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Is Nursing education still inside of the nursing profession? A multilevel national analysis of students' interprofessional education experiences

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Running title

Nursing students interprofessional education experiences

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All the authors have no financial or other relationships to report.

Data Sharing Statement

None

Author Contributions

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Abstract

Objective: To explore nursing students' interprofessional education (IPE) experiences during their most recent clinical rotation and factors influencing their occurrence.

Design: National cross-sectional study on 2016 data.

Setting: 95 Bachelor of Nursing Sciences programmes; 27 universities.

Participants: Students who a) were attending or just completed their clinical rotations lasting at least two weeks in the same unit, and b) expressed a willingness to participate in the study.

Primary and secondary outcome: occurrence of IPE experiences in the most recent clinical rotation; the secondary outcome was to discover the associated factors.

Measures: The primary outcome was measured using question based upon a 4-point Likert scale (from 0 = *never* to 3 = *always*). Explanatory variables were collected at individual and regional levels by including items in the same questionnaire.

Results: 9,607 out of 10,480 participated. Overall, 666 (6.9%) students perceived not having any IPE experiences, while 3,248 (33.8%), 3,653 (38%), and 2,040 (21.3%) reported having experienced IPE opportunities only on a few occasions, to some extent, or only when required, respectively. From the multilevel analysis, factors promoting the occurrence of IPE experiences were mainly set at the clinical learning environment level (high: quality of the learning environment, self-directed learning expectations, learning opportunities, quality of safety and nursing care, quality of tutorial strategies) and at the regional level where significant differences emerged across regions. In contrast, males have been negatively associated with the perception of having IPE experiences.

Conclusions: A large number of nursing students experienced either 'never' or 'only a little' IPE occasions, thus suggesting that nursing education still remains inside of the nursing profession. Limiting students' interprofessional exposure during education can prevent collaborative approaches recommended as providing the best patients care. Strategies designed for the unit and regional levels aimed at increasing IPE are urgently needed.

Keywords: clinical learning, collaboration, interprofessional education, interprofessional cooperation, nursing students, student perception, teamwork

Article summary

Strengths and limitations of this study

- This is the first study examining the extent and associated factors of interprofessional education among nursing students.
- This is a national study involving a large number of nursing programmes, thus potentially fostering the generalizability of the findings.
- This is the first multilevel study in this context aimed at identifying the complexity of factors influencing interprofessional education opportunities.
- A cross-sectional design was adopted to measure the primary outcome and associated factors at the same time, thus suggesting caution in considering the factors that emerged as predictors of interprofessional education opportunities experienced by students.
- Data affecting interprofessional education opportunities (e.g., the contents of interprofessional collaboration in the study programs, healthcare professional profiles available at the unit level) were not collected.

Introduction

The need to increase complexities both in health care and clinical pathways, especially with the growing aging population, all have been documented as requiring better collaborative and team-based models of care delivery[1] with interprofessional teams being best positioned to ensure quality and safe care.[2] In this context, interprofessional collaboration (IPC) has been defined as implying a range of key dimensions, including shared goals, team identity, commitment, clear team roles and responsibilities, interdependence between team members, and integration between work practice.[3] From the side of patients, IPC has been documented as enhancing patient- and family-centred care, thus increasing the patient-reported quality of care,[4] also preventing the occurrence of the most frequent adverse events.[5] From the side of the healthcare professionals, IPC has been documented as improving communication among caregivers, increasing opportunities of shared responsibilities and effective participation in multidisciplinary decision-making across disciplines[6, 7] and, ultimately, increasing satisfaction and well-being.[8] According to its relevance, different strategies aimed at increasing IPC has been documented to date, and among others, interprofessional education (IPE) offered in undergraduate programs has been documented as effective in increasing further interprofessional collaboration.[9, 10]

Nurses have been highlighted to fulfil a strategic position to embrace IPC by cooperating with a wide range of healthcare professional (HCPs) in all healthcare settings.[11] Given their role in promoting and enhancing IPC in daily practice,[2] it has become imperative for universities to provide nursing students with interprofessional knowledge and competences.[7] In this light, different policies[12, 13] and evidence in the field[14] have recommended that nursing students should be exposed early to IPE both at classroom lecturing and clinical environment levels in order to acquire collaborative skills, position their role as a member of a team and not as a subordinate, and to understand the roles they are expected to fulfil in the future. Students who have been exposed to IPE can enter the profession equipped to function effectively in a team context;[15, 16] moreover, extending their nursing perspective towards patients, knowledge, and competence with other disciplines has been documented as promoting problem-solving and critical thinking abilities.[17] Differently, when their IPE experiences are poor or take place at the end of their program, their effectiveness as part of a team after graduation is threatened.[18]

Despite its relevance, IPE opportunities have been documented as often not being included in undergraduate healthcare programmes, and nursing students have reported only a few opportunities to have meaningful contact with other HCPs during their education.[7] Nurses are often educated exclusively within their profession without having the opportunity to learn other HCP roles and responsibilities.[7] As a consequence, students have shown a lack of collaborative and teamwork competences[19] and less exposed to conflicts within the healthcare team when entering into

professional life.[11] Factors threatening the intent of nursing faculties to integrate IPE opportunities in clinical training have been established at the organizational level (e.g., lack of institutional collaboration), managerial level (e.g., poor vision and desire to change), practical level (e.g., lack of time), and cultural level (e.g., different perceptions of teamwork, stereotyped behaviours, and the potential risk of dominance for one profession—usually medicine—over others).[20, 21] However, despite its relevance, the degree of IPE opportunities experienced by nursing students has not been studied in large samples; above all, factors promoting IPE have not been identified to date at the country level where national healthcare policies and healthcare professional educational policies can both have an influence in promoting IPC. Therefore, the purposes of this study were to cover the gap in the available evidence by exploring nursing students' IPE experiences during their clinical learning and associated factors.

Methods

Study network and design

On a preliminary basis, this study formed an Italian network aimed at evaluating nursing students' clinical education by involving all Bachelor of Nursing Sciences (BNS) degrees. Specifically, the study invited 43 universities, offering 208 BNS located in 20 Italian regions by sending an open call to participate in the research network with a summary of the study protocol.[22] After two months, the invitation was closed, and the network was composed of 27 universities with 95 BNS degrees located in 15 regions.[22] Thus, the nation-wide, cross-sectional study was performed, and the findings have been reported here according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE).[23]

Participants

Eligible students were those who: (a) were attending a BNS degree belonging the national research network; (b) were attending their clinical practical rotations lasting at least two weeks in the same unit; or (c) had just completed their clinical rotation in the previous two weeks without having started a new rotation at the time of the survey; and (d) expressed a willingness to participate in the study after being informed of the aims.

Primary outcome, other variables, and instruments

The experience of IPE in clinical practice in students' most recent clinical learning experience was the primary outcome of the study and was assessed with an item on the survey questionnaire: 'Did you experience IPE during your most recent clinical rotation?' Aiming at ensuring consistency in IPE concept interpretation, the item also provided some examples of IPE (e.g., working and/or

learning bedside with other HCPs; participating in multi-professional meetings, etc.). The answers were based on a 4-point Likert scale, (0 = *never*; 1 = *a little*; 2 = *to some extent*; and 3 = *always when required*).

There were collected variables established at the (a) individual and (b) regional levels.

- at the individual level the following variables were collected: socio-demographic (e.g., age, gender, marital status); academic year attended (1st, 2nd, or 3rd); previous secondary and academic education; working experiences, both previously and during nursing education; and previous clinical rotation experiences attended (in number) and in which settings (i.e., only at the hospital level, in the community levels, or in both). In regards to their most recent clinical learning experience, participants were asked: (a) its duration (weeks); (b) the supervision model adopted by the unit (whether the student was under the supervision of a clinical nurse, the entire staff, a nurse identified by the head nurse, a nurse teacher, or head nurse); and (c) the perceived effectiveness on the degree of competence learned (4-point Likert scale ranging from 0 = *none* to 3 = *very much*). Moreover, the perceived quality of the learning processes enacted during the most recent clinical rotation was required by the Clinical LEarning Quality Evaluation Index (CLEQI) tool:[24] this tool is constituted by five factors: 'Quality of the tutorial strategies' (6 items), 'Learning opportunities' (6 items), 'Self-directed learning' (3 items), 'Safety and nursing care quality' (4 items), and 'Quality of the learning environment' (3 items). Each factor, as well as the overall CLEQI score, may range from 0 to 3, with larger scores indicating a higher quality of the learning processes enacted in the clinical setting as perceived by students.
- at the regional level, the region where the BNS degree was offered was recorded: by law, nursing education is provided through lectures in academic settings, while clinical rotations take place in local healthcare organizations (e.g., hospitals). With the federalisation of the healthcare system at the regional level,[25] Italy has different systems according to regional policies and rules that can affect nursing education.

After piloting the questionnaire aimed at ensuring its feasibility and comprehensiveness, the data collection process was started in the same period in all nursing programmes, forming the research network via paper and pencil or via Google Drive, according to local feasibility and resources.

Data analysis

Descriptive statistical analysis was performed by calculating frequencies and percentages, averages with standard deviations (SD) or confidence intervals (CI) at 95%. A bivariate analysis was performed, where the primary outcome was considered as a categorical variable forming four groups: students who experienced IPE opportunities as 'not at all', 'only a little', 'to some extent',

and 'always'. Chi-square tests, ANOVA, and Kruskal-Wallis tests were used to explore the significant differences, if any, across groups.

On a preliminarily basis, the intra class correlation (ICC) was evaluated under fixed and random effect assumptions to identify cluster effects at different levels, specifically: (a) at the unit level attended by students during their clinical rotation, assuming that some units (e.g., intensive care units vs. nursing homes) can offer IPE opportunities due to differences in their teams (at high or low IPC according to their skill mix), (b) at the nursing programme level, assuming that BNS degrees can develop different strategies to promote IPE, and (c) at the regional level, since Italian regions have developed different healthcare systems after reforms from federalising healthcare delivery, with an additional potential impact on the culture of teamwork collaboration that permeates the clinical settings attended by students.[25] ICCs at the unit level were 0.07 (random effects) and 0.06 (fixed effects); at the nursing programme level they were 0.01 (both under random and fixed effects); and at the regional level they were 0.06 (random effects) and 0.03 (fixed effects), respectively.

Next, a multilevel analysis using the generalized linear mixed model was performed by calculating the odd-ratios (OR; CI 95%) and the pseudo R2. The primary outcome was entered in the model as a dichotomous variable (to 'some extent' + 'always' vs. 'not at all' + 'only a little'), as well as those variables emerging as significantly associated with the outcome at bivariate analysis. All analyses were performed by using the SPSS Statistical Package version 24 and R Core Team.[26] Statistical significance was set at $p < .05$.

Ethical issues

The study protocol was approved by the University Ethical Committee of Milan University (Italy).[22] Participants gave their consent to participate in the study.

Patient and Public Involvement

Patients and public were not involved.

