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Original Article

Research-training needs of clinical nurses: A nationwide study among tertiary hospitals in China

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ABSTRACT

Objective: This study aimed to evaluate Chinese tertiary hospital nurses' research output, research ability, and their related training needs regarding scientific research methodology and analyze the relations among them.

Methods: A nationwide survey was conducted in China on a large sample of tertiary hospital nurses ($n = 27,335$) recruited from 22 provinces, autonomous regions, and municipalities. A validated, self-designed questionnaire, consisted of a common questionnaire, the Science Research Skills Self-Rating Questionnaire (SRSQ) and the Scientific Research Training Needs Questionnaire (SRTNQ) were used to assess nurses' research output, self-rated research skills and research-training needs.

Results: The nurses' scientific research participation rates (with 4.13%, 7.85%, 5.35%, and 2.04% in research projects, research attendance, papers published, and patent, respectively) and their self-rated research skills 25.00 (12.50, 37.50) were very low. However, the research training needs were relatively high 53.12(37.50, 75.00). Significant differences in research participation rates (research projects, research attendance, papers published, and patent), scientific research skills, and research-training needs were determined by age, highest education level, nursing experience, employment, technical title, administrative post, and clinical tutoring experience ($P < 0.05$). Female and male nurses had different research participation rates (only research projects and studies published) and scientific research skills ($P < 0.05$). Positive correlations were observed among research output, scientific research skills, and research-training needs ($P < 0.01$).

Conclusions: Nurses' scientific research participation and self-rated research ability were below the optimal despite that they had relatively high research-training needs. Nurses should be provided further research training with tailored content to their characteristics and capacity.

What is known?

- Nurses are increasingly involved in scientific research.
- Policy makers and administrators are seeking to determine the level of nurses' research ability and training needs.

What is new?

- This was a wide range survey for nurses from 22 provinces, autonomous regions and municipalities in China.

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- The study revealed the levels of nurses' scientific research output, research skills, and research-training needs.
- Differences in nurses' training needs regarding scientific research methodology were determined by demographic and job-related characteristics.

1. Introduction

The integrity of reporting nursing research studies has been questioned because of claims that few clinical trials are published in leading nursing journals [1]. Nurses are expected to implement scientific research on topics related to health care and deliver high-quality health care based on recent research in accordance with evidence-based practice [2–4]. Despite their positive attitudes toward evidence-based practice and nursing research, clinical nurses have infrequently applied scientific knowledge [5]. This observation is an obstacle to increasing the quantity and improving the quality of nursing research. Lack of knowledge and skills are individual barriers that prevent nurses from implementing evidence-based practice in hospital settings [3]. Therefore, understanding the needs of nurses' on-going training and education in scientific research methodology worldwide is necessary. This cross-sectional study in China was conducted to investigate tertiary hospitals nurses' scientific research output, skills, and training needs and analyze their influencing factors.

The Brigg's Report underscored that "nursing should be a research-based profession" [6] considering that scientific research is indispensable to the development of the nursing profession. According to a number of nursing scholars, including Keteflan [7], Buckenham and McGrath [8], Deane and Campbell [9], Chandler [10], McSherry [11], and Watson and Thompson [12], nursing research is the pathway by which "professionalism" and "professional effectiveness" can be pursued and achieved. Scientific research attempts to increase the body of knowledge by discovering new facts through systematic scientific enquiry [13]. The implementation of scientific research enables evidence-based knowledge to be accumulated and used by nurses to improve the quality of nursing care in clinical settings. Therefore, all registered nurses are both "consumers" and "producers" of scientific literature [11].

Nurses' demands to participate in scientific research are increasing. However, registered nurses that actually undertake research during their nursing practice are limited. Many nurses have severely limited research knowledge and ability, so they cannot conduct a research project [14]. Unlike medical research and related research areas, research in nursing remains relatively less and enterprise and university faculty perform the majority of research. However, nursing educators and researchers are seldom directly responsible for patients; thus, poor dissemination and utilization of their research are observed [15]. Therefore, scientific research should be one of the essential duties of nurses, instead of being a burden. Being a researcher should be recognized as an important role of clinical nurses, especially with the development of evidence-based practice [16]. High-quality research from clinical settings can play a key role in expanding the scientific knowledge base to improve patient care and influencing policy [1].

