass index, N: Number of patients, OA: Osteoarthritis, ON: Osteonecrosis, FAI: Femoroacetabular impingement, LT: Labral tear, THA: Total hip arthroplasty, SCOPE: Hip arthroscopy, ASA: American Society of Anesthesiologists, CCI: Charlson comorbidity index. *Student's t-test, ‡Pearson's c^2-test, ♂Z Score test. A p-value (two-sided) of less than 0.05 was considered significant and bold indicates all p-values with statistical differences

Table 2: Comparison of patient self-evaluated CBI-24 scores and PSI scores between groups

	Before COVID-19			During COVID-19			p-value	
Variables	PNC (n = 32) $\bar{X}$±SD	p-value	TNC (n = 32) $\bar{X}$±SD	PNC (n = 25) $\bar{X}$±SD	p-value	TNC (n = 24) $\bar{X}$±SD	Between PNC groups	Between TNC groups
CBI-24 subscales								
Professional knowledge and skills	4.34±0.9	**<0.001**	5.30±0.7	4.60±0.9	**0.002**	5.30±0.5	0.308	0.954
Assurance of human presence	5.16±1.0	0.879	5.10±0.6	4.48± 0.8	**0.003**	5.25±0.6	**0.008**	0.450
Patient respectfulness	5.03±0.8	0.888	5.00±1.0	5.24±0.5	0.243	4.88±0.7	0.233	0.589
Positive connectedness	5.34±0.8	**<0.001**	3.90±0.9	4.76±0.7	**<0.001**	4.38±1.0	**0.003**	0.074
Total score of CBI-24	4.97±0.7	0.291	4.84±0.7	4.77±0.5	0.178	4.96±0.5	0.126	0.374
PSI subscales								
Patient education	3.97±0.6	**<0.001**	4.70±0.5	4.28±0.7	0.549	4.17±0.6	0.085	**0.001**
Trust	4.72±0.5	**<0.001**	3.80±0.7	4.64±0.5	**<0.001**	3.96±0.7	0.537	0.558
Technical professional	4.19±0.7	0.288	4.40±0.7	3.76±0.9	0.201	4.04±0.6	0.052	0.067
Total score of PSI	4.29±0.3	0.178	4.30±0.7	4.23±0.4	0.134	4.05±0.4	0.506	**0.024**

PNC: Primary nursing care, TNC: Team nursing care, CBI-24: Caring behaviors inventory-24, PSI: Patient satisfaction index, $\bar{X}$: Mean, SD: Standard deviation. Student's t-test was adopted to conducted univariate analysis. A p-value (two-sided) of less than 0.05 was considered significant and bold indicates all p values with statistical differences

Statistical analysis showed that before the pandemic, there were significant differences between both groups in professional knowledge and skills and positive connectedness subscales ($p<0.001$). During the pandemic, there were significances between both groups in all subscales, except in patient respectfulness (Table 2). In terms of comparative period (pre and peri-pandemic), there were significant differences in assurance of human presence and positive connectedness subscales between PNC groups ($p<0.01$, Table 2). There was no statistically significant difference observed between TNC groups in all four subscales ($p>0.05$, Table 2).

Comparison of patient satisfactory index between the two groups and study periods: Before the pandemic, the total mean score for PSI was 4.29±0.3 and 4.30±0.7 in the PNC group and TNC group, respectively (Table 2). During the pandemic, patients who attended PNC and TNC recorded a PSI total mean score of 4.23±0.4 and 4.05±0.4, respectively (Table 2). Whether before or during the pandemic, the subscale with the highest score was trust (4.72±0.5 vs 4.64±0.5) for patients who attended PNC and patient education (4.70±0.5 vs 4.17±0.6) for patients who were cared for through TNC (Table 2).

Before the pandemic, the patient education subscale was highly scored by patients in the TNC group than by those in the PNC group (4.70±0.5 vs 3.97±0.6) and the difference was statistically significant ($p<0.001$) (Table 2). The score for the trust subscale was higher in the PNC group than that of the TNC group (4.72±0.5 vs 3.80±0.7) and the difference was statistically significant ($p<0.001$) (Table 2). During the pandemic, the only subscale with a significant difference between the two groups was trust as the PNC group recorded a higher score than the TNC group (4.64±0.5 vs 3.96±0.7, $p<0.001$) (Table 2).

In terms of comparative analysis period (pre and peri-pandemic), there were significant differences in the patient education subscale between TNC groups ($p<0.05$, Table 2) and no statistically significant difference was found in all three subscales between the PNC groups ($p>0.05$, Table 2).

Correlation between caring behaviour and patient satisfactory: In order to assess the correlation between the perception of nurse caring behaviours by the patients and the patient satisfaction index, a Spearman rank correlation test was performed. Findings revealed that a significant correlation was observed in PNC (rho = 0.366, $p<0.05$) and TNC (rho = 0.582, $p<0.01$) groups, before and during the pandemic, respectively (Table 3).