Bias control

At the national level, several strategies have been promoted to obtain nursing programme participation in the network by sending an open call invitation at different times, usually two weeks apart, thus preventing selection bias. Information bias was prevented by standardising the information provided to those identified as responsible for the data collection in each participating nursing programme and by providing a precise description of study aims and data collection procedures on the first page of the questionnaire as well as on a sheet sent to the contact person for

each BNS degree. Aimed at preventing recall bias, students were invited to fill in the questionnaire during the last week of their clinical rotation or at least after the following two weeks after its end when they were not exposed to other clinical rotations. Data were analysed by the coordinator centre (University of Udine) in a blind fashion to ensure anonymity in regards to the units, nursing programmes, and regions (which were number consecutively; e.g., Region 1). Moreover, students were free to participate in the survey without any pressure or incentives.

Results

Primary outcome

Out of 10,480 eligible students, 9,607 participated in the study. A total of 666 (6.9%) students reported to never have been involved in IPE opportunities; 3,248 (33.8%) reported experiencing only a little opportunity; 3,653 (38.0%) reported experiencing these opportunities to some extent; while the remaining 2,040 (21.3%) reported consistently experiencing IPE during their most recent clinical rotations.

Bivariate analysis

At the individual level (Table 1), students who reported no experiences of IPE were more often female ($p < .00$), older ($p = .015$), unmarried ($p = .032$), with previous work experience ($p = .017$), and with more previous clinical rotations exclusively in hospital settings ($p < .001$).

Specifically, with regard to the most recent clinical rotation, students who reported no IPE experiences attended a shorter-duration clinical rotation ($p = .007$) where they were more frequently supervised by the nursing staff ($p < .001$) and reported having learnt less competences ($p < .001$). They also reported lower average scores both in all factors (all p's $< .001$) and in the total CLEQI score ($p < .001$; Table 1). Instead, those students who reported to have consistently experienced IPE were more often attending their third year ($p < .001$) and were working during their nursing education ($p = .016$; Table 1).

At the regional level, 0.9% of students from region 2 and 13% from region 15 who were attending their nursing programmes reported no IPE experiences versus 8.7% of students in region 12 and 41.1% in region 2, who reported having experienced IPE opportunities consistently (Table 1).

Factors affecting IPE

The multilevel analysis performed using the generalized linear mixed model showed an acceptable value for the pseudo R^2 of 15.1%.

At the individual level, most recent rotations that had a high-quality learning environment (OR = 1.506, 95% CI [1.337, 1.659]), highly encouraged self-directed learning opportunities (OR = 1.485, 95% CI [1.361, 1.620]), and offered higher learning opportunities (OR = 1.408, 95% CI [1.242, 1.597]) all promoted the likelihood of IPE. Moreover, a context based upon high safety and nursing care quality (OR = 1.317, 95% CI [1.178, 1.473]), where high-quality tutorial strategies were offered (OR = 1.196, 95% CI [1.066, 1.341]), and where students reported high competences learned (OR = 1.411, 95% CI [1.292, 1.540]) also promoted the likelihood of IPE. Differently, males (OR = 0.821, 95% CI [0.727,0.927]) were negatively associated with the perception of having experienced IPE (Table 2).

At the regional level, students attending a nursing programme in region 2 were approximately 1.75 times more likely to have experienced IPE opportunities compared to region 1 (OR = 1.746, 95% CI [1.119, 2.726]). In contrast, students attending their nursing programmes in other regions (specifically, numbers 3, 4, 6, 7, and 15) reported a lower likelihood (OR from 0.554 to 0.716) of IPE experiences compared to region 1.

Discussion

This study explored nursing students' experiences of IPE during their clinical rotations and their promoting factors at the national level. IPE has been considered an effective educational strategy to increase professional and collaborative competences, thus ultimately promoting IPC in a real context.[14, 27, 28] It is recommended that learning non-technical skills—such as teamwork—should be offered early to healthcare students as part of their undergraduate core curriculum, since cooperation between different HCPs is pivotal to provide patients high-quality and safe everyday care.[2, 29] However, despite its wide recognition, Italian nursing students experienced a lack of opportunities to learn by working with other healthcare professionals, with 40.7% of them reporting 'not at all' to 'only a little' IPE opportunities during their last clinical rotation. This can affect their future ability to cooperate with other members of a team. Students experiencing limited IPE because, for example, there are poor examples of IPC in their clinical settings,[30] lacked an understanding of each HCP's role and were unclear on HCP responsibilities and strategies to achieve effective collaboration among staff.[16, 31]

According to our findings, IPE occurrences were only partially affected by individual factors, whereas a greater influence has emerged in the clinical environment and geographical context where clinical rotations were attended. Regarding the latter, students have been exposed to different IPE occurrences across Italian regions, suggesting that different healthcare systems[25] have developed different IPC sensitivities at the ward level. High occurrences of IPE in some regions should be considered best practices for other regions, and policies and/or interventions that are

developed at different levels should be shared (e.g., hospitals, regional levels) to increase IPE. On the other hand, those regions where healthcare institutions have offered few IPE experiences to students should reflect on whether the care models leading the delivery of services are still based upon the traditional hierarchy across healthcare professionals in order to identify strategies that can move a teamwork perspective forward.

With regard to the impact of the clinical setting attended by students, it was found that all factors measured with the CLEQI tool[24] detecting the quality of learning processes enacted by the student in the actual context were positively associated with the high likelihood of IPE occurrences. The clinical learning environment is composed of different psychosocial, organizational, cultural, and interactional factors in addition to physical space and the teaching/learning components that all promote the learning of competences, [32] including interprofessional ones. Specifically, those students who perceived a higher-quality clinical learning environment were 1.5 times more likely to report IPC experiences in their most recent rotation. The perceived quality of the clinical environment has already been associated with the type, quality, and amount of interactions between students and the nursing staff,[33] suggesting that a good-quality environment can also increase the quality of interprofessional interactions, thus promoting IPE occasions.

Moreover, students who were encouraged to be independent in their learning processes reported to have experienced around 1.5 times more IPC opportunities. Self-directed learning has been documented as encouraging self-evaluation and learning;[34] by evaluating their own learning needs and searching for different strategies to address them, students can be encouraged to collaborate with other healthcare professionals as a source to clarify the nature of patients' problems[16] and learning from other disciplines.[35]

Perceiving higher learning opportunities as well as high-quality and safe nursing care delivered in the ward also increased the perceptions of IPE opportunities. Having the opportunity to learn a range of technical and non-technical skills (e.g., communication) is deeply intertwined with IPE because students can increase their confidence in searching for multidisciplinary collaboration.[29] Moreover, teamwork, cooperation, and shared discussions across HCPs[16] have all been documented as foundational in promoting the quality of care and patient safety: students experiencing their clinical learning in units based upon these principles can discuss with their supervisors various care processes,[36] be directly involved in or witness interprofessional collaboration occurring during meetings, and participate in integrated care planning.[16] On the other hand, those wards with limited attention on patient safety and with poor quality of care can have a few interprofessional collaborative opportunities: as a consequence, a missed interprofessional involvement of students can limit the opportunity of IPE.[28, 36]

Furthermore, the quality of tutorial strategies increased the likelihood of IPE experiences, thus suggesting that those nurses responsible for clinical teaching can create opportunities to expose students to interprofessional contacts. However, the contribution of these factors on IPE is limited; in line with this finding, tutorial models delivered at the ward level have not influenced students' IPE experiences, given that the different options (e.g., being supervised by a clinical nurse or staff) are all inside of the nursing profession. Providing a more complex model of nursing student supervision, and also involving other HCPs, should be further studied for its capability to increase IPE. According to available evidence,[37] only student exposure to the team can increase understanding of interprofessional processes of care, thus allowing the development of strong interprofessional skills.

Finally, the increased competences acquired during students' last clinical training was positively associated with the perception of IPC experiences, suggesting that environments allowing the acquisition of greater clinical competences are around 2.41 times more likely to expose students to IPC; in contrast, those units offering a few competence acquisitions have resulted in limited interprofessional collaboration experiences.

At the individual level, only males emerged as negatively associated with IPC experiences: the reasons behind these findings[38] should be explored in more detail, and suggest that male students should be more supported in developing interdisciplinary skills compared to female students.

Limitations

Students were asked to self-report their IPE occurrences (from never to always) in their most recent clinical rotations, not in their entire nursing rotations; moreover, no data have been collected on the core contents of IPC across degrees that could have promoted different IPE expectations among students. Also, some relevant data such as healthcare professional profiles available at the unit level (e.g., only nurses and physicians) and the team-to-students' ratio, as well as the role of the students (e.g., supernumerary or fully involved in nursing care), were not collected. Furthermore, we used only questions to explore IPE experiences by providing some examples of IPC to increase clarity and consistency in data collection; however, the type and quality of these IPE experiences have not been investigated. In addition, the cross-sectional design suggests caution in considering factors that emerged in the multilevel analysis as predictors of IPC according to students' perception, since other study designs would have been preferable to answer causative questions. Finally, the multilevel analysis only explained 15% of students' perceptions of IPC opportunities. Consequently, future research is recommended to capture other significant factors not identified in this study. Moreover, future studies should also target the barriers preventing IPE occasions among

nursing students by also involving other healthcare professionals, aimed at acquiring a complete picture of IPE across healthcare professional education in Italy.

Conclusion

A large number of nursing students ranged in their perceptions from 'not at all' to 'only a little' IPE experiences, thus suggesting that nursing education seems to remains mainly inside the nursing profession. Graduate nurses are not always trained to interact with other HCPs, thus suggesting that IPC is still challenging both in current practice, where a few occasions are offered to students, and in future practice, given that interprofessional collaboration is also based upon the quality of education offered before graduation. The limited opportunities to develop teamwork skills to transfer into future practice for a large number of next-generation healthcare workers may also prevent the complete transition from hierarchical approaches to collaborative approaches, which have been recommended as providing the best patient care.

Associated factors have emerged mainly at the clinical context levels where students attend their clinical rotations, and at the regional levels, suggesting that IPE is influenced by a collaborative culture promoted at the ward level and by the policies developed at regional levels, inspiring both healthcare institutions and universities. Differently, individual factors have emerged that have a limited contribution to IPE occurrences, suggesting that male students should be more encouraged to collaborate with other HCPs.

At the clinical environment level, each HCP should be supported by adopting a teamwork approach and learning environments should be periodically assessed for their ability to offer students the opportunity to develop collaborative skills. Moreover, benchmarking policies at the regional level aimed at promoting a higher sensitivity concerning the positive correlation between interprofessional teamwork and patient safety are recommended. IPC should become routine across all healthcare facilities regardless of the type of clinical environment or geographical context.

Data Statement

Technical appendix, statistical code, and dataset available from the Coordinating centre (Udine university, Alvisa Palese and Luca Grassetti).