Nurses need to have adequate knowledge and skills commensurate with role's responsibility because deficiencies in experimental design and inaccurately reporting information can lead to biased estimates of treatment effects. Hicks [17] reported that a paper written by a nurse was given significantly lower ratings on research methodology and statistical analysis than similar paper written by a doctor. According to Hicks [18], wide-scale implementation of appropriate research-training courses developed as a top–down initiative from management should be available. The number of registered nurses that participate in policy-making and research is limited [19], despite considerable top–down pressure on nurses to conduct research. Moreover, a paucity of published studies on research skills and research-training needs of nurses remains, which might pose potential or actual barriers to research activity [18].

To date, nationwide evaluation of nurses' knowledge of research methodology has not been performed in China or any other country. Furthermore, evaluation of nurses' publication performance, including productivity and impact, has never been conducted in conjunction with self-evaluations of nurses' research skills and research-training needs. Thus, assessment of nurses' knowledge and skills regarding scientific research methodology should be conducted given recent developments in evidence-based practice and changes in the workflow of nursing [3,24].

This study examined nurses' research output, self-rated research skills, and training needs related to research methodology. The framework of this study was developed and applied based on research procedures described in nursing research articles [20–23]. Such procedures include finding a valuable research problem related to nursing care, conducting a literature review, decreasing bias through proper study design, performing statistical analyses of data, and writing and preparing a manuscript for publication.

This study aimed to address two issues through a nationwide survey in China: to investigate and describe the status of research participation, namely, research skills and training needs among Chinese clinical nurses, as measured by objective indicators (e.g., research participation rates) and subjective indicators (e.g., self-rated research methodology knowledge and skills); and to examine whether significant differences exist among nurses with different demographic and job-related characteristics in research participation, self-rated research skills, and training needs. The relations among research outputs, research skills, and training needs were also analyzed.

The hypotheses about factors associated with nurses' research output, research skills, and research-training needs were illustrated as following.

A. Associations between demographic, job-related characteristics, and research measures:

Hypothesis A1. Female nurses and regular employees have more research participation and higher self-rated research skills and training needs.

Hypothesis A2. Nurses with long nursing work years and high technical titles have more research participation and higher self-rating of their research skills and training needs.

Hypothesis A3. Nurses who work in administrative posts and as nursing students' clinical tutors have more research participation and higher self-rating of their research skills and training needs.

B. Relationships among research output, research skills, and research-training needs:

Hypothesis B1. Nurses' research output is positively correlated with their self-rated research skills.

Hypothesis B2. Nurses' self-rated research skills are positively correlated with their research-training needs.

Hypothesis B3. Nurses' research output is positively correlated

with their research-training needs.

2. Methods

2.1. Study design and sample

This nationwide study adopted a cross-sectional design by using a web-based questionnaire. A multistage sampling method was used in consideration of regional differences. All the administrative regions in China were divided into six parts (Eastern, Southern, Western, Central, Central-Southern, and Northern). At least eight tertiary hospitals (Provincial Capital *vs.* non-Capital, teaching *vs.* non-teaching, and military *vs.* non-military) in each region were selected randomly. The initial sample consisted of all nurses employed in target hospitals to fully understand the whole scientific research level of nurses. The inclusion criteria were registered nurses who worked longer than one year. The exclusion criteria were nurses who were on long-term (more than 3 months) sick leave or maternity leave.

All surveyed hospitals approved the study, and the survey form included a clear statement that the subjects provided informed consent for their participation in the survey. In addition, the study protocol was reviewed and approved by the Nursing Branch of the Chinese Research Hospital Association to protect the welfare of the participants. The anonymity and confidentiality of the participants were ensured in the web-based investigation.

2.2. Instruments

The entire questionnaire was divided into four sections: (1) demographic and job-related characteristics; (2) scientific research output; (3) self-rated scientific research skills, and (4) research-training needs.

2.2.1. Demographic and job-related characteristics variables

Data on the following background variables were collected: gender, age, highest educational level, work experience, technical title, employment, administrative post, and clinical tutor (whether or not).

2.2.2. Scientific research output

Respondents were asked how many research projects they conducted as Principal Investigators (PIs) and group members, the number of published papers they had, and the number of pending or issued patents they had. Position descriptions related to the conduct of research specify the researchers' main responsibilities, such as developing research activities and publication productivity [22,25]. The itemized data for research output and patents were classified according to the scheme used by the government to allocate funding.

2.2.3. Self-rated scientific research skills

Respondents' skills related to scientific research methodology were measured using the Science Research Skills Self-Rating Questionnaire (SRSQ). This newly developed and validated instrument consists of 40 items and six subscales. As alluded in the Introduction section, the six subscales are based on competencies required to perform the entire process of nursing research [20,22,23,26]: topic selection, literature review, research design, data collection and analysis, study writing, and research transformations (e.g., patents). The six subscales measured six dimensions of the competencies required in each phase of the research. Self-evaluations were rated based on the statement "I think I can do this," and rated on a five-point Likert scale: 1 = "Not at all", 2 = "Not sufficient", 3 = "More or less", 4 = "Sufficient", and 5 = "Good" [27]. The Cronbach's α of the SRSQ subscales ranged from 0.828 to 0.968.