Table 3: Correlation between caring behaviours inventory and patient satisfaction index

Period	Groups	Factor	N	$\bar{X}$±SD	Spearman's rho	p-value	Interpretation
Before COVID-19	PNC	CBI-24	32	4.97±0.5	0.366	**0.039***	Significant
		PSI	32	4.29±0.4			
	TNC	CBI-24	32	4.84±0.5	0.222	0.222	Insignificant
		PSI	32	4.30±0.4			
During COVID-19	PNC	CBI-24	25	4.77±0.5	0.360	0.076	Insignificant
		PSI	25	4.23±0.4			
	TNC	CBI-24	24	4.96±0.5	0.582	**0.002****	Significant
		PSI	24	4.06±0.4			

PNC: Primary nursing care, TNC: Team nursing care, CBI-24: Caring behaviors inventory-24, PSI: Patient satisfaction index, N: Number of cases, $\bar{X}$: Mean, SD: Standard deviation, Spearman's rho: Spearman rank correlation. Correlation between the mean is considered statistically significant at p-value (two-sided) of less than 0.05, *p<0.05 and **p<0.01

Variables associated with patient self-evaluating caring behaviour inventory: In order to assess the influence of various variables on the patient self-evaluated nurse caring behaviour inventory, a variable subset analysis was performed and findings were displayed in Table 4. Before the pandemic, there was no significant correlation between the total mean score for CBI-24 and any variables whether within each group or between the two groups.

However, during the pandemic, the total mean score for CBI-24 was significantly associated with several variables within and between groups. Within the PNC group, the total mean score for CBI-24 was significantly correlated with age (p = 0.012), ASA status (p = 0.004), CCI status (p = 0.011) and comorbidities (p = 0.001) (Table 4). Furthermore, *post hoc* analysis showed that it was a significant difference between ASA I and ASA II (p<0.01), CCI 1 and CCI ≥3 (p<0.01) and between those with no comorbidities and those with COPD (p<0.05), diabetes (p<0.01) and hypertension (p<0.05), respectively (Table 4).

Regarding the TNC group, the total mean score for CBI-24 was significantly associated with age (p<0.001), CCI status (p = 0.001), diagnosis (p = 0.016) and type of surgery (p<0.001) (Table 4). The *post hoc* analysis revealed that the significant difference was between CCI 1 and CCI 2 (p<0.01) and CCI ≥3 (p<0.01) and between OA and FAI (p<0.05) (Table 4).

Moreover, during the pandemic, between both groups, the total mean score for CBI-24 was only found significantly associated with the female gender (p = 0.022), ASA I (p<0.001) and no comorbidities (p<0.001).

Variables associated with patient satisfactory index: Table 5 presented the multivariable analysis performed to assess the association of several variables with the patient satisfaction index. Before the pandemic, there was no significant correlation between the total mean score for PSI and any variables whether within each group or between the two groups.

However, during the pandemic, the multivariable analysis results showed that the total mean score for PSI was significantly associated with more than four variables within and between groups. Within the PNC group, the total mean score for PSI was significantly correlated with age (p = 0.031), CCI status (p = 0.004), diagnosis (p = 0.037) and surgery order (p = 0.047) (Table 5). Furthermore, *post hoc* analysis showed that it was a significant difference between CCI 1 and CCI 2 (p<0.05) and CCI ≥3 (p<0.05) and between FAI and LT (p<0.05) (Table 5).

As for the TNC group, the total mean score for PSI was significantly associated with age (p = 0.006), ASA status (p = 0.007), CCI status (p = 0.011), surgery type (p = 0.049) and comorbidities (p = 0.005) (Table 5). The *post-hoc* analysis showed that the significant difference was between ASA I and ASA II (p<0.05) and ASA III (p<0.01), between CCI 1 and CCI ≥3 (p<0.05) and between those with no comorbidities and those with smoking history (p<0.01) and CVD subgroup (p<0.05) (Table 5).

Table 4: Association between general information variables and overall patient's self-evaluated caring behaviors