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Table 1. IPE opportunities as experienced by students during the most recent clinical rotation

	Not at all N = 666 (6.9%)	Only a little N = 3248 (33.8%)	To some extent N = 3653 (38.0%)	Always when requested N = 2040 (21.3%)	$p^{\ddagger}$
Individual level					
Age, years, mean (95% CI)	23.2 (23-23.7)	22.9 (22.7-23.0)	22.79 (22.7-22.9)	23.0 (22.8-23.2)	0.015
Female (n=9596), n (%)	531 (80.0)	2561 (78.9)	2732 (74.9)	1479 (72.6)	<0.001
Civil status, n (%)					
Unmarried	629 (94.4)	3047 (93.8)	3460 (94.7)	1909 (93.6)	0.032
Married/cohabitant	26 (3.9)	164 (5.0)	138 (3.8)	107 (5.3)	
Divorced	3 (0.5)	110 (0.4)	14 (0.4)	9 (0.4)	
Widowed	2 (0.3)	1 (0.0)	1 (0.0)	3 (0.1)	
Missing	6 (0.9)	25 (0.8)	40 (1.1)	12 (0.6)	
With children, n (%)	26 (3.9)	138 (4.3)	174 (4.8)	90 (4.5)	0.636
Secondary education (n=9442), n (%)					
High school	450 (68.2)	2260 (70.8)	2507 (69.9)	1414 (70.3)	0.287
Technical school	25 (3.8)	149 (4.7)	160 (4.5)	76 (3.8)	
Professional school	112 (17.0)	490 (15.4)	596 (16.6)	320 (15.9)	
Teacher school	58 (8.8)	256 (8.0)	282 (7.9)	172 (8.6)	
Secondary school abroad	15 (2.2)	34 (1.1)	39 (1.1)	28 (1.4)	
Academic year attended (n=9579), n (%)					
First	183 (27.5)	1008 (31.2)	1123 (30.8)	595 (29.3)	<0.001
Second	249 (37.5)	1149 (35.5)	1251 (34.3)	633 (31.1)	
Third	233 (35.0)	1078 (33.3)	1272 (34.9)	805 (39.6)	
Academic experience (n=9515), n (%)					
None	428 (64.5)	2235 (69.3)	2538 (70.2)	1386 (68.9)	0.224
Graduated in other fields	38 (5.7)	130 (4.0)	154 (4.3)	98 (4.9)	
Uncompleted degree	191 (28.9)	829 (25.7)	894 (24.7)	512 (25.4)	
Other	5 (0.8)	31 (1.0)	30 (0.8)	16 (0.8)	
Previous work experience (n=9553), n (%)	248 (37.6)	1059 (32.8)	1254 (34.5)	740 (36.4)	0.017
Work experience during the degree (n=9526), n (%)	147 (22.2)	629 (19.6)	709 (19.6)	457 (22.6)	0.016
Previous clinical rotations, (n=9498), number, mean (95% CI)	5.05 (4.80-5.31)	4.85 (4.74-4.97)	4.87 (4.77-4.98)	5.01 (4.87-5.14)	0.216
Setting (n=9551), n (%)					
Only hospital	479 (72.1)	2249 (69.6)	1478 (68.3)	1300 (64.1)	<0.001
Only community setting	10 (1.5)	53 (1.6)	51 (1.4)	39 (1.9)	
Hospital and community	175 (26.4)	932 (28.8)	1097 (30.3)	688 (34.0)	
Length of the most recent clinical rotation, weeks, mean (95% CI)*	5.75 (5.52-5.98)	5.74 (5.64-5.83)	5.78 (5.69-5.86)	5.99 (5.88-6.10)	0.007
Tutorial model of the most recent clinical rotation (n=9563), n (%)* I was supervised by					<0.001
A clinical nurse	278 (42.1)	1570 (48.6)	1999 (54.9)	1249 (61.5)	
The nursing staff	335 (50.8)	1436 (44.4)	1386 (38.1)	647 (31.9)	
A nurse identified daily by the head nurse	6 (0.9)	37 (1.1)	29 (0.8)	21 (1.0)	
A nurse teacher	33 (5.0)	140 (4.3)	160 (4.4)	72 (3.6)	
The head nurse	8 (1.2)	50 (1.6)	66 (1.8)	41 (2.0)	
Degree competence learned in the most recent clinical rotation, (n=9577), mean (95% CI)*,†	1.50 (1.45-1.56)	1.83 (1.80-1.85)	2.15 (2.13-2.17)	2.50 (2.49-2.54)	<0.001
CLEQI factor scores, mean (95% CI)*,†					
Tutorial strategies quality	1.31 (1.25-2.37)	1.71 (1.68-1.73)	2.04 (2.02-2.06)	2.48 (2.45-2.50)	<0.001
Learning opportunities	1.40 (1.35-1.46)	1.71 (1.69-1.73)	2.02 (2.01-2.04)	2.46 (2.44-2.49)	<0.001
Self-directed learning	0.83 (0.78-0.89)	1.24 (1.21-1.26)	1.57 (1.55-1.59)	2.03 (2.00-2.06)	<0.001
Safety and nursing care quality	1.58 (1.53-1.63)	1.86 (1.84-1.88)	2.12 (2.10-2.13)	2.50 (2.48-2.52)	<0.001
Quality of the learning environment	1.33 (1.27-1.39)	1.76 (1.73-1.78)	2.11 (2.09-2.14)	2.50 (2.48-2.53)	<0.001
Overall CLEQI score*,†	1.29 (1.24-1.34)	1.66 (1.64-1.68)	1.98 (1.96-1.99)	2.40 (2.38-2.42)	<0.001
Regional level (n)					<0.001
Region 1 (701)	29 (4.1)	208 (29.7)	297 (42.4)	167 (23.8)	
Region 2 (469)	4 (0.9)	78 (16.6)	194 (41.4)	193 (41.1)	
Region 3 (943)	66 (7.0)	231 (24.5)	397 (42.1)	249 (26.4)	
Region 4 (2000)	129 (6.4)	720 (36.0)	745 (37.3)	406 (20.3)	
Region 5 (54)	2 (3.7)	17 (31.5)	20 (37.0)	15 (27.8)	

Region 6 (1094)	66 (6.0)	364 (33.3)	426 (38.9)	238 (21.8)
Region 7 (1256)	72 (5.7)	398 (31.7)	482 (38.4)	304 (24.2)
Region 8 (626)	51 (8.2)	193 (30.8)	262 (41.8)	120 (19.2)
Region 9 (179)	14 (7.8)	57 (31.8)	71 (39.7)	37 (20.7)
Region 10 (977)	86 (8.8)	412 (42.2)	332 (34.0)	147 (15.0)
Region 11 (166)	18 (10.8)	75 (45.2)	53 (31.9)	20 (12.1)
Region 12 (207)	25 (12.1)	96 (46.4)	68 (32.8)	18 (8.7)
Region 13 (169)	21 (12.4)	67 (39.6)	64 (37.9)	17 (10.1)
Region 14 (407)	48 (11.8)	137 (33.7)	151 (37.1)	71 (17.4)
Region 15 (269)	35 (13.0)	105 (39.1)	91 (33.8)	38 (14.1)

* The more recent clinical experience was that under evaluation.

† On a 4-point Likert scale (0 = nothing; 3 = very much).

‡ Chi square for dichotomous variables, analysis of variance and Kruskal-Wallis test for continuous variables.

CI, confidence interval; CLEQI, Clinical Learning Quality Evaluation Index; IPE, Interprofessional Educational experience; SD, standard deviation.

Table 2. IPE experienced by students during the most recent clinical rotation: multilevel analysis

	Estimate	Std. Error	z value	Pr(>|z|)	OR	CI 95%	
(Intercept)	-2.904	0.333	-8.733	0.000	0.055	0.029	0.105
Individual level							
Age, years	-0.009	0.008	-1.118	0.264	0.991	0.975	1.007
Male gender vs female	-0.197	0.062	-3.183	0.001	0.821	0.727	0.927
Unmarried vs no	0.175	0.136	1.291	0.197	1.192	0.913	1.555
Year of nursing education attended, 1st	§						
Year of nursing education attended, 2nd vs 1st	-0.093	0.066	-1.402	0.161	0.911	0.800	1.038
Year of nursing education attended, 3rd vs 1st	0.076	0.070	1.074	0.283	1.079	0.939	1.238
Previous work experience yes vs no	0.097	0.063	1.544	0.123	1.102	0.974	1.246
Work experience during the degree yes vs no	0.051	0.069	0.738	0.461	1.052	0.919	1.206
Context of previous clinical learning experiences							
Only hospital	§						
Only community setting	-0.040	0.212	-0.190	0.849	0.961	0.634	1.455
Hospital and community setting	-0.035	0.064	-0.551	0.581	0.965	0.851	1.095
More recent clinical rotation, tutorial model							
I was supervised by a clinical nurse	§						
By the nursing staff	0.106	0.065	1.631	0.103	1.112	0.979	1.262
By a nurse identified daily by the head nurse	-0.435	0.271	-1.608	0.108	0.647	0.381	1.100
By the head nurse	0.190	0.135	1.407	0.159	1.209	0.928	1.575
By the nurse teacher	-0.212	0.197	-1.074	0.283	0.809	0.550	1.191
Length of the most recent clinical rotation, weeks, mean (95% CI)[†]	-0.001	0.010	-0.105	0.916	0.999	0.979	1.020
Degree competence learned in the most recent clinical rotation[†]	0.344	0.045	7.687	0.000	1.411	1.292	1.540
CLEQI factors							
Quality of the tutorial teaching strategies (0-3)[*,†]	0.179	0.059	3.053	0.002	1.196	1.066	1.341
Self–direct learning (0-3)[*,†]	0.395	0.045	8.874	0.000	1.485	1.361	1.620
Learning opportunities (0-3)[*,†]	0.342	0.064	5.341	0.000	1.408	1.242	1.597
Safety and nursing care quality (0-3)[*,†]	0.275	0.057	4.830	0.000	1.317	1.178	1.473
Quality of the learning environment (0-3)[*,†]	0.409	0.061	6.752	0.000	1.506	1.337	1.695
Regional level							
Region 1	§						
Region 2	0.557	0.227	2.453	0.014	1.746	1.119	2.726
Region 3	-0.471	0.172	-2.736	0.006	0.624	0.446	0.875
Region 4	-0.412	0.149	-2.768	0.006	0.662	0.495	0.887
Region 5	-0.318	0.394	-0.808	0.419	0.727	0.336	1.575
Region 6	-0.386	0.166	-2.328	0.020	0.680	0.491	0.941
Region 7	-0.334	0.163	-2.051	0.040	0.716	0.520	0.985
Region 8	0.023	0.185	0.124	0.901	1.023	0.712	1.470
Region 9	-0.153	0.281	-0.545	0.586	0.858	0.495	1.488
Region 10	-0.305	0.167	-1.833	0.067	0.737	0.531	1.021
Region 11	0.070	0.281	0.251	0.802	1.073	0.618	1.862
Region 12	-0.401	0.235	-1.708	0.088	0.670	0.423	1.061
Region 13	-0.286	0.269	-1.061	0.289	0.751	0.443	1.274
Region 14	0.411	0.220	1.865	0.062	1.508	0.979	2.324
Region 15	-0.590	0.278	-2.124	0.034	0.554	0.321	0.955