2.2.4. Self-evaluations of the need for training on scientific research methodology

Training topics in scientific research methodology were listed as potential needs related to the six dimensions of the SRSQ. The respondents were asked to rate their training needs regarding the conduct of scientific research on 16 items comprising the subscales of training needs. The participants' evaluation of each item was based on the statement "I think I need training about this" and rated on a five-point Likert scale: 1 = "Never", 2 = "Rarely"), 3 = "Occasionally", 4 = "Frequently"), and 5 = "Always" [27]. The Cronbach's α of the training needs subscales ranged from 0.893 to 0.977.

Given that the total scores of the SRSQ and the questionnaire for scientific research training needs were different and to make the dimensions of scientific research skills and training needs comparable, we used adjusted scores calculated from the raw ratings of the total scores by the following formula. The values of the adjusted scores ranged from 0 to 100 [28]:

$$\text{Adjusted Score (AS)} = \frac{\text{Raw Rating (RR)} - \text{Lowest possible score}}{\text{Highest possible score} - \text{Lowest possible score}} \times 100. \quad (1)$$

2.3. Data collection

Data were collected from the 1st to the 31st of May 2017. The questionnaire was posted on the Internet, and eligible candidates received an invitation to participate via an advertisement that contained a link to the survey. The instructions on the questionnaire included information about the study's objectives and whom to contact if the nurses had any questions about the online survey. Nurses could complete the questionnaire during work time or spare time. In addition, flyers were sent to all the hospitals by email to draw attention to the investigation and questionnaire and obtain a high response rate. Reminders were sent to all potential respondents after 2 weeks by the coordinator of the research to remind completing the survey.

2.4. Data analysis

All the original data were placed into Excel by a computer to build a database and conduct the statistical analysis by using SPSS 21. In the first step, the data were screened to detect errors prior to the analysis. Individual records with obvious logical errors, such as 110 research projects as a PI, were rejected as invalid responses. The distributions of all the variables were examined for normality before the analysis. The second step used various statistical analyses to test different hypotheses, as described below. All tests were two-tailed, and the level of significance was set at P less than 0.05.

2.4.1. Hypotheses A1–A3: differences in scientific research outputs and self-rated research skills and training needs by demographic and job-related characteristics

Chi-square tests were performed to compare differences in participation rates in research outputs [research projects (PI), research attendance, studies published, and patent] by demographic and job-related characteristics. Adjusted P-values were computed using Bonferroni method, and comparison among

groups was conducted by "select cases" command. Nonparametric tests were performed to compare differences in scientific research skills and training needs skills by demographic and job-related characteristics. Kruskal–Wallis test for k samples was used, and comparison among groups was achieved by pairwise comparison.

2.4.2. Hypotheses B1–B3: relationships among research outputs and self-rated research skills and training needs

Nonparametric (Spearman's) correlations were performed to determine the bivariate associations between research output and self-rated research skills and training needs.

3. Results

The entire questionnaire was completed by 27,840 nurses, 505 of whom committed logic errors (e.g., letters or symbols instead of numerals for the number of papers published). After excluding the 505 respondents from the data analysis, the final sample included 27,335 valid responses (98.19%).

3.1. Demographic and job-related characteristics in research measures

The demographic and job-related characteristics of the respondents are shown in Table 1, along with the measures of research participation rates in research projects, research attendance, studies published, and patent. The nurses' research participants rates were very low (with 4.13%, 7.85%, 5.35%, and 2.04% in research projects, research attendance, studies published, and patent), implying that the respondents were not very involved in scientific research activities on average.