	Before COVID-19			During COVID-19			p-value		
	PNC (n = 32)		TNC (n = 32)	PNC (n=25)		TNC (n = 24)	Between	Between	p-value
Variable	X̄±SD	p-value	X̄±SD	X̄±SD	p-value	X̄±SD	PNC groups	TNC groups	*Post hoc*
Age									
<65	4.92±0.4	0.767	4.88±0.5	4.58±0.5	0.711	4.65±0.4	0.056	0.147	
≥65	5.02±0.5	0.253	4.80±0.5	5.05± 0.4	0.145	5.27±0.3	0.835	**0.010**	
p-value	0.566		0.690	**0.012**		**<0.001**			
Gender									
Male	4.83±0.4	0.477	4.94±0.5	4.93±0.6	0.865	4.88±0.5	0.645	0.770	
Female	5.07±0.5	0.055	4.73±0.5	4.67±0.4	**0.022**	5.05±0.3	**0.016**	0.069	
p-value	0.130		0.235	0.240		0.393			
ASA status									
I$^{\alpha}$	5.00±0.4	0.275	4.82±0.5	4.32±0.4	**<0.001**	5.13±0.1	**0.002**	**0.046**	α vs β: **
II	4.94±0.4	0.562	4.84±0.4	5.06±0.3	0.567	4.97±0.5	0.438	0.471	
III$^{\gamma}$	4.95±0.7	0.938	5.00±0.9	4.71±0.6	0.678	4.58±0.3	0.560	0.525	
p-value	0.920		0.852	**0.004**		0.295			
CCI status									
0	5.13±0.2	0.071	4.63±0.4	-	-	-	-	-	α vs γ: **
1$^{\alpha, 1}$	4.88±0.1	0.724	4.79±0.5	4.29±0.4	0.764	4.35±0.1	0.019	0.099	1 vs 2: **
2$^{\beta, 2}$	4.98±0.5	0.924	4.95±0.4	4.67±0.5	0.358	5.04±0.2	0.434	0.610	1 vs 3: **
≥3$^{\gamma, 3}$	4.98±0.5	0.697	4.89±0.6	4.97±0.4	0.247	5.15±0.4	0.939	0.251	
p-value	0.926		0.622	**0.011**		**0.001**			
Diagnosis									
OA^{1}	5.06±0.5	0.784	5.02±0.5	4.89±0.4	0.144	5.13±0.4	0.323	0.467	1 vs 3: *
ON^{2}	4.83±0.5	0.681	4.71±0.5	4.81±0.4	0.523	5.00±0.3	0.964	0.321	
FAI^{3}	4.92±0.1	0.208	4.65±0.4	4.08±0.4	0.294	4.42±0.3	**0.038**	0.371	
LT^{4}	5.00±0.2	0.209	4.63±0.4	4.81±0.6	0.223	4.38±0.2	0.580	0.374	
p-value	0.615		0.260	0.070		**0.016**			
Surgery type									
THA	5.01±0.5	0.360	4.88±0.5	4.88±0.4	0.099	5.11±0.4	0.333	0.119	
SCOPE	4.82±0.4	0.886	4.79±0.5	4.50±0.6	0.695	4.40±0.2	0.261	**0.036**	
p-value	0.311		0.643	0.163		**<0.001**			
Surgery									
Primary	4.99±0.4	0.200	4.83±0.5	4.69±0.5	0.105	4.96±0.5	0.056	0.344	
Revision	4.88±0.6	0.724	5.00±0.3	4.96±0.4	0.894	4.92±0.5	0.772	0.845	
p-value	0.690		0.644	0.168		0.894			
Comorbidities									
None$^{\alpha}$	5.05±0.3	0.305	4.79±0.6	4.32±0.4	**<0.001**	5.10±0.1	**0.001**	0.213	α vs δ: *
Smoking	4.91±0.5	0.671	5.00±0.4	4.94±0.5	0.498	4.71±0.4	0.923	0.233	α vs λ: **
CHF	5.00±ind.	-	-	4.00±ind.	-	-	-	-	α vs φ: *
CVD$^{\gamma}$	5.50±ind.	-	5.06±0.4	4.88±0.2	0.172	4.53±0.2	-	0.076	
COPD$^{\delta}$	4.95±0.7	0.408	4.50±0.7	5.25±0.0		4.80±ind.	0.402	-	
Diabetes$^{\lambda}$	4.97±0.6	0.920	4.94±0.6	5.07±0.2	0.610	5.17±0.5	0.645	0.398	
Cancer history	-	-	-	4.00±ind.	-	-	-	-	
HTN$^{\varphi}$	4.88±0.4	0.394	4.70±0.4	5.08±0.1	0.793	5.14±0.5	0.270	0.091	
p-value	0.942		0.534	**0.001**		0.145			

PNC: Primary nursing care, TNC: Team nursing care, X̄: Mean, SD: Standard deviation, OA: Osteoarthritis, ON: Osteonecrosis, FAI: Femoroacetabular impingement, LT: Labral tear, THA: Total hip arthroplasty, SCOPE: Hip arthroscopy, ASA: American Society of Anaesthesiologists, CCI: Charlson comorbidity index, CHF: Congestive heart failure, CVD: Cardiovascular disease, COPD: Chronic obstructive pulmonary disease, HTN: Hypertension. Bold indicates all p values with statistical differences. α, β, γ, δ, λ and φ are used for *post hoc* analysis purpose to identify variable groups within PNC group. 1, 2, 3 and 4 are used for *post hoc* analysis purpose to identify variable groups within TNC group, *p<0.05 and **p<0.01

Besides, during the pandemic, between both groups, the total mean score for PSI was only found significantly associated with ASA II and smoking variables as proven by the value of p = 0.004 (Table 5).