CI, confidence interval; CLEQI, Clinical LEarning Quality Evaluation Index; IPE, Interprofessional Educational experience(s); OR, odds ratio; Std. Error, standard error.
§ reference group;[*] The most recent clinical rotation was that under evaluation.
[†] On a 4-point Likert scale (from 0= "never" to 3= "always").
Sigma indiv 0.169; AIC 9376.414; BIC 9629.481; LogLik -4652.207 (df 36); LogLik_null -5479.081 (df 2); Pseudo R2 0.151

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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		Reporting Item	Page Number
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6
Study design	#4	Present key elements of study design early in the paper	1
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6

	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6-7
Bias	#9	Describe any efforts to address potential sources of bias	8-9
Study size	#10	Explain how the study size was arrived at	6-7
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7-8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7-8
	#12b	Describe any methods used to examine subgroups and interactions	7-8
	#12c	Explain how missing data were addressed	7-8
	#12d	If applicable, describe analytical methods taking account of sampling strategy	7-8
	#12e	Describe any sensitivity analyses	n/a
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	9
	#13b	Give reasons for non-participation at each stage	6-7, 9
	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	table 1, 9

	#14b	Indicate number of participants with missing data for each variable of interest	table 1
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	tabe 1
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	See note 1
	#16b	Report category boundaries when continuous variables were categorized	See note 2
	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a
Key results	#18	Summarise key results with reference to study objectives	10-12
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	12
Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

Author notes

1. 9-10, table 2
2. 9-10, table 1 and 2

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Nursing students interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study

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Nursing students interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study

Running title

Nursing students interprofessional educational experiences

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All the authors have no financial or other relationships to report.

Data Sharing Statement

None

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3650

Abstract

Objective: To explore nursing students' interprofessional education (IPE) experiences during their most recent clinical rotation and study the factors supporting IPE experiences.

Design: National cross-sectional study on 2016 data.

Setting: 95 Bachelor of Nursing Sciences programmes; 27 Universities.

Participants: Students who a) were attending or just completed their clinical rotations lasting at least two weeks in the same unit, and b) expressed a willingness to participate in the study.

Primary and secondary outcome: measure the occurrence of IPE experiences in the most recent clinical rotation; the secondary outcome was to discover the factors associated with IPE occurrence.

Measures: The primary outcome was measured using questions based upon a 4-point Likert scale (from 0 = *never* to 3 = *always*). Explanatory variables were collected at individual and regional levels with items included in the same questionnaire.

Results: 9,607 out of 10,480 students participated. Overall, 666 (6.9%) perceived not having had any IPE experience, while 3,248 (33.8%), 3,653 (38%), and 2,040 (21.3%) reported having experienced IPE opportunities 'only a little', to 'some extent', or 'always', respectively. From the multilevel analysis, factors promoting the occurrence of IPE experiences were mainly set at the clinical learning environment level, such as high quality of the learning environment, self-directed learning, learning opportunities, quality of safety and nursing care, and quality of tutorial strategies; and (b) at the regional level, where significant differences emerged across regions. In contrast, male gender has been negatively associated with the perception of having IPE experiences.

Conclusions: A large number of nursing students experienced either 'never' or 'only a little' IPE opportunities, thus suggesting that nursing education tends to remain within the nursing profession. Limiting students' interprofessional exposure during education can prevent future collaborative approaches that have been shown to be essential in providing best patient care. In order to increase IPE it is necessary to develop strategies designed both at unit and regional levels.

Keywords: clinical learning, collaboration, interprofessional education, interprofessional cooperation, nursing students, student perception, teamwork

Article summary

Strengths and limitations of this study

- This is the first study examining the extent and associated factors of interprofessional education experiences among nursing students.
- This is a national study involving a large number of nursing programmes, thus potentially affecting the generalizability of the findings.
- This is the first multilevel study in this context aimed at identifying the complexity of factors influencing interprofessional education opportunities.
- A cross-sectional design was adopted to measure the primary outcome and associated factors at the same time, so considering factors emerged as predictors of interprofessional education opportunities experienced by students should be done with caution.
- Data affecting interprofessional education opportunities such as study programs contents and healthcare professional profiles available at the unit level, were not collected.

Introduction

The need to increase proficiency both in health care and clinical pathways, especially with the aging population, has been documented as requiring improved collaboration and team-based models of care delivery[1] with interprofessional teams being in the best position to ensure quality and safe care.[2] In this context, InterProfessional Collaboration (IPC) has been defined as implying a range of key dimensions, including shared goals, team identity, commitment, clear team roles and responsibilities, interdependence and integration among team members.[3]

From the patient's point of view, IPC has been documented as enhancing patient- and family-centred care, thus increasing patient-reported quality of care,[4] also preventing the occurrence of the most frequent adverse events.[5] From the healthcare professionals' point of view, IPC has been documented as improving communication among caregivers, increasing opportunities for shared responsibilities and effective participation in multidisciplinary decision-making[6, 7] and, ultimately, satisfaction and well-being.[8] Because of its relevance, different strategies aimed at increasing IPC have been documented to date, and among others, Interprofessional Education (IPE) offered in undergraduate programs has been documented as effective in increasing future interprofessional collaboration.[9, 10]

Nurses have been shown to play a strategic role to implement IPC by cooperating with a wide range of healthcare professional (HCPs) in all settings.[11] Given their role in promoting and enhancing IPC in daily practice,[2] it has become imperative for universities to provide nursing students with interprofessional knowledge and competences.[7] According to this, different policies[12, 13] and evidence [14] have recommended that nursing students should be exposed early to IPE both at a clinical and didactic levels. Thus, students who have been exposed to IPE can start their professional career and work effectively in a team;[15, 16] moreover, implementing their views by comparing their data and clinical thinking with other disciplines has been documented as promoting problem-solving and critical thinking abilities.[17] On the other hand, when their IPE experiences are poor or take place at the end of the nursing program, their effectiveness as part of a team after graduation can be significantly limited.[18]

Despite its relevance, IPE opportunities have been documented as often not being included in undergraduate programmes, and nursing students have reported only a few opportunities to have meaningful contact with other HCPs during their education.[7] Nurses are often educated exclusively within their profession without having the opportunity to learn other HCP roles and responsibilities.[7] As a consequence, students have been reported to be less proficient in teamwork competences[19] and needing more support when starting a professional role requiring teamwork.[11] Factors threatening the integration of IPE opportunities in clinical training have been established at the (a) organizational level, such as the lack of institutional collaboration; (b) managerial level, such as barriers in changing practices; (c)

practical level, as for example the lack of time, and (d) at the cultural levels such as different perceptions of teamwork, stereotyped behaviours, and the potential risk of dominance for one profession—usually medicine—over others.[20, 21]

To date, despite its documented relevance, the degree of IPE opportunities experienced by nursing students has not been studied in large samples; above all, factors promoting IPE have not been identified up to now at the country level where national healthcare policies and healthcare professional educational policies can both have an influence in promoting interprofessional education and cooperation. Therefore, the purpose of this study was to cover the gap in the available evidence by exploring nursing students' IPE experiences during their clinical learning and factors promoting IPE experiences.

Methods

Setting, study network and design

Nursing education in Italy is provided at the University level and the duration of the course is three years; enrolment is allowed for candidates at the end of their secondary education, after having passed an examination based upon a programme defined by the national law. Theoretical education is offered at the University level; clinical rotations are instead offered in the National Health Care (NHS) services, after the first semester of the 1st year, and then in the 2nd and in the 3rd year for a total of 1,800 hours of education. The total amount of clinical rotation range on average from two to five/year. At the time of the study, there were a total of 208 Bachelor of Nursing Sciences (BNS) in 43 universities, located in the 20 Italian regions.

On a preliminary basis, an Italian network aimed at evaluating nursing students' clinical education quality by involving all degrees was formed, and different research lines were established. Specifically, an open offer was sent to all BNS degrees to participate in the research network with a summary of the study protocol.[22] After two months, the invitation was closed, and the network resulted composed by 27 universities with 95 BNS degrees located in 15 regions.[22] Thus, the nation-wide, cross-sectional study was conducted, and the findings have been reported here according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE).[23]

Participants

Eligible students were those who: (a) were attending a BNS degree belonging to the national research network; (b) were attending their clinical practical rotations lasting at least two weeks in the same unit; or (c) had just completed their clinical rotation in the previous two weeks without having started a new

rotation at the time of the survey; and (d) expressed a willingness to participate in the study after being informed on the aims.

Primary outcome, other variables, and instruments

IPE occurrence as experienced by students was the primary outcome of the study. Its assessment was performed through the following item included in the questionnaire: 'Did you experience IPE occasions during your most recent clinical rotation?' Aiming at ensuring consistency in IPE concept interpretation, participants were also provided with concrete examples such as working and/or learning at the bedside (e.g., assessing patient needs, deciding clinical treatments) with other health care professionals, or with other students attending their education in different disciplines; or participating in multi-professional meetings where integrated decisions are undertaken. Participants were required to answer by using a 4-point Likert scale according to their experience: the possible answers were 0 = *never*; 1 = *only a little*; 2 = *to some extent*; and 3 = *always, when the situation requires.* The concept of '*when the situation requires'* was introduced at the end of each level of the Likert scale, aimed at helping students to rank the IPE occasions experienced as compared to those expected by the different situations encountered in the clinical environment.

Some variables at the (a) individual and (b) regional levels were also collected:

- at the individual level the following variables were collected: socio-demographic (e.g., age, gender, marital status); academic year attended (1st, 2nd, or 3rd); previous secondary and academic education; working experiences, both previous and during nursing education; and previous clinical rotation experiences attended (in number) and in which settings.

  With regards to their most recent clinical rotation, participants were asked about: (a) its duration in weeks; (b) the supervision model adopted by the unit, whether the student was under the supervision of a clinical nurse, the entire staff, a nurse identified by the head nurse, a nurse teacher, or head nurse; and (c) the perceived degree of competences learned (4-point Likert scale ranging from 0 = *none* to 3 = *very much*). Moreover, the perceived quality of the learning processes was measured by the Clinical LEarning Quality Evaluation Index (CLEQI) tool.[24] The tool has been developed and validated at the national level for nursing programmes; due to its properties, it has been recommended as an essential tool to evaluate routinely each clinical rotation attended by students.[24] It is composed of 22 item divided in five factors, namely 'Quality of the tutorial strategies' (6 items), 'Learning opportunities' (6 items), 'Self-directed learning' (3 items), 'Safety and nursing care quality' (4 items), and 'Quality of the learning environment' (3 items). Each factor, as well as the overall CLEQI score, can range from 0 – 'nothing' to 3 – 'very

much', with higher scores indicating a higher quality of the learning processes enacted in the clinical setting as perceived by students.