Female nurses have higher research participation rates in research projects and studies published than male nurses. Nurses aged over 55 years old have higher participation in research projects, research attendance, and papers published than those aged 18–24 or 25–34 ($P < 0.01$). Meanwhile, nurses aged 45–54 or 55–63 have higher participation in patent than those aged 18–24 or 25–34 ($P < 0.01$). With regard to the education level, nurses with master degree have higher participation in research projects, research attendance, papers published, and patent than those with secondary education or college degree or bachelor degree ($P < 0.01$). On nursing experience, nurses with over 40 years working life have higher participation in research projects than those who worked 1–5 years or 6–9 years or 10–14 years or 15–19 years ($P < 0.01$), higher participation in research attendance than those who worked 1–5 years or 6–9 years or 10–14 years or 15–19 years(all $P < 0.01$) or 20–19 years ($P = 0.004$), higher participation in papers published than those who worked 1–5 years or 6–9 years or 10–14 years or 15–19 years ($P < 0.01$), and higher participation in patent than those who worked 1–5 years or 6–9 years or 10–14 years or 15–19 years ($P < 0.01$). Chief superintendent nurses have higher participation in research projects, research attendance, and patent than those who were only nurses or nurse practitioners or nurses-in-charge or co-chief superintendent nurses ($P < 0.01$). In addition, these nurses have higher participation in papers published than those who were only nurses or nurse practitioners or nurses-in-charge ($P < 0.01$). For administrative post, those who were director of the nursing department have higher participation in research projects than nurses without administrative post ($P < 0.01$) or head nurses ($P = 0.012$), have higher participation in research attendance and patent than nurses without administrative post ($P < 0.01$), and have higher participation in papers published than nurses without administrative post ($P < 0.01$) or who were directors of a nursing department ($P = 0.07$). Additionally, nurses who were regular employee or clinical tutor have higher participation in research projects, research attendance, papers published, and patent than the other groups ($P < 0.01$).

3.2. Self-evaluated skills and training needs

Nurses' self-evaluated skills and training needs are shown in Table 2. The standardized score of self-rated research skills varied from 0 to 100 (0 representing the RR as the lowest possible score, 100 representing the RR as the highest possible score), with a median score of 25.00 (12.50, 37.50). The standardized scores of training needs in research methodology were relatively higher, ranging from 0 to 100, with a median score of 53.13 (37.50, 75.00). This result indicated that the study sample had a positive attitude toward training in research methodology.

Male nurses have relatively higher self-evaluated skills than female nurses ($P < 0.05$), but no difference was found in training needs ($P = 0.107$). Significant differences in scientific research skills and training needs were found by age, highest education level, nursing experience, employment, technical title, administrative post, and clinical tutoring experience ($P < 0.01$). Nurses aged over 55 scored higher than those aged 18–24 or 25–34 ($P < 0.01$). Nurses aged 35–44 have higher training needs than those aged 18–24 ($P < 0.01$), 25–34 ($P = 0.018$), over 55 ($P = 0.024$). Nurses with master degree have higher scientific skill scores and training needs scores than other education levels ($P < 0.01$). Nurses with 30–39 years working life scored higher than those with a working life of 1–5 years, 6–9 years, 10–14 years, or 15–19 years ($P < 0.01$). Nurses with 20–29 years working life have higher training needs than those with a working life of 1–5 years, 6–9 years, 10–14 years, or 15–19 years ($P < 0.01$). Nurses who were regular employed have higher scientific skill scores and training scores than contract-employed nurses ($P < 0.01$). Chief superintendent nurses scored higher than the other groups in skill scores and scored higher than those with primary technical titles ($P < 0.01$) and middle technical title ($P = 0.003$). Directors of the nursing department scored higher than nurses without administrative post ($P < 0.01$). A nursing supervisor has higher training needs than nurses having no administrative post ($P < 0.01$). Nurses who are clinical tutor have higher scientific skill and training needs scores than those who are not clinical tutor.

3.3. Relationships among research output, scientific research skills, and research training needs

The subscale standardized scores of scientific research skills and training needs are shown in Table 3, and data of bivariate correlations among research output, scientific research skills, and research training needs are shown in Table 4. Positive bivariate correlations were observed between research participation and research-training needs ($P < 0.01$), indicating that those who had several research participations thought they needed many research trainings. In addition, scores on the six subscales of self-rated scientific research skills had a significant positive relationship to participants' research-training needs ($P < 0.01$), implying that nurses with good research skills thought they needed further research training.

4. Discussion

This study examined the research output, self-rated scientific research skills, and research-training needs of tertiary hospital nurses in a nationwide study conducted in China by using a theoretical model and instruments designed in keeping with the principles of research methodology. The results of the current study

Table 1
Demographic characteristics of the respondents and different scientific research participations($n = 27{,}335$).