Comparison of Harris hip score between the two groups: Whether before or during the pandemic, statistical analysis did not show any significant difference in harris scores between both groups before and at three months after surgery (p>0.05) (Table 6).

Table 5: Association between general information variables and overall patient satisfaction index

	Before COVID-19			During COVID-19			p-value		
Variable	PNC (n=32) $\bar{X}$±SD	p-value	TNC (n=32) $\bar{X}$±SD	PNC (n=25) $\bar{X}$±SD	p-value	TNC (n=24) $\bar{X}$±SD	Between PNC groups	Between TNC groups	p-value *Post hoc*
Age									
<65	4.29±0.3	0.969	4.30±0.3	4.11±0.4	0.106	3.83±0.4	0.196	**0.006**	
≥65	4.29±0.4	0.899	4.31±0.4	4.40± 0.2	0.217	4.28±0.2	0.362	0.798	
p-value	1.000		0.921	**0.031**		**0.006**			
Gender									
Male	4.33±0.3	0.879	4.31±0.4	4.20±0.3	0.140	3.95±0.4	0.358	**0.024**	
Female	4.26±0.4	0.837	4.29±0.3	4.24±0.4	0.683	4.18±0.4	0.890	0.459	
p-value	0.575		0.849	0.772		0.169			
ASA status									
I [1]	4.33±0.3	0.853	4.36±0.3	4.00±0.6	0.103	4.44±0.3	0.189	0.543	1 vs 2: *
II [2]	4.33±0.4	0.438	4.21±0.4	4.31±0.2	**0.004**	3.98±0.3	0.837	0.074	1 vs 3: **
III [3]	4.07±0.4	0.343	4.44±0.5	4.33±0.2	0.192	3.67±0.6	0.197	0.155	
p-value	0.317		0.462	0.160		**0.007**			
CCI status									
0	4.50±0.2	0.408	4.28±0.3	-	-	-	**0.011**	**<0.001**	α vs β: *
1 [α, 1]	4.11±0.3	0.360	4.28±0.3	3.83±0.5	0.560	3.67±0.4	0.270	**0.027**	α vs γ: *
2 [β ,2]	4.40±0.4	0.725	4.33±0.4	4.44±0.2	0.085	4.00±0.5	0.801	0.186	1 vs 3: *
≥3 [γ, 3]	4.26±0.3	0.821	4.30±0.3	4.33±0.2	0.291	4.23±0.3	0.513	0.649	
p-value	0.370		0.988	**0.004**		**0.011**			
Diagnosis									
OA [α]	4.42±0.3	0.631	4.35±0.4	4.19±0.3	0.670	4.13±0.4	0.077	0.120	γ vs δ: *
ON	4.17±0.4	0.699	4.24±0.4	4.42±0.3	0.488	4.25±0.3	0.249	0.957	
FAI [γ]	4.00±0.3	0.243	4.33±0.3	3.78±0.4	1.000	3.78±0.2	0.491	**0.024**	
LT [δ]	4.33±0.3	0.548	4.17±0.3	4.50±0.2	0.300	3.50±0.7	0.495	0.426	
p-value	0.152		0.784	**0.037**		0.083			
Surgery type									
THA	4.35±0.3	0.675	4.30±0.4	4.24±0.3	0.474	4.16±0.7	0.320	0.242	
SCOPE	4.10±0.4	0.239	4.31±0.3	4.19±0.5	0.069	3.76±0.4	0.680	**0.021**	
p-value	0.141		0.966	0.800		**0.049**			
Surgery									
Primary	4.32±0.3	0.830	4.30±0.4	4.15±0.4	0.449	4.05±0.4	0.136	**0.037**	
Revision	4.17±0.4	0.698	4.33±0.5	4.43±0.2	0.082	4.11±0.2	0.209	0.640	
p-value	0.420		0.937	**0.047**		0.680			
Comorbidities									
None [1]	4.37±0.3	0.842	4.33±0.3	4.00±0.6	0.146	4.40±0.3	0.164	0.715	1 vs 2: **
Smoking [2]	4.38±0.3	0.274	4.17±0.4	4.25±0.2	**0.004**	3.72±0.2	0.404	**0.025**	1 vs 3: *
CHF	4.00±ind.	-	-	4.00±ind.	-	-	-	-	
CVD [3]	4.70±ind.	-	4.50±0.4	4.50±0.2	0.111	3.67±0.6	0.530	0.104	
COPD	4.07±0.4	0.802	4.00±0.3	4.33±0.0	-	4.00±ind.	0.178	0.501	
Diabetes [4]	4.37±0.4	0.851	4.41±0.4	4.33±0.2	0.146	4.19±0.2	0.831	0.125	
Cancer history	-	-	-	4.30±ind.	-	-	-	-	
HTN [5]	4.21±0.3	0.600	4.13±0.3	4.44±0.2	0.111	4.14±0.3	0.178	0.951	
p-value	0.455		0.231	0.334		**0.005**			