- at the regional level, the region where the BNS degree was offered was recorded: by law, nursing education is provided through lectures in academic settings, while clinical rotations take place in local healthcare organizations. With the federalisation of the healthcare system at the regional level,[25] Italy has different systems according to regional policies and rules that can affect nursing education.

After piloting the questionnaire aimed at ensuring its feasibility and comprehensiveness, the data collection process was started in the same period in all nursing programmes part of the research network via paper and pencil or via Google Drive, according to local feasibility and resources.

Data analysis

The descriptive statistical analysis was performed by calculating frequencies and percentages, averages with standard deviations (SD) or confidence intervals (CI) at 95%. A bivariate analysis was performed, where the primary outcome was considered as a categorical variable forming four groups: students who experienced IPE opportunities as 'never', 'only a little', 'to some extent', and 'always'. Chi-square tests, ANOVA, and Kruskal-Wallis tests were used to explore the significant differences, if any, across groups.

On a preliminary basis, the intraclass correlation (ICC) was evaluated under fixed and random effect assumptions to identify cluster effects at different levels, specifically: (a) at the unit level attended by students during their clinical rotation, assuming that some units can offer specific IPE opportunities due to differences in the interprofessional collaboration according to their skill mix; (b) at the nursing programme level, assuming that BNS programme can have designed different strategies to promote IPE, and (c) at the regional level, since Italian regions have developed different healthcare systems after reforms federalising healthcare, with an additional potential impact on the culture of teamwork collaboration permeating the clinical settings attended by students.[25] The ICCs at the unit level were 0.07 (random effects) and 0.06 (fixed effects); at the nursing programme level they were 0.01 (both under random and fixed effects); and, at the regional level, they were 0.06 (random effects) and 0.03 (fixed effects), respectively, meaning that the possible alternative hierarchical structures were not relevant in the studied phenomenon.

Next, a multilevel analysis using the generalized linear mixed model was performed by calculating the odd-ratios (OR; CI 95%) and the pseudo R^2. The primary outcome was entered in the model as a dichotomous variable by aggregating options given by students 'always'+ 'some extent' vs. those reporting 'only a little' + 'never'; the model specification included the variables significantly associated

with the outcome at bivariate analysis as explanatory variables. All analyses were performed by using the SPSS Statistical Package version 24 and R Core Team.[26] Statistical significance was set at $p < .05$.

Ethical issues

The study protocol was approved by the University Ethical Committee of Milan University (Italy).[22] Participants gave their consent to participate in the study.

Patient and Public Involvement

Patients and public were not involved.

Bias control

At the national level, several strategies have been promoted to ensure a large participation of BNS by sending an open call invitation at different times, usually two weeks apart, thus preventing selection bias. Information bias was prevented by standardising the information provided to local researchers identified as responsible for the data collection in each participating nursing programme and by providing a precise description of study aims and data collection procedures on the first page of the questionnaire.

Aimed at preventing recall bias, students were invited to fill in the questionnaire during the last week of their clinical rotation or at least after the following two weeks after its end when they were not exposed to the next clinical rotation. Data were analysed by the coordinator centre (University of Udine) in a blind fashion to ensure anonymity in regards to the units, nursing programmes, and regions numbered consecutively (for example, region 1). Moreover, students were free to participate in the survey without any pressure or incentives.

Results

Primary outcome

Out of 10,480 eligible students, 9,607 participated in the study. A total of 666 (6.9%) students reported to never have been involved in IPE opportunities; 3,248 (33.8%) reported experiencing 'only a little' opportunity; 3,653 (38.0%) reported experiencing these opportunities 'to some extent'; while the remaining 2,040 (21.3%) reported having always experienced IPE, when required, during their most recent clinical rotations.

Bivariate analysis

At the individual level (Table 1), students who reported no experiences of IPE were more often female ($p < .00$), older ($p = .015$), unmarried ($p = .032$), with previous work experience ($p = .017$), and with more previous clinical rotations exclusively in hospital settings ($p < .001$).

Specifically, with regards to the last clinical rotation, students who reported no IPE experiences attended a shorter-duration clinical rotation ($p = .007$) where they were more frequently supervised by the nursing staff ($p < .001$) and reported having learnt less competences ($p < .001$). They also reported lower average scores both in all factors (all p-values < .001) and in the total CLEQI score ($p < .001$; Table 1). Instead, those students who reported to have always experienced IPE were more often attending their third year ($p < .001$) and were working during their nursing education ($p = .016$; Table 1).

At the regional level, 0.9% of students from region 2 and 13% from region 15 who were attending their nursing programmes reported no IPE experiences versus 8.7% of students in region 12 and 41.1% in region 2, who reported having always experienced IPE opportunities (Table 1). There is a significant difference between the Italian regions.

Factors affecting IPE

The multilevel analysis performed using the generalized linear mixed model showed an acceptable value for the pseudo R^2 of 15.1%.

At the individual level, most recent rotations reporting a high-quality learning environment (OR = 1.506, 95% CI [1.337, 1.659]), highly encouraged self-directed learning (OR = 1.485, 95% CI [1.361, 1.620]), and offered higher learning opportunities (OR = 1.408, 95% CI [1.242, 1.597]) all increased the likelihood of IPE occurrence. Moreover, an environment characterized by high safety and nursing care quality (OR = 1.317, 95% CI [1.178, 1.473]), where high-quality tutorial strategies were offered (OR = 1.196, 95% CI [1.066, 1.341]), and where students reported high competences learned (OR = 1.411, 95% CI [1.292, 1.540]) also promoted the likelihood of IPE occurrence. Differently, male gender (OR = 0.821, 95% CI [0.727,0.927]) was negatively associated with IPE occurrence (Table 2).

At the regional level, students attending a nursing programme in region 2 were approximately 1.75 times more likely to have experienced IPE opportunities as compared to those of region 1 (OR = 1.746, 95% CI [1.119, 2.726]). On the other hand, students attending their nursing programmes in other regions such as region n. 3, 4, 6, 7, and 15, reported a lower likelihood (OR from 0.554 to 0.716) of IPE occurrence as compared to region 1.

Discussion

This study explored nursing students' IPE experiences and promoting factors during the clinical rotations at the national level. IPE has been considered an effective educational strategy to increase professional and collaborative competences, thus promoting IPC in the real context.[14, 27 28] It has been recommended that learning non-technical skills—such as teamwork—should be offered early to healthcare students as part of their undergraduate core curriculum since cooperation between different carers is pivotal in providing high-quality and safe care.[2, 29] However, despite its wide recognition, Italian nursing students experienced a lack of interprofessional learning occasions, with 40.7% of them reporting 'never' to 'only a little' IPE opportunities during their last clinical rotation. Poor examples of IPC in the clinical settings,[30] as well as a poor understanding of each HCP's role and responsibility have been reported as affecting the opportunity to have interprofessional education experiences[16, 31] that can affect also the future ability to cooperate with other members of a team.

Aimed at discovering IPE experiences during their undergraduate education, we have involved the largest sample of nursing students where the main socio-demographic characteristics were in line to those reported at the national level.[24] However, according to the findings, IPE occurrences were only partially affected by individual factors, whereas a greater influence has emerged in the clinical environment and geographical context where clinical rotations were attended. Regarding the latter, students have been exposed to different IPE occurrences across Italian regions, suggesting that different healthcare systems[25] have developed different IPC sensitivities at the ward level. High occurrences of IPE in some regions should be considered best practices for other regions, thus encouraging to share policies and/or interventions implemented. On the other hand, those regions where healthcare institutions have offered few IPE experiences to students should reflect on whether the care models leading the delivery of services are still based upon the traditional hierarchy across healthcare professionals in order to identify strategies that can promote teamwork. Moreover, given the IPE variability emerged across region, case studies are also suggested in order to understand policies and/or factors in those regions where students reported a greater IPE occurrence.

All factors measured with the CLEQI tool[24] detecting the quality of learning processes enacted by the student in the actual context were positively associated with the high likelihood of IPE occurrences. The clinical learning environment is composed of different psychosocial, organizational, cultural, and interactive factors in addition to physical space and the teaching/learning components that all promote the learning of competences, [32] including interprofessional ones. Specifically, the odds of reporting IPE experience in the last rotation was positively affected by the perceived quality of the clinical learning environment. A unit gain in the quality of the environment corresponds to odds in the IPE occasions of around 1.5 times as compared to the baseline. The perceived quality of the clinical environment has

already been associated with the type, quality, and amount of interactions between students and the nursing staff,[33] suggesting that a good-quality environment can also increase the quality of interprofessional interactions, thus promoting IPE occasions.

Similarly, the odds of reporting IPE experience in the last rotation was also positively affected by the environments encouraging students to be independent in their learning processes as self-directed learners. Self-directed learning has been documented as encouraging self-evaluation;[34] by evaluating their own learning needs and searching for different strategies to address them, students can be encouraged also to collaborate with other health care professionals, e.g. as a source to understand the nature of patients' problems[16] thus learning from other disciplines.[35]

Perceiving higher learning opportunities as well as high-quality and safe nursing care delivered in the ward also increased the perceptions of IPE opportunities. Having the chance to learn a range of technical and non-technical skills (e.g., communication) is deeply intertwined with IPE because students can increase their confidence in searching for multidisciplinary collaboration.[29] Moreover, teamwork, cooperation, and shared discussions across HCPs[16] have all been documented as fundamental in promoting the quality of care and patient safety: students experiencing their clinical learning in units based upon these principles can discuss with their supervisors various care processes,[36] they can be involved in or witness interprofessional collaboration during meetings, and they can also be involved in integrated care planning.[16] On the other hand, those units with poor attention at patient safety and quality of care can have a few interprofessional collaborative opportunities: as a consequence, a missed interprofessional involvement of students can limit the opportunity of IPE.[28, 36]

Furthermore, the quality of tutorial strategies increased the likelihood of IPE experiences, thus suggesting that those nurses responsible for clinical teaching can create opportunities to expose students to interprofessional contacts. However, the contribution of these factors to IPE is limited; in line with this finding, tutorial models delivered at the ward level have not influenced students' IPE experiences, given that the different options (e.g., being supervised by a clinical nurse or staff) are all inside the nursing profession. Provision of a more complex model of nursing student supervision, and also involving other HCPs, should be further studied for its ability to increase IPE. According to available evidence,[37] only student exposure to the team can increase understanding of interprofessional processes of care, thus allowing the development of strong interprofessional skills.

Finally, the increased competencies acquired during the students' last clinical training was positively associated with the perception of interprofessional education experiences, suggesting that environments allowing the acquisition of greater clinical competencies are presenting an odd of exposure to IPE 2.41

times larger than the benchmark level; in contrast, those units offering fewer competence acquisitions have resulted in limited interprofessional collaboration experiences.