Characteristics	*n*(%)	Research projects (PI)		Research attendance		Studies published		Patent	
		No	Yes	No	Yes	No	Yes	No	Yes
Gender									
Male	974(3.56)	948(97.33)	26(2.67)	901(92.51)	73(7.49)	948(97.33)	26(2.67)	953(97.84)	21(2.16)
Female	26361(96.44)	25257(95.81)	1104(4.19)	24287(92.13)	2074(7.87)	24924(94.55)	1437(5.45)	25825(97.97)	536(2.03)
χ^2		5.466		0.180		14.349		0.071	
P		0.019		0.671		<0.001		0.790	
Age (years)									
18–24	3533(13.00)	3500(99.07)	33(0.93)	3410(96.52)	123(3.48)	3527(99.83)	6(0.17)	3526(99.80)	7(0.20)
25–34	17701(64.90)	17399(98.29)	302(1.71)	16936(95.68)	756(4.27)	17197(97.15)	504(2.85)	17502(98.88)	199(1.12)
35–44	4455(16.30)	3926(88.13)	529(11.87)	3617(81.19)	838(18.81)	3797(85.23)	658(14.77)	4219(94.70)	236(5.30)
45–54	1537(5.60)	1284(83.54)	253(16.46)	1134(73.78)	403(26.22)	1256(81.72)	281(18.28)	1428(92.91)	109(7.09)
55–63	48(0.20)	37(77.08)	11(22.92)	34(70.83)	14(29.17)	36(75.00)	12(25.00)	44(91.67)	4(8.33)
χ^2		1659.372		1883.196		1729.022		578.009	
P		<0.001		<0.001		<0.001		<0.001	
Educational level									
Vocational school	398(1.46)	395(99.25)	3(0.75)	382(95.98)	16(4.02)	389(97.74)	9(2.26)	398(100.00)	0(0.00)
Diploma degree	5781(21.15)	5686(98.36)	95(1.64)	5534(95.73)	247(4.27)	5679(98.24)	1021.76)	5757(99.58)	24(0.40)
Bachelor of science in nursing	20578(75.28)	19694(95.70)	884(4.30)	18930(91.99)	1648(8.01)	19359(94.08)	1219(5.92)	20125(97.80)	453(2.20)
Master of nursing	557(2.04)	414(74.33)	143(25.67)	325(58.35)	232(41.65)	424(76.12)	133(23.88)	478(85.82)	79(14.18)
Doctoral of nursing	21(0.08)	16(76.19)	5(23.81)	17(80.95)	4(19.05)	21(100.00)	0(0.00)	20(95.24)	1(4.76)
χ^2		775.909		993.957		546.238		499.674	
P		<0.001		<0.001		<0.001		<0.001	
Nursing experience (years)									
1–5	11037(40.38)	10925(98.99)	112(1.01)	10677(96.74)	360(3.26)	10935(99.08)	360(3.26)	10984(99.52)	53(0.48)
6–9	7081(25.90)	6963(98.33)	118(1.67)	6754(95.38)	327(4.62)	6870(97.02)	327(4.62)	6996(98.80)	85(1.20)
10–14	4040(14.78)	3850(95.30)	190(4.70)	3708(91.78)	332(8.22)	3726(92.23)	332(8.22)	3937(97.45)	103(2.55)
15–19	1927(7.05)	1771(91.90)	156(8.10)	1663(86.30)	264(13.70)	1690(87.70)	264(13.70)	1851(96.06)	76(3.94)
20–29	2564(9.38)	2142(83.54)	422(16.46)	1910(74.49)	654(25.51)	2102(81.98)	654(25.51)	2374(92.59)	190(7.41)