PNC: Primary nursing care, TNC: Team nursing care, $\bar{X}$: Mean, SD: Standard deviation, OA: Osteoarthritis, ON: Osteonecrosis, FAI: Femoroacetabular impingement, LT: Labral tear, THA: Total hip arthroplasty, SCOPE: Hip arthroscopy, ASA: American Society of Anaesthesiologists, CCI: Charlson comorbidity index, CHF: Congestive heart failure, CVD: Cardiovascular disease, COPD: Chronic obstructive pulmonary disease, HTN: Hypertension. Bold indicates all p-values with statistical differences. α, β, γ, δ and λ are used for *post hoc* analysis purpose to identify variable groups within PNC group. 1, 2, 3, 4 and 5 are used for *post hoc* analysis purpose to identify variable groups within TNC group, *p<0.05 and **p<0.01

Comparison of hospital anxiety and depression scale between the two groups: There was no statistically significant difference in hospital anxiety and depression scale between both groups before and at three months after surgery, before the pandemic (p>0.05) (Table 6). However; during the pandemic, there was a statistically significant difference in anxiety and depression subscales between both groups, respectively before and at three months after surgery (p<0.05 and p<0.01, respectively) (Table 6).

Table 6: Comparison of hip functional postoperative outcomes between the groups

	Primary nursing care		Team nursing care		
Variable	Data	p-value	Data	p-value	p-value
Before the COVID-19	N = 32		N = 32		
HHS ($\bar{X}$±SD)					
Pre-surgery	49.00±8.8	**<0.001**	46.68±9.0	**<0.001**	0.304
Post-surgery	92.90±2.6		92.65±2.9		0.722
HADS ($\bar{X}$±SD)					
HADS-anxiety					
Pre-surgery	7.37±1.8	**<0.001**	6.87±1.6	**<0.001**	0.253
Post-surgery	2.72±0.9		2.47±0.9		0.298
HADS-depression					
Pre-surgery	4.16±1.5	**<0.001**	3.94±1.9	**<0.001**	0.615
Post-surgery	1.50±0.7		1.50±0.8		1.000
NRS pain ($\bar{X}$±SD)					
Pre-surgery	7.37±0.7	**<0.001**	7.22±0.7	**<0.001**	0.421
Post-surgery	1.56±0.5		1.40±0.5		0.217
PSI ($\bar{X}$±SD)	4.29±0.3	**<0.001**	4.30±0.3	**<0.001**	0.908
CBI-patient ($\bar{X}$±SD)	4.96±0.4	**<0.001**	4.84±0.5	**<0.001**	0.291
Hospital LOS (days) ($\bar{X}$±SD)	8.06±1.8	**0.002**	7.62±1.3	**0.014**	0.279
During COVID-19	N = 25		N = 24		
HHS ($\bar{X}$±SD)					
Pre-surgery	50.28±9.3	**<0.001**	48.67±9.1	**<0.001**	0.544
Post-surgery	92.40±2.6		92.04±2.9		0.652
HADS ($\bar{X}$±SD)					
HADS-anxiety					
Pre-surgery	8.52±1.6	**<0.001**	7.62±1.3	**<0.001**	**0.037**
Post-surgery	2.60±1.0		2.12±0.7		0.064
HADS-depression					
Pre-surgery	5.08±1.6	**<0.001**	4.37±1.1	**<0.001**	0.082
Post-surgery	1.96±0.5		1.50±0.5		**0.003**
NRS pain ($\bar{X}$±SD)					
Pre-surgery	7.40±0.8	**<0.001**	7.25±0.7	**<0.001**	0.502
Post-surgery	1.60±0.5		1.71±0.5		0.435
PSI ($\bar{X}$±SD)	4.23±0.4	**0.019**	4.06±0.4	0.233	0.134
CBI-24 patient ($\bar{X}$±SD)	4.77±0.5	**<0.001**	4.96±0.5	**<0.001**	0.178
Hospital LOS (days) ($\bar{X}$±SD)	5.92 ±0.7	**<0.001**	5.67±0.6	**<0.001**	0.192

$\bar{X}$: Mean, SD: Standard deviation, N: Number of patients, HHS: Harris hip score, HADS: Hospital anxiety and depression scale, NRS pain: Numeric rating scale for pain, PSI: Patient satisfaction index, CBI-24 patient: Caring behaviors inventory-24, Hospital LOS: Hospital length of stay, Pre-op: Pre-operative, Post-op: Post-operative. Postoperative assessment done at 3 months after surgery and bold indicates all p-values with statistical differences

Comparison of pain and hospital length of stay between the two groups: There was no statistically significant difference in pain and hospital length of stay between both groups, whether before or during the pandemic (p>0.05) (Table 6).