At the individual level, only male gender emerged as negatively associated with IPE experiences suggesting that male students should be more supported in developing interdisciplinary skills compared to female students; however, the reasons behind these findings[38] should be further explored.

Limitations

Students were asked to self-report their IPE occurrences in their most recent clinical rotations, not in their entire nursing rotations or, for example in the academic setting, such as in simulation laboratories or in classroom. Moreover, their perception regarding the occurrence (from 'never' to 'always') has been based on their personal judgment and further studies are encouraged to measure quantitatively the experiences of IPE. Furthermore, no data have been collected on the interprofessional collaboration theoretical core contents across nursing programmes that could have promoted different IPE expectations among students; similarly, the quality of interprofessional collaboration examples witnessed in the clinical practice was not assessed. What students see about the team in clinical practice may not be ideal (e.g. when reinforcing hierarchies) and should be thoughtfully debriefed ideally within an interprofessional student group and with a facilitator skilled in surfacing these issues.

Also, some relevant data such as healthcare professional profiles available at the unit level (e.g., only nurses and physicians) and the team-to-students' ratio, as well as the role of the students (e.g., supernumerary or fully involved in nursing care), were not collected.

We used only one question to explore IPE occurrence by providing some examples of interprofessional collaboration to increase clarity and consistency in data collection; however, the type and quality of these IPE experiences have not been investigated. In the attempt of discovering the explanatory variables, we have used the CLEQI[24] tool which measures the quality of the clinical environment while no data with regards to the quality of the academic environment have been collected. In addition, the cross-sectional design must be used with caution when considering emerged factors in the multilevel analysis as predictors of IPE according to students' perception, since other study designs would have been preferable to answer causative questions. Finally, the multilevel analysis results show that students' perceptions of IPE opportunities is only partially explained by the considered model (the pseudo-R^2 is 0.15). Consequently, future research is recommended to capture other significant factors not identified in this study. Moreover, future studies should also target the barriers preventing IPE occasions among nursing students by also involving other healthcare professionals, aimed at acquiring a complete picture of interprofessional education across healthcare professionals in Italy.

Conclusions

A large number of nursing students ranged in their perceptions from 'never' to 'only a little' IPE experiences, thus suggesting that nursing education seems to remains mainly inside the nursing profession. Graduate nurses are not always trained to interact with other HCPs, thus suggesting that interprofessional collaboration is still challenging both in current practice, where a few occasions are offered to students and in future practice, given that interprofessional competencies are also based upon the quality of education offered before graduation. The limited opportunities to develop teamwork skills to transfer into future practice for a large number of next-generation healthcare workers may also prevent the complete transition from hierarchical approaches to collaborative approaches, which have been recommended as providing the best patient care.

Associated factors have emerged mainly at the clinical context levels where students attend their clinical rotations, and at the regional levels, suggesting that IPE is influenced by a collaborative culture promoted at the ward level and by the policies developed at regional levels, inspiring both healthcare institutions and the nursing programmes. Nurse academicians should include in their agenda strategies aimed at developing IPE opportunities both at the university and at the clinical levels. Specifically, learning environments should be periodically assessed for their ability to offer students the opportunity to develop collaborative skills. Moreover, benchmarking policies at the regional level, aimed at promoting a higher sensitivity concerning the positive correlation between interprofessional teamwork and patient safety are recommended. Differently, individual factors have shown a limited contribution to IPE occurrences, suggesting that male students should be more encouraged to collaborate with other health care professionals.

Data Statement

Technical appendix, statistical code, and dataset available from the Coordinating centre (Udine university, Alvisa Palese and Luca Grassetti).

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Table 1. IPE occasions as experienced by students during the most recent clinical rotation

	Never N = 666 (6.9%)	Only a little N = 3248 (33.8%)	To some extent N = 3653 (38.0%)	Always N = 2040 (21.3%)	*p*‡
Individual level					
Age, years, mean (95% CI)	23.2 (23-23.7)	22.9 (22.7-23.0)	22.79 (22.7-22.9)	23.0 (22.8-23.2)	0.015
Female (n=9596), n (%)	531 (80.0)	2561 (78.9)	2732 (74.9)	1479 (72.6)	<0.001
Civil status, n (%)					
Unmarried	629 (94.4)	3047 (93.8)	3460 (94.7)	1909 (93.6)	0.032
Married/cohabitant	26 (3.9)	164 (5.0)	138 (3.8)	107 (5.3)	
Divorced	3 (0.5)	110 (0.4)	14 (0.4)	9 (0.4)	
Widowed	2 (0.3)	1 (0.0)	1 (0.0)	3 (0.1)	
Missing	6 (0.9)	25 (0.8)	40 (1.1)	12 (0.6)	
With children, n (%)	26 (3.9)	138 (4.3)	174 (4.8)	90 (4.5)	0.636
Secondary education (n=9442), n (%)					
High school	450 (68.2)	2260 (70.8)	2507 (69.9)	1414 (70.3)	0.287
Technical school	25 (3.8)	149 (4.7)	160 (4.5)	76 (3.8)	
Professional school	112 (17.0)	490 (15.4)	596 (16.6)	320 (15.9)	
Teacher school	58 (8.8)	256 (8.0)	282 (7.9)	172 (8.6)	
Secondary school abroad	15 (2.2)	34 (1.1)	39 (1.1)	28 (1.4)	
Academic year attended (n=9579), n (%)					
First	183 (27.5)	1008 (31.2)	1123 (30.8)	595 (29.3)	<0.001
Second	249 (37.5)	1149 (35.5)	1251 (34.3)	633 (31.1)	
Third	233 (35.0)	1078 (33.3)	1272 (34.9)	805 (39.6)	
Academic experience (n=9515), n (%)					
None	428 (64.5)	2235 (69.3)	2538 (70.2)	1386 (68.9)	0.224
Graduated in other fields	38 (5.7)	130 (4.0)	154 (4.3)	98 (4.9)	
Uncompleted degree	191 (28.9)	829 (25.7)	894 (24.7)	512 (25.4)	
Other	5 (0.8)	31 (1.0)	30 (0.8)	16 (0.8)	
Previous work experience (n=9553), n (%)	248 (37.6)	1059 (32.8)	1254 (34.5)	740 (36.4)	0.017
Work experience during the degree (n=9526), n (%)	147 (22.2)	629 (19.6)	709 (19.6)	457 (22.6)	0.016
Previous clinical rotations, (n=9498), number, mean (95% CI)	5.05 (4.80-5.31)	4.85 (4.74-4.97)	4.87 (4.77-4.98)	5.01 (4.87-5.14)	0.216
Setting (n=9551), n (%)					
Only hospital	479 (72.1)	2249 (69.6)	1478 (68.3)	1300 (64.1)	<0.001
Only community setting	10 (1.5)	53 (1.6)	51 (1.4)	39 (1.9)	
Hospital and community	175 (26.4)	932 (28.8)	1097 (30.3)	688 (34.0)	
Length of the most recent clinical rotation, weeks, mean (95% CI)*	5.75 (5.52-5.98)	5.74 (5.64-5.83)	5.78 (5.69-5.86)	5.99 (5.88-6.10)	0.007
Tutorial model of the most recent clinical rotation (n=9563), n (%)* I was supervised by					<0.001
A clinical nurse	278 (42.1)	1570 (48.6)	1999 (54.9)	1249 (61.5)	
The nursing staff	335 (50.8)	1436 (44.4)	1386 (38.1)	647 (31.9)	
A nurse identified daily by the head nurse	6 (0.9)	37 (1.1)	29 (0.8)	21 (1.0)	
A nurse teacher	33 (5.0)	140 (4.3)	160 (4.4)	72 (3.6)	
The head nurse	8 (1.2)	50 (1.6)	66 (1.8)	41 (2.0)	
Degree competence learned in the most recent clinical rotation, (n=9577), mean (95% CI)*,†	1.50 (1.45-1.56)	1.83 (1.80-1.85)	2.15 (2.13-2.17)	2.50 (2.49-2.54)	<0.001
CLEQI factor scores, mean (95% CI)*,†					
Tutorial strategies quality	1.31 (1.25-2.37)	1.71 (1.68-1.73)	2.04 (2.02-2.06)	2.48 (2.45-2.50)	<0.001
Learning opportunities	1.40 (1.35-1.46)	1.71 (1.69-1.73)	2.02 (2.01-2.04)	2.46 (2.44-2.49)	<0.001
Self-directed learning	0.83 (0.78-0.89)	1.24 (1.21-1.26)	1.57 (1.55-1.59)	2.03 (2.00-2.06)	<0.001
Safety and nursing care quality	1.58 (1.53-1.63)	1.86 (1.84-1.88)	2.12 (2.10-2.13)	2.50 (2.48-2.52)	<0.001
Quality of the learning environment	1.33 (1.27-1.39)	1.76 (1.73-1.78)	2.11 (2.09-2.14)	2.50 (2.48-2.53)	<0.001
Overall CLEQI score*,†	1.29 (1.24-1.34)	1.66 (1.64-1.68)	1.98 (1.96-1.99)	2.40 (2.38-2.42)	<0.001
Regional level (n)					<0.001
Region 1 (701)	29 (4.1)	208 (29.7)	297 (42.4)	167 (23.8)	
Region 2 (469)	4 (0.9)	78 (16.6)	194 (41.4)	193 (41.1)	
Region 3 (943)	66 (7.0)	231 (24.5)	397 (42.1)	249 (26.4)	

Region 4 (2000)	129 (6.4)	720 (36.0)	745 (37.3)	406 (20.3)
Region 5 (54)	2 (3.7)	17 (31.5)	20 (37.0)	15 (27.8)
Region 6 (1094)	66 (6.0)	364 (33.3)	426 (38.9)	238 (21.8)
Region 7 (1256)	72 (5.7)	398 (31.7)	482 (38.4)	304 (24.2)
Region 8 (626)	51 (8.2)	193 (30.8)	262 (41.8)	120 (19.2)
Region 9 (179)	14 (7.8)	57 (31.8)	71 (39.7)	37 (20.7)
Region 10 (977)	86 (8.8)	412 (42.2)	332 (34.0)	147 (15.0)
Region 11 (166)	18 (10.8)	75 (45.2)	53 (31.9)	20 (12.1)
Region 12 (207)	25 (12.1)	96 (46.4)	68 (32.8)	18 (8.7)
Region 13 (169)	21 (12.4)	67 (39.6)	64 (37.9)	17 (10.1)
Region 14 (407)	48 (11.8)	137 (33.7)	151 (37.1)	71 (17.4)
Region 15 (269)	35 (13.0)	105 (39.1)	91 (33.8)	38 (14.1)

* The more recent clinical experience was that under evaluation.
† On a 4-point Likert scale (0 = nothing; 3 = very much).
‡ Chi-square for dichotomous variables, analysis of variance and Kruskal-Wallis test for continuous variables.
CI, confidence interval; CLEQI, Clinical Learning Quality Evaluation Index; IPE, Interprofessional Educational experience; SD, standard deviation.