30–39	660(2.41)	531(80.45)	129(19.55)	454(68.79)	206(31.21)	526(79.79)	206(31.21)	611(92.58)	49(7.42)
40–45	7(0.03)	5(71.43)	2(28.57)	5(71.43)	2(28.57)	5(71.43)	2(28.57)	6(85.71)	1(14.29)
χ^2		1848.564		2121.939		1846.897		670.87	
P		<0.001		<0.001		<0.001		<0.001	
Employment									
Contract employee	19089(69.83)	18777(98.37)	312(1.63)	18301(95.87)	788(4.13)	18608(97.48)	481(2.52)	18903(99.03)	186(0.97)
Regular employee	7269(26.59)	6482(89.17)	787(10.83)	5991(82.42)	1278(17.58)	6331(87.10)	938(12.90)	6919(95.19)	350(4.81)
Others	977(3.58)	946(96.83)	31(3.17)	896(91.71)	81(8.29)	933(95.50)	44(4.50)	956(97.85)	21(2.15)
χ^2		1124.829		1316.785		1122.082		389.059	
P		<0.001		<0.001		<0.001		<0.001	
Technical title									
Nurse	7780(28.46)	7712(99.13)	68(0.87)	7561(97.19)	219(2.81)	7752(99.64)	28(0.36)	7763(99.78)	17(0.22)
Nurse practitioner	12836(46.96)	12665(98.67)	171(1.33)	12351(96.22)	485(3.78)	12492(97.32)	344(2.68)	12710(99.02)	126(0.98)
Nurse-in-charge	5737(20.99)	5223(91.04)	514(8.96)	4784(83.39)	953(16.61)	4937(86.06)	800(13.94)	5486(95.62)	251(4.38)
Co-chief superintendent nurse	902(3.30)	574(63.64)	328(36.36)	464(51.44)	438(48.56)	635(70.40)	267(29.60)	769(85.25)	133(14.75)
Chief superintendent nurse	80(0.29)	31(38.75)	49(61.25)	28(35.00)	52(65.00)	56(70.00)	24(30.00)	50(62.50)	30(37.50)
χ^2		3822.754		3601.401		2542.795		1591.38	
P		<0.001		<0.001		<0.001		<0.001	
Administrative post									
None	25530(93.40)	25013(97.97)	517(2.03)	24221(94.87)	1309(5.13)	24566(96.22)	964(3.78)	25256(98.93)	274(1.07)
Head nurse	1645(6.02)	1105(67.17)	540(32.83)	886(53.86)	759(46.14)	1187(72.16)	458(27.84)	1395(84.80)	250(15.20)
Nursing Supervisor	118(0.43)	67(56.78)	51(43.22)	60(50.85)	58(49.15)	81(68.64)	37(31.36)	95(80.51)	23(19.49)
Director of nursing department	42(0.15)	20(47.62)	22(52.38)	21(50.00)	21(50.00)	38(90.48)	4(9.52)	32(76.19)	10(23.81)
χ^2		4405.427		3975.03		1926.649		1825.944	
P		<0.001		<0.001		<0.001		<0.001	
Clinical tutor									
Yes	9761(60.57)	16524(94.03)	1050(5.97)	15713(89.41)	1861(10.59)	16206(92.22)	1368(7.78)	17054(97.04)	520(2.96)
No	17574(39.43)	9681(99.18)	80(0.82)	9475(97.07)	286(2.93)	9666(99.03)	95(0.97)	9724(99.62)	37(0.38)
χ^2		420.827		508.694		574.681		209.239	
P		<0.001		<0.001		<0.001		<0.001	