Comparison of postoperative incidence of complications between the two groups: No aseptic loosening, prosthesis dislocation, or postoperative bone fracture was recorded in either group, before or during the pandemic. Before the pandemic, there was no statistical significant difference in the occurrence of postoperative incidence either within the same group or between both groups, between those who developed postoperative complications and those who did not (p>0.05, Table 7). However, during the pandemic, there was a statistically significant difference between those who developed postoperative complications and those who did not within the PNC group (p<0.05), while no significant difference was found within the TNC group and between both groups (p>0.05, Table 7).

Table 7: Comparison of postoperative incidence of complications between the groups

	Before COVID-19			During COVID-19		
Variable	PNC (n = 32) n (%)	p-value	TNC (n = 32) n (%)	PNC (n = 25) n (%)	p-value	TNC (n = 24) n (%)
Infection	2 (6.25)	-	-	2 (8)	0.873	3 (12.5)
Nausea	14 (43.75)	0.535	10 (31.25)	13 (52)	0.763	11 (45.83)
Vomiting	5 (15.63)	1.000	5 (15.63)	6 (24)	0.967	6 (25)
Chronic pain	2 (6.25)	0.813	4 (12.5)	6 (24)	0.900	5 (20.83)
Nerve injury	3 (9.37)	0.714	6 (18.75)	8 (32)		4 (16.67)
Aseptic loosening	-		-	-		-
Fracture	-		-	-		-
DVT/PE	1 (3.12)	1.000	1 (3.12)	2 (8)	-	-
Hip dislocation	-	-	-	-	-	-
90 days mortality	-	-	-	1 (4)	-	-
p-value[a]	0.297 [*]		1.000[*]	**0.021***		0.235[*]
p-value[b]		0.451[‡]			0.305[‡]	

PNC: Primary nursing care, TNC: Team nursing care, DVT: Deep vein thrombosis, PE: Pulmonary embolism. p[a]: p-value expressing comparative analysis between those who developed postoperative complication and those who did not, within the same group. p[b]: p-value expressing comparative analysis between those who developed postoperative complications and those who did not, between the two groups, [‡]Pearson's c^2-test, [*]Z score test and bold indicates all p-values with statistical differences

DISCUSSION

The current study aimed to comparatively assess the clinical effectiveness of two nursing care delivery models (PNC vs TNC) by comparing primary nurse caring behaviour and patient satisfaction and subsequently patient health outcomes in patients following hip surgeries. Known as the method to organise and deliver nursing care to patients, the nursing care delivery model is driven by values and beliefs and used either an independent or collaborative approach to enhance patient's quality of life[8,19]. With the noticeable nurse staffing shortage worldwide, nursing managers are called to efficiently use the two key components of the nursing care delivery model (mode of nursing care and staffing skill mix) not only to assure patients of high quality care but also to enhance patient satisfaction from nursing and institution perspectives.

Patient's baseline demographic characteristics in PNC and TNC within each period (before and during the pandemic) were comparable. Although there were significant differences in baseline variables such as age, BMI, type and rank of surgeries within each group whether before or during the pandemic, no significant difference between the two nursing care delivery models was found. However, an overall view of all baseline variables shows that there is a considerable decrease in the number (e.g., patients and surgeries) or mean values (e.g., age) between groups before and during the pandemic. A primary explanation would be associated with a COVID-19 related cancellation of orthopedic elective surgery in order to better accommodate emergency orthopedic surgery during the pandemic era. A second explanation may relate to a possible role of psychosocial distress, emotional status and fear in patients scheduled for elective surgery during that era[38], although elective surgeries had resumed almost more than a year ago, at the time conducted this study for the COVID-19 section.

Caring attitudes and behaviours are two core concepts throughout nurse-patient interactions are displayed. Defined as the essence of nursing, nurses express it by performing their role and activities through caring behaviours[39]. The findings of the CBI-24 overall score and of each of its subscales for both PNC and TNC groups were high whether before or during the pandemic. Moreover, in the current study, the scores of CBI-24 were higher than those reported in some studies conducted before[25,40] and during the pandemic[10,39], regardless of the type of nursing care delivery model patients attended to. Before the pandemic, of the four subscales, 'positive connectedness', 'assurance of presence human' and 'professional knowledge and skills' and 'assurance of presence human' were the highest scores reported in the PNC group and TNC group, respectively. During the pandemic 'patient respectfulness' and 'professional knowledge and skills' were scored highest in the PNC group and TNC group, respectively. Based on this

study, patients in the PNC group gave more value to the quality of caring behaviours by scoring 'positive connectedness' (before the pandemic) and 'patient respectfulness' (during the pandemic) higher than other subscales. Meanwhile, patients from the TNC group did value more technical caring behaviours by rating 'professional knowledge and skills' higher than all other subscales, before and during the pandemic.