Table 2. IPE occurrence[a] as experienced by students during the most recent clinical rotation: a multilevel analysis

	Estimate	Std. Error	z value	Pr(>|z|)	OR	CI 95%	
(Intercept)	-2.904	0.333	-8.733	0.000	0.055	0.029	0.105
Individual level							
Age, years	-0.009	0.008	-1.118	0.264	0.991	0.975	1.007
Male gender vs female	-0.197	0.062	-3.183	0.001	0.821	0.727	0.927
Unmarried vs no	0.175	0.136	1.291	0.197	1.192	0.913	1.555
Year of nursing education attended, 1st	§						
Year of nursing education attended, 2nd vs 1st	-0.093	0.066	-1.402	0.161	0.911	0.800	1.038
Year of nursing education attended, 3rd vs 1st	0.076	0.070	1.074	0.283	1.079	0.939	1.238
Previous work experience yes vs no	0.097	0.063	1.544	0.123	1.102	0.974	1.246
Work experience during the degree yes vs no	0.051	0.069	0.738	0.461	1.052	0.919	1.206
Context of previous clinical learning experiences							
Only hospital	§						
Only community setting	-0.040	0.212	-0.190	0.849	0.961	0.634	1.455
Hospital and community setting	-0.035	0.064	-0.551	0.581	0.965	0.851	1.095
More recent clinical rotation, tutorial model							
I was supervised by a clinical nurse	§						
By the nursing staff	0.106	0.065	1.631	0.103	1.112	0.979	1.262
By a nurse identified daily by the head nurse	-0.435	0.271	-1.608	0.108	0.647	0.381	1.100
By the head nurse	0.190	0.135	1.407	0.159	1.209	0.928	1.575
By the nurse teacher	-0.212	0.197	-1.074	0.283	0.809	0.550	1.191
Length of the most recent clinical rotation, weeks, mean (95% CI)[†]	-0.001	0.010	-0.105	0.916	0.999	0.979	1.020
Degree competence learned in the most recent clinical rotation[†]	0.344	0.045	7.687	0.000	1.411	1.292	1.540
CLEQI factors							
Quality of the tutorial teaching strategies (0-3)[*,†]	0.179	0.059	3.053	0.002	1.196	1.066	1.341
Self–direct learning (0-3)[*,†]	0.395	0.045	8.874	0.000	1.485	1.361	1.620
Learning opportunities (0-3)[*,†]	0.342	0.064	5.341	0.000	1.408	1.242	1.597
Safety and nursing care quality (0-3)[*,†]	0.275	0.057	4.830	0.000	1.317	1.178	1.473
Quality of the learning environment (0-3)[*,†]	0.409	0.061	6.752	0.000	1.506	1.337	1.695
Regional level							
Region 1	§						
Region 2	0.557	0.227	2.453	0.014	1.746	1.119	2.726
Region 3	-0.471	0.172	-2.736	0.006	0.624	0.446	0.875
Region 4	-0.412	0.149	-2.768	0.006	0.662	0.495	0.887
Region 5	-0.318	0.394	-0.808	0.419	0.727	0.336	1.575
Region 6	-0.386	0.166	-2.328	0.020	0.680	0.491	0.941
Region 7	-0.334	0.163	-2.051	0.040	0.716	0.520	0.985
Region 8	0.023	0.185	0.124	0.901	1.023	0.712	1.470
Region 9	-0.153	0.281	-0.545	0.586	0.858	0.495	1.488
Region 10	-0.305	0.167	-1.833	0.067	0.737	0.531	1.021
Region 11	0.070	0.281	0.251	0.802	1.073	0.618	1.862
Region 12	-0.401	0.235	-1.708	0.088	0.670	0.423	1.061
Region 13	-0.286	0.269	-1.061	0.289	0.751	0.443	1.274
Region 14	0.411	0.220	1.865	0.062	1.508	0.979	2.324

Region 15	-0.590	0.278	-2.124	0.034	0.554	0.321	0.955

CI, confidence interval; CLEQI, Clinical LEarning Quality Evaluation Index; IPE, Interprofessional Educational experience(s); OR, odds ratio; Std. Error, standard error.

[a] 'always'+ 'some extent' vs. 'only a little' + 'never'.

§ reference group;[*] The most recent clinical rotation was that under evaluation.

[†] On a 4-point Likert scale (from 0= "never" to 3= "always").

Sigma indiv 0.169; AIC 9376.414; BIC 9629.481; LogLik -4652.207 (*df* 36); LogLik_null -5479.081 (df 2); Pseudo R^2 0.151

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6
Study design	#4	Present key elements of study design early in the paper	1
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6

	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6-7
Bias	#9	Describe any efforts to address potential sources of bias	8-9
Study size	#10	Explain how the study size was arrived at	6-7
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7-8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7-8
	#12b	Describe any methods used to examine subgroups and interactions	7-8
	#12c	Explain how missing data were addressed	7-8
	#12d	If applicable, describe analytical methods taking account of sampling strategy	7-8
	#12e	Describe any sensitivity analyses	n/a
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	9
	#13b	Give reasons for non-participation at each stage	6-7, 9
	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	table 1, 9

	#14b	Indicate number of participants with missing data for each variable of interest	table 1
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	tabe 1
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	See note 1
	#16b	Report category boundaries when continuous variables were categorized	See note 2
	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a
Key results	#18	Summarise key results with reference to study objectives	10-12
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	12
Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

Author notes

1. 9-10, table 2
2. 9-10, table 1 and 2

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Nursing students interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study

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Nursing students interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study

Running title

Nursing students interprofessional educational experiences

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Data Sharing Statement

None

Author Contributions

All the authors equally contributed to the research's design; A. Palese, A. Brugnolli, L. Saiani, S. Terzoni, A. Destrebecq, I. Mansutti, L. Zannini, and V. Dimonte plus the SVIAT team; A. Palese, L. Grassetti and S. Gonella performed the data analysis and contributed to data interpretation; and A. Palese and S. Gonella drafted the manuscript. All authors critically revised the manuscript, agreed to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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Abstract

Objective: To explore nursing students' interprofessional education (IPE) experiences during their most recent clinical rotation and study the factors supporting IPE experiences.

Design: National cross-sectional study on data collected in 2016.

Setting: 95 Bachelor of Nursing Sciences programmes; 27 Universities.

Participants: Students who a) were attending or just completed their clinical rotations lasting at least two weeks in the same unit, and b) expressed a willingness to participate in the study.

Primary and secondary outcome: measure the occurrence of IPE experiences in the most recent clinical rotation; the secondary outcome was to discover the factors associated with IPE occurrence.

Measures: The primary outcome was measured using questions based upon a 4-point Likert scale (from 0 = *never* to 3 = *always*). Explanatory variables were collected at individual and regional levels with items included in the same questionnaire.

Results: 9,607 out of 10,480 students participated. Overall, 666 (6.9%) perceived not having had any IPE experience, while 3,248 (33.8%), 3,653 (38%), and 2,040 (21.3%) reported having experienced IPE opportunities 'only a little', to 'some extent', or 'always', respectively. From the multilevel analysis, factors promoting the occurrence of IPE experiences were mainly set at the clinical learning environment level, such as high quality of the learning environment, self-directed learning, learning opportunities, quality of safety and nursing care, and quality of tutorial strategies; and (b) at the regional level, where significant differences emerged across regions. In contrast, male gender has been negatively associated with the perception of having IPE experiences.

Conclusions: A large number of nursing students experienced either 'never' or 'only a little' IPE opportunities, thus suggesting that nursing education tends to remain within the nursing profession. Limiting students' interprofessional exposure during education can prevent future collaborative approaches that have been shown to be essential in providing best patient care. In order to increase IPE, it is necessary to develop strategies designed both at unit and regional levels.

Keywords: clinical learning, interprofessional education, interprofessional cooperation, nursing students, student perception, teamwork

Article summary

Strengths and limitations of this study

- This is the first study examining the extent and associated factors of interprofessional education (IPE) experiences among nursing students.
- This is a national study involving a large number of nursing programmes, thus potentially affecting the generalizability of the findings.
- This is the first multilevel study in this context aimed at identifying the complexity of factors influencing IPE opportunities.
- A cross-sectional design was adopted to measure the primary outcome and associated factors at the same time; therefore, considering factors emerged as predictors of IPE experiences should be done with caution.
- Data affecting IPE opportunities such as study programs contents and healthcare professional profiles available at the unit level, were not collected.

Introduction

The need to increase proficiency both in health care and clinical pathways, especially with the aging population, has been documented as requiring improved collaboration and team-based models of care delivery[1] with interprofessional teams being in the best position to ensure quality and safe care.[2] In this context, interprofessional collaboration (IPC) as the degree of cooperation between nursing staff and other health care professionals, has been defined as including a range of key dimensions, including shared goals, team identity, commitment, clear team roles and responsibilities, interdependence and integration among team members.[3]

From the patient's point of view, IPC has been documented as enhancing patient- and family-centred care, thus increasing patient-reported quality of care,[4] also preventing the occurrence of the most frequent adverse events.[5] From the healthcare professionals' point of view, IPC has been documented as improving communication among caregivers, increasing opportunities for shared responsibilities and effective participation in multidisciplinary decision-making[6, 7] and, ultimately, satisfaction and well-being.[8] Because of its relevance, different strategies aimed at increasing IPC have been documented to date, and among others, Interprofessional education (IPE), i.e. the opportunity to attend theoretical modules, courses and/or clinical training together (=nursing students and students in other health professions) present in undergraduate programs, has been documented as effective in increasing future collaboration among health care professionals (HCPs).[9, 10]

Nurses have been shown to play a strategic role to implement IPC by cooperating with a wide range of HCPs in all settings.[11] Given their role in promoting and enhancing IPC in daily practice,[2] it has become imperative for universities to provide nursing students with interprofessional knowledge and competences.[7] According to this, different policies[12, 13] and evidence [14] have recommended that nursing students should be exposed early to IPE both at a clinical and didactic levels. Thus, students who have been exposed to IPE can start their professional career and work effectively in a team;[15, 16] moreover, implementing their views by comparing their data and clinical thinking with other disciplines has been documented as promoting problem-solving and critical thinking abilities.[17] On the other hand, when their IPE experiences are poor or take place at the end of the nursing program, their effectiveness as part of a team after graduation can be significantly limited.[18]

Despite their relevance, IPE opportunities have been documented as often not being included in undergraduate programmes, and nursing students have reported only a few opportunities to have meaningful contact with other HCPs during their education.[7] Nurses are often educated exclusively within their profession without having the opportunity to learn other HCP roles and responsibilities.[7] As a consequence, students have been reported to be less proficient in teamwork competences[19] and needing more support when starting a professional role requiring teamwork.[11] Factors threatening the integration of IPE opportunities in clinical training have been established at the (a) organizational

level, such as the lack of institutional collaboration; (b) managerial level, such as barriers in changing practices; (c) practical level, as for example the lack of time, and (d) at the cultural levels such as different perceptions of teamwork, stereotyped behaviours, and the potential risk of dominance for one profession—usually medicine—over others.[20, 21]

To date, despite its documented relevance, the degree of IPE opportunities experienced by nursing students has not been studied in large samples; above all, factors promoting IPE have not been identified up to now at the national level where national healthcare policies and healthcare professional educational policies can both have an influence in promoting IPE and, consequently, future HCPs' cooperation. Therefore, the purpose of this study was to cover the gap in the available evidence by exploring nursing students' IPE experiences during their clinical learning and factors promoting IPE experiences.