Note: All the data in the rows of research projects (PI), research attendance, studies published, and patent are the number of participants and participation rates. Chi square tests were performed to calculate the *P*-value.

indicated that nurses were not sufficiently ready to conduct scientific research, and they seldom integrated scientific methodology in their clinical practice although they were aware of the research value. We discuss the results from different perspectives in the following sections.

4.1. Nurses' insufficient involvement in scientific research

Nurses are not sufficiently involved in scientific research activities (Table 1). Nurses even worked in tertiary hospitals, representing high level research, seldom performed scientific research, and rarely directed research projects as PIs. This result accords with the common feeling that nursing research is not sufficiently integrated into clinical practice. Although nursing research has developed worldwide, problems, such as lack of fund, arguments about nurses' contributions to research, and limited research capacity, still exist similar to different countries [29]. According to Gray [30] and Smith [1], the quality of published outcome analysis definitions

Table 2
Differences in self-evaluated skills and training needs by respondents' demographic characteristics($n = 27,335$).

Characteristics	Scientific research skills	Training needs
Gender		
Male	29.38(17.50, 49.38)	50.00(38.67, 75.00)
Female	25.00(12.50, 36.88)	53.13(37.50, 75.00)
Z	4.978	1.267
P	<0.001	0.107
Age (years)		
18–24	25.00(11.88, 37.50)	50.00(34.38, 75.00)
25–34	23.75(11.88, 35.50)	51.56(35.94, 75.00)
35–44	27.50(16.88, 42.50)	60.94(45.31, 75.00)
45–54	28.75(17.50, 45.00)	56.25(40.63, 75.00)
55–63	33.13(20.63, 51.41)	52.34(31.64, 73.44)
H	414.479	172.109
P	<0.001	<0.001
Highest educational level		
Vocational school	22.50(9.38, 34.38)	50.00(25.00, 64.06)
Diploma degree	22.50(10.00, 33.13)	50.00(28.13, 70.31)
Bachelor of science in nursing	25.00(13.13, 37.50)	54.69(40.63, 75.00)
Master of nursing	52.50(37.50, 66.56)	75.00(59.38, 90.63)
Doctoral of nursing	40.63(25.63, 52.50)	50.00(46.88, 61.72)
H	860.625	783.003
P	<0.001	<0.001
Nursing experience (years)		
1–5	25.78(11.25, 35.63)	53.88(35.94, 75.00)
6–9	25.30(11.88, 35.00)	54.52(35.94, 75.00)
10–14	27.26(13.13, 37.50)	55.23(35.94, 75.00)
15–19	29.15(16.25, 40.00)	58.27(42.19, 75.00)
20–29	30.84(16.88, 43.13)	58.49(45.31, 75.00)
30–39	33.71(18.75, 48.13)	56.45(39.06, 75.00)
40–45	25.36(3.75, 39.38)	51.34(25.00, 75.00)
H	363.752	318.5
P	<0.001	<0.001
Employment		
Contract employee	25.42(11.88, 35.00)	53.18(34.38, 75.00)
Regular employee	30.15(15.63, 43.13)	59.79(46.88, 75.00)
Others	28.30(14.38, 38.13)	56.45(40.63, 75.00)
H	992.321	592.271
P	<0.001	<0.001
Technical title		
Nurse	25.47(10.63, 35.00)	50.65(29.69, 75.00)
Nurse practitioner	25.00(11.25, 34.38)	54.59(35.94, 75.00)
Nurse-in-charge	30.02(16.88, 41.25)	60.06(46.88, 76.56)
Co-chief superintendent nurse	40.13(26.25, 51.88)	66.38(51.17, 79.69)
Chief superintendent nurse	56.91(45.31, 68.75)	70.72(53.13, 82.42)
H	992.321	592.271
P	<0.001	<0.001
Administrative post		
None	25.70(11.88, 35.63)	53.86(34.38, 75.00)
Head nurse	41.52(28.13, 52.50)	71.97(57.81, 87.50)
Nursing Supervisor	44.87(32.34, 56.41)	73.11(60.94, 84.38)
Director of nursing department	54.30(37.97, 68.91)	67.04(50.00, 81.25)
H	1275.203	771.344
P	<0.001	<0.001
Clinical tutor		
Yes	24.88(10.63, 34.38)	52.55(32.81, 75.00)
No	27.83(13.75, 38.75)	56.44(40.63, 75.00)
Z	−14.092	−10.268
P	<0.001	<0.001

Note: All the data in the rows of scientific research skills and training needs are median (first quartile [25%] score, third quartile [75%] score). Nonparametric test of two- or k-independent samples was performed to calculate the *P*-value.

Table 3
Subscale standardized scores of scientific research skills and training needs ($n = 27,335$).

Subscale standardized scores	Scientific research skills	Research training needs
Research topic selection	32.5(22.50, 47.50)	50(50.00, 75.00)
Literature review	25(15.00, 40.00)	50(37.50, 75.00)
Research design	25(2.50, 37.50)	50(35.00, 75.00)
Data processing	20(0.00, 30.00)	50(33.33, 75.00)
Paper composition	25(10.00, 50.00)	50(50.00, 75.00)
Research transformation	15(5.00, 25.00)	50(37.50, 75.00)

Note: All the data in the rows are median (first quartile [25%] score, third quartile [75%] score) because of skewed distributions.

Table 4
Training needs subscale score and their correlation with research output and skills ($n = 27{,}335$, r value).

Subscales	Scientific research training needs					
	Research topic selection	Literature review	Research design	Data processing	Paper composition	Research transformation
Research projects (*PI*)	0.109	0.092	0.109	0.110	0.085	0.094
Research attendance	0.138	0.115	0.140	0.139	0.117	0.127
Papers published	0.140	0.122	0.144	0.147	0.135	0.145
Patent	0.074	0.069	0.080	0.077	0.067	0.077
Scientific research skills	0.208	0.231	0.250	0.246	0.219	0.232
Research topic selection	0.201	0.204	0.218	0.214	0.194	0.205
Literature review	0.222	0.261	0.256	0.255	0.236	0.243
Research design	0.176	0.197	0.225	0.222	0.186	0.202
Data processing	0.154	0.186	0.208	0.207	0.173	0.185
Paper composition	0.222	0.247	0.263	0.260	0.250	0.253
Research transformation	0.163	0.190	0.210	0.203	0.179	0.192

Note: all $P < 0.001$.

and the registration of randomized controlled trials are not often optimal in nursing journals. Unnecessary delays in beginning a research project may occur because of organizational and/or personnel factors, such as time pressure or limited knowledge; lack of time and knowledge are important barriers to research [3,31]. From a policy and professional perspective, nurses and other allied health practitioners should contribute to research to develop strong research basis for improving patient care. Moreover, nursing is still struggling to develop as an academic discipline, in addition to becoming a significant contributor to collaborative research [31]. Nurses have highlighted the importance of nursing research and acknowledge that they are connected to professional development and advanced clinical nursing care and are essential to recognize that improving nurses' research ability is an outcome in itself [32,33].