A potential explanation for this can partly be subject to the nursing care delivery model and to the time of the study. The PNC delivery model, better than any other nursing delivery model, allows patients to identify their direct primary nurse throughout the entire course of hospitalization, ensures continuity of higher quality of care as no other method,[41] and promotes nurse-patient relationship by creating and emphasising a positive bound between the patients and their primary nursing staff[19]. The shift of quality in caring behaviours before (positiveness connectedness) and during the pandemic (patient respectfulness) could be partly explained by the decrease of time spent with the patient, which was potentially subjected to numerous factors such as workload, post-traumatic, emotional and psychological stress experienced by nursing staff[42]. However, one of the PNC delivery model disadvantages might be the nurse qualifications that could be reflected on the low scores attributed to the technical caring behaviours (professional knowledge and skills and assurance of human presence). This could be significantly interpreted by the statistical difference of 'assurance' mean score before and during the pandemic (5.16 vs 4.48, $p<0.01$). The delay in responding quickly to the patient's call due to the aforementioned factors during the pandemic could be a potential reason.

With regard to the TNC delivery model, it takes advantage of the mix of skills of nursing staffing. Patients feel secure as a team of different skilful nurses attend to their care. This model promotes effectiveness in nursing care delivery[19]. On the nurse perspective, the TNC delivery model ensure that most experienced and competent staff exercise their professional skills through effective work to provide a high quality care. This may be the potential explanation why whiter before or during the pandemic, patients who attended this nursing care delivery model rated 'professional knowledge and skills' much higher than all other subscales, followed by 'assurance of human presence'. Moreover, both technical caring behaviours are rated higher than the quality of caring behaviour and each of their mean score is above 5, explaining how much patients in TNC groups highly perceived technical caring behaviours compared to the quality of caring behaviours from the mix skills nursing staff.

The patient satisfaction is a vital metric of quality of health care assessment and can be used to improve patient experience. Usually associated with medical institution performance, it can be used as an evaluative tool to assess not only the process of care but also the outcomes of care expected by patients. Regardless of the study period (before or during the pandemic), patients in the PNC group highly rated the 'trust' subscale followed by 'technical professional' and 'patient education', before and during the pandemic, respectively. Meanwhile, whether before or during the pandemic, patients who attended the TNC delivery model highly rated perceived 'patient education' followed by 'technical professional'. Concerning findings from the PNC group, as discussed earlier, this nursing care delivery model promotes better relationships between nurses and patients and/or family primary caregivers. It creates a positive connectedness between the parties involved, allowing personalized care and increased patient/family satisfaction[19]. The potential correlation between the CBI-24's 'positive connectedness' and the PSI's 'trust' can be observed by their highest mean scores (5.34 ± 0.8 and 4.72 ± 0.5, Table 2). Results from the TNC group suggested that these patients highly perceived technical factors in comparison to others. While the quality of care was an objective concern during the pandemic, we should not undermine that technical professional of nursing personnel and patient education from health care professionals were emphasized, in order to help the population to avoid contracting the virus, or to give instructions if it happens. Thus, this may explain why during the pandemic, patients from the PNC groups also rated 'patient education' as a second-high score. Moreover, this may be a potential explanation for why only in the 'trust' and 'patient education' subscales statistically recorded significant differences between both groups, whether before or during a pandemic. Also, during the pandemic, PNC group recorded higher scores compared to patients in the TNC group.

Age, pain management, patient expectations, gender, comorbidities and hospital length of stays have been well established in nursing literature to be associated with patient satisfaction[43]. In terms of age, less satisfaction has been reported in younger patients undergoing hip surgeries, possibly to the higher expectations from these patients as they are more associated with a more active lifestyle[43,44]. Current results in both nursing care delivery model groups corroborated findings from these previous studies, in terms of age variables. In addition, there was a statistical difference between ages groups within each group, during the pandemic ($p = 0.031$ and $p = 0.006$, for PNC and TNC, respectively, Table 5). The correlation between gender and patient satisfaction still needs to be proven as there is no general consensus. In this study, in both groups, men were slightly associated with better satisfaction and dissatisfaction, before and during the pandemic, respectively (Table 5). These findings corroborated results from previous studies highlighted by Okafor and Chen[43]. The correlation between comorbidities and patient satisfaction relies not only on the number of comorbidities but also on their type. Usually, a patient with no comorbidities will be more satisfied than one with one or more comorbidities. However, some patients might make a clear difference between satisfaction related to the outcomes of care to the one associated with the process of care[45]. Meaning, even by experiencing a negative outcome of care, a patient might still express satisfaction with the process of care[43].

Before the pandemic, caring behaviors and patient satisfaction were significantly correlated in the PNC group and statistically insignificant for the patients in the TNC group. However, during the pandemic, finding were totally contrary. It was found to be significantly related in the TNC group and insignificant correlated in the PNC group (Table 3).