Methods

Setting, study network and design

Nursing education in Italy is provided at the University level and the duration of the course is three years; enrolment is allowed for candidates at the end of their secondary education, after having passed an examination based upon a programme defined by the national law. Theoretical education is offered at the University level; clinical rotations are instead offered in the National Health Care (NHS) services, after the first semester of the 1st year, and then in the 2nd and in the 3rd year for a total of 1,800 hours of education. The average number of clinical rotation ranges from two to five/year. At the time of the study, there were a total of 208 Bachelor of Nursing Sciences (BNS) in 43 universities, located in the 20 Italian regions.

On a preliminary basis, an Italian network aimed at evaluating nursing students' clinical education quality by involving all degrees was formed, and different research lines were established. Specifically, an open offer was sent to all BNS degrees to participate in the research network with a summary of the study protocol.[22] After two months, the invitation was closed, and the network resulted composed by 27 universities with 95 BNS degrees located in 15 regions.[22] Thus, the nation-wide, cross-sectional study was conducted, and the findings have been reported here according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE).[23]

Participants

Eligible students were those who: (a) were attending a BNS degree belonging to the national research network; (b) were attending their clinical practical rotations lasting at least two weeks in the same unit; or (c) had just completed their clinical rotation in the previous two weeks without having started

a new rotation at the time of the survey; and (d) expressed a willingness to participate in the study after being informed on the aims.

Primary outcome, explanatory variables and instruments

The primary outcome of the study was IPE occurrence as experienced by students. This was assessed by the following question included in the questionnaire: 'Did you experience IPE occasions during your most recent clinical rotation?' Aiming at ensuring consistency in concept interpretation, some concrete examples of IPE were included in brackets, e.g. working and/or learning at the bedside (e.g., assessing patient needs, deciding clinical treatments) with other HCPs, or with other students attending their education in different disciplines; or participating in multi-professional meetings where integrated decisions are made. Participants were required to answer by using a 4-point Likert scale according to their experience: the possible answers were 0 = *never*; 1 = *only a little*; 2 = *to some extent*; and 3 = *always, when the situation requires*. The concept of '*when the situation requires'* was introduced at the end of each level of the Likert scale, aimed at helping students to rank the IPE occasions experienced as compared to those expected in the different circumstances of the specific clinical environment. The item was developed by the research team[22] and piloted to assess its clarity and understandability among 100 students and this data has not been considered in this report.

The explanatory variables were collected at the individual and regional levels:

- at the individual level: we collected socio-demographic data (e.g., age, gender, marital status); previous secondary and academic education data; the academic year attended (1st, 2nd, or 3rd); the working experiences, both before and during nursing education; and previous clinical rotation experiences attended (in number) and in which settings. With regards to their most recent clinical rotation, participants were asked about: (a) its duration in weeks; (b) the supervision model adopted by the unit, whether the student was under the supervision of a clinical nurse, the entire staff, a nurse identified by the head nurse, a nurse teacher, or head nurse; (c) the perceived degree of competences learned (4-point Likert scale ranging from 0 = *none* to 3 = *very much*) and (d) the perceived quality of the learning processes as measured by the Clinical LEarning Quality Evaluation Index (CLEQI) tool.[24] The tool has been developed and validated at the national level for nursing programmes; due to its properties, it has been recommended as an essential tool to evaluate routinely each clinical rotation attended by students.[24] It is composed of 22 items divided into five factors, namely 'Quality of the tutorial strategies' (6 items), 'Learning opportunities' (6 items), 'Self-directed learning' (3 items), 'Safety and nursing care quality' (4 items), and 'Quality of the learning environment' (3 items). Each factor, as well as the overall CLEQI score, can range from 0 – 'nothing' to 3 – 'very much', with higher scores indicating a higher quality of the learning processes enacted in the clinical setting as perceived by students.

- at the regional level: we recorded the region where the BNS degree was offered. In fact, by law, nursing education is provided through lectures in academic settings, while clinical rotations take place in local healthcare organizations. With the federalisation of the healthcare system at the regional level,[25] Italy has different systems according to regional policies and rules that can affect nursing education.

After piloting the questionnaire aimed at ensuring its feasibility and comprehensiveness, the data collection process was started in the same period in all nursing programmes part of the research network via paper and pencil or via Google Drive, according to local feasibility and resources.

Data analysis

The descriptive statistical analysis was performed by calculating frequencies and percentages, averages with standard deviations (SD) or confidence intervals (CI) at 95%. A bivariate analysis was performed, where the primary outcome was considered as a categorical variable forming four groups: students who experienced IPE opportunities as 'never', 'only a little', 'to some extent', and 'always'. Chi-square tests, ANOVA, and Kruskal-Wallis tests were used to explore the significant differences, if any, across groups.

On a preliminary basis, the intraclass correlation (ICC) was evaluated under fixed and random effect assumptions to identify cluster effects at different levels, specifically: (a) at the unit level attended by students during their clinical rotation, assuming that some units can offer specific IPE opportunities due to differences in culture and skill mix; (b) at the nursing programme level, assuming that BNS programme can have designed different strategies to promote IPE, and (c) at the regional level, since Italian regions have developed different healthcare systems after reforms federalising healthcare, with an additional potential impact on the culture of teamwork collaboration permeating the clinical settings attended by students.[25] The ICCs at the unit level were 0.07 (random effects) and 0.06 (fixed effects); at the nursing programme level they were 0.01 (both under random and fixed effects); and, at the regional level, they were 0.06 (random effects) and 0.03 (fixed effects), respectively, meaning that the possible alternative hierarchical structures were not relevant in the studied phenomenon.

Next, a multilevel analysis using the generalized linear mixed model was performed by calculating the odd-ratios (OR; CI 95%) and the pseudo R^2. The primary outcome was entered in the model as a dichotomous variable by aggregating options given by students 'always'+ 'some extent' vs. those reporting 'only a little' + 'never'; the model specification included the variables significantly associated with the outcome at bivariate analysis as explanatory variables. All analyses were performed by using the SPSS Statistical Package version 24 and R Core Team.[26] Statistical significance was set at $p < .05$.

Ethical issues

The study protocol was approved by the University Ethical Committee of Milan University (Italy).[22] Participants gave their consent to participate in the study.

Patient and Public Involvement

Patients and public were not involved.

Bias control

At the national level, several strategies have been promoted to ensure a large participation of BNS by sending an open call invitation at different times, usually two weeks apart, thus preventing selection bias. Information bias was prevented by standardising the information provided to local researchers identified as responsible for the data collection in each participating nursing programme and by providing a precise description of study aims and data collection procedures on the first page of the questionnaire.

Aimed at preventing recall bias, students were invited to fill in the questionnaire during the last week of their clinical rotation or at least after the following two weeks after its end when they were not exposed to the next clinical rotation. Data were analysed by the coordinator centre (University of Udine) in a blind fashion to ensure anonymity in regards to the units, nursing programmes, and regions numbered consecutively (for example, region 1). Moreover, students were free to participate in the survey without any pressure or incentives.

Results

Primary outcome

Out of 10,480 eligible students, 9,607 participated in the study. A total of 666 (6.9%) students reported to never have been involved in IPE opportunities; 3,248 (33.8%) reported experiencing 'only a little' opportunity; 3,653 (38.0%) reported experiencing these opportunities 'to some extent'; while the remaining 2,040 (21.3%) reported having always experienced IPE, when required, during their most recent clinical rotations.

Bivariate analysis

At the individual level (Table 1), students who reported no experiences of IPE were more often female ($p < .00$), older ($p = .015$), unmarried ($p = .032$), with previous work experience ($p = .017$), and with more previous clinical rotations exclusively in hospital settings ($p < .001$).

Specifically, with regards to the last clinical rotation, students who reported no IPE experiences attended a shorter-duration clinical rotation ($p = .007$) where they were more frequently supervised by the nursing staff ($p < .001$) and reported having learnt less competences ($p < .001$). They also reported lower average scores both in all factors (all p-values < .001) and in the total CLEQI score ($p < .001$; Table 1). Instead, those students who reported to have always experienced IPE were more often attending their third year ($p < .001$) and were working during their nursing education ($p = .016$; Table 1).

At the regional level, 0.9% of students from region 2 and 13% from region 15 who were attending their nursing programmes reported no IPE experiences versus 8.7% of students in region 12 and 41.1% in region 2, who reported having always experienced IPE opportunities (Table 1). There is a significant difference between the Italian regions.

Factors affecting IPE

The multilevel analysis performed using the generalized linear mixed model showed an acceptable value for the pseudo R^2 of 15.1%.

At the individual level, most recent rotations reporting a high-quality learning environment (OR = 1.506, 95% CI [1.337, 1.659]), highly encouraged self-directed learning (OR = 1.485, 95% CI [1.361, 1.620]), and offered higher learning opportunities (OR = 1.408, 95% CI [1.242, 1.597]) all increased the likelihood of IPE occurrence. Moreover, an environment characterized by high safety and nursing care quality (OR = 1.317, 95% CI [1.178, 1.473]), where high-quality tutorial strategies were offered (OR = 1.196, 95% CI [1.066, 1.341]), and where students reported high competences learned (OR = 1.411, 95% CI [1.292, 1.540]) also promoted the likelihood of IPE occurrence. Differently, male gender (OR = 0.821, 95% CI [0.727,0.927]) was negatively associated with IPE occurrence (Table 2).

At the regional level, students attending a nursing programme in region 2 were approximately 1.75 times more likely to have experienced IPE opportunities as compared to those of region 1 (OR = 1.746, 95% CI [1.119, 2.726]). On the other hand, students attending their nursing programmes in other regions such as region n. 3, 4, 6, 7, and 15, reported a lower likelihood (OR from 0.554 to 0.716) of IPE occurrence as compared to region 1.

Discussion

This study explored nursing students' IPE experiences and promoting factors during the clinical rotations at the national level. IPE has been considered an effective educational strategy to increase professional and collaborative competences, thus promoting IPC in the real context.[14, 27 28] It has been recommended that learning non-technical skills—such as teamwork—should be offered early to

healthcare students as part of their undergraduate core curriculum since cooperation between different carers is pivotal in providing high-quality and safe care.[2, 29] However, despite its wide recognition, Italian nursing students experienced a lack of interprofessional learning occasions, with 40.7% of them reporting 'never' to 'only a little' IPE opportunities during their last clinical rotation. Poor examples of IPC