4.2. Nurses' low scientific research skill and relatively high research training needs

Nurses in this study had a negative opinion of their research ability, indicating their lack of fundamental knowledge and basic skills, such as accessing the literature, designing a study, and performing statistical analysis. Nurses had low ability in data processing and research transformation but relatively high ability in research topic selection (Table 3). For research training needs, the scores on six subscales were almost equal with higher levels compared with self-rated scientific research skills (Table 3). Nurses' research training needs were positively related to research outputs and scientific skills (Table 4), and differences were found by demographic and job-related characteristics (Table 2). Hence, organizing suitable programs for nurses in considering different research ability levels, different training needs, and different characteristics is necessary to enhance the whole nursing professional research ability and output.

Nursing schools and colleges are intended to "catch-up" with their non-nursing counterparts in research and academic outcomes [22,31]. Whether they are productive enough to completely fill the nursing staff positions, especially the large number of clinical nursing faculty, is arguable [34]. Despite the anti-academic attitudes of some nurses, clinical health caregivers and academic faculty are encouraged to work together to integrate research with a holistic educational approach and ensure that nursing will be a coherent research-focused profession in the future. From the perspective of professional development, international collaboration and building research networks are commonly described as crucial approaches to increase research participation and lift the whole nursing profession level [35–37].

4.3. Variables influencing nurses' scientific research output, skills, and training needs

In this study, significant differences were found by gender, age, working life years, education, technical title, administrative post, employment and whether or not a clinical tutor in nurses' research participation, scientific skills, and research training needs (Tables 1 and 2). In general, nurses with higher educational level, technical title, and administrative post may have more research participation, higher self-rated research ability, and research training needs than others. These factors may be classified into external and internal factors. Most of the variables were considered to be beyond nurses' own sphere of influence, e.g., demographic and job-related variables, which may be considered external determinants [27]. Lack of knowledge of methodology, which would determine nurses' behavior and even be an excuse for not doing research, can be considered an internal attribution. Previous research on the relationship between attributions and performance indicated that internal and stable attributions predict high levels of academic performance [38–40]. This finding is remarkable because education and courses that teach research methodology should focus on teaching skills related to different external factors [41,42].

This study suggests that using a holistic approach to determine the research ability and training needs of different nurses may encourage them to conduct a research project. Courses and tutorial instructions are essential to foster nurses' independent learning and equip them with the skills to conduct research in clinical practice [14,16,43]. In general, nurses have no shortage of ideas for proposing scientific research on various topics, but they seldom have enough knowledge or ability to develop their ideas into studies; and even when they conduct research, minimal support is provided to them to help them through the research process [42,44]. Nurses could benefit in many ways if careful consideration was given to providing research support tailored to their own situation and ability, e.g., novel teaching strategies, role playing, and e-learning strategies to maintain engagement [43].

4.4. Strengths and limitations

The study has a number of strengths, including the fact that it surveyed a large nationwide sample of Chinese nurses from tertiary hospitals with a relative response rate. Moreover, the survey questionnaire was designed within the framework of the whole research process; as such, the questionnaire could well assess nurses' scientific research skills and training needs. All the data were collected throughout the country within 1 month to ensure the structure stability over time. The results provide valuable evidence for nursing managers and international collaborators when

organizing and designing scientific research programs for nurses.

However, this work does not come without limitations. First, this study is quantitative, in which all the data come from China. Thus, some of the observed results may be considered “local” or regional although it has implications for capacity building globally. In addition, international cooperative comparative projects on building scientific research capacity are encouraged. Second, data were collected via a self-rated questionnaire because no standardized instrument could be used. However, we used a research framework to accurately reflect nurses' research ability and training needs. The questionnaire was reviewed and approved by the Nursing Branch of the Chinese Research Hospital Association before distribution. The reliability (assessed by Cronbach's α) of the questionnaire was relatively high. The results and conclusions may also be limited for presenting the whole national level because nurses in this study were from tertiary hospitals. We also consider expanding our investigation among secondary hospitals and primary hospitals in the next study.

5. Conclusion

This study showed a significant disparity in nurses' scientific research output and self-reported research skills from that current expectation of nursing professionals. Nurses reported high needs for training in scientific research methodology, whereas differences were found by demographic and job-related characteristics. These factors should be considered to improve the quantity and enhance the quality of clinical research conducted by clinical nurses, managers, and educators. Therefore, programs should tailor training in research methodology to fit nurses' specific situations, including their internal attributions (research methodology skills) and external factors (demographic and job-related characteristics).

Conflicts of interest

None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2019.05.007.

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