These findings corroborate the possible explanation that although nurse caring behaviour and patient satisfaction are correlated, usually patient satisfaction is often associated with the nursing care delivery model performed in a specific institution/unit or department and at a particular timeline.

In the current study, HHS, HADS, NRS pain, hospital length of stay and complications were analysed as secondary endpoints. The results of this study showed that all secondary variables were comparable between both groups (Table 6). While there was only a significant difference between both groups in HADS-anxiety (pre-surgery, $p<0.05$) and HADS-depression (post-surgery, $p<0.01$) during the pandemic, no significant difference between the two groups was noted in all other variables, whether before or during the pandemic ($p>0.05$, Table 6). Thus, suggesting that there was no difference between the PNC delivery model and the TNC delivery model before the pandemic regarding surgical or therapeutic outcomes. Hip surgeries are usually cost-effective and are associated with a significant burden affecting society and quality of life. The burden is multidimensional and touches every aspect of the patient's life including his psychology and socioeconomic status. Thus, it can be associated with significant disability and reducing the patient's sphere of mobility and quantity and quality of daily activities. Thus, patients scheduled for hip surgeries are challenged with psychological stress such as depression and anxiety[46].

However, it is worthy of note to say that age, gender, disability and clinical or social setting are often the main dependent factors associated with depression and anxiety[33]. Current results showed that regardless of the type of nursing care delivery model, a high prevalence of depression and anxiety was recorded during the pandemic. This could have been associated with the study timeline, in conjunction with hip surgeries-associated psychological and emotional stress[33]. The overall mean of hospital length of stays had considerably decreased during the pandemic, due to various policies implemented during COVID-19. These policies helped to avoid contracting the virus during hospital stays. Nevertheless, patients in TNC groups did record a shorter number of days, whether before or during the pandemic (Table 6). A potential explanation could be the high mix of skills nursing staff and their professional technical skills. In addition, generally, a shorter hospital length of stay is also a positive factor in patient satisfaction following numerous orthopaedic surgeries[43].

All post-operative complications that occurred during the hospital stay up to the final follow-up set point were shown in Table 7. The results of the current study showed that no aseptic loosening, postoperative prosthesis fracture or hip dislocation occurred in both groups. Moreover, the incidence of all other post-operative complications was relatively low and similarly equivalent in both groups, with no significant difference ($p>0.05$). The patient who experienced nerve injury had complete recovery over the course of the postoperative period. It did occur that the nerve might be stretched during the operation due to direct nerve transection[28]. Patients who experienced post-surgery DVT were carefully and successfully treated with anticoagulation therapy (warfarin). During the pandemic, the PNC group recorded one case of 90 days mortality. After investigation, this mortality rate was not associated with surgical-related peri or post-complications. However, it was related to covid infection in a community cluster. The patient was a 73 years female, who had 5 on the Charlson comorbidity index. This was potentially due to the degree and type of her comorbidity and the status of her COVID-19 infection.

The present study is relatively extensive and among the first of its kind in nursing literature to assess nursing care delivery models in orthopaedic settings, before and during a global pandemic. Univariate and multivariate analyses were performed and a significant correlation between CBI-24 and PSI was found. However, in an attempt to design and conduct a well-designed study, the study had some limitations to be considered when interpreting the results. First, nurse staffing data were not presented, making it impossible to assess staffing mix skills levels in different groups and to assert their correlative congruence with technical caring behaviors in both groups. Second, the Covid pandemic period could be considered as a confounding variable, although taking measures to significantly decrease its impact on patient-related outcomes measures. Despite these limitations, the current study is meaningful and provides significant information regarding the choice of nursing care delivery models in an orthopaedic setting.

CONCLUSION

This study is the first to evaluate patients perceived nurse caring behaviors and patient satisfaction and their mutual correlation, with a pre-and peri-pandemic matched period. Several variables such as age, gender, comorbidities, pain management, hospital length of stay and psychological and emotional stress are usually associated with patient satisfaction following hip surgeries, this study clearly suggested that PNC patients tend to value more quality of caring behaviors and TNC patients highly rate technical caring behaviors. The findings showed an important correlation between patients' perceived nursing care behaviour and patient satisfaction, although based on the importance of the therapeutic timeline. Overall, both nursing care delivery models investigated in this study helped to achieve excellent results, either before or during the pandemic. According to current observations, further investigations should take into consideration the professional experience of the nursing workforce taking place in a multicenter setting.

SIGNIFICANCE STATEMENT

The current study discusses the clinical effectiveness of two different types of nursing care delivery models in patients following hip surgery, before and during a major international public health event. Its findings will help researchers from the nursing workforce, according to nurse staffing and institutional factors, to better tackle nurse caring behaviors and significantly adopt a nurse caring model to attend to different types of patients, as they aim to provide high-quality of care.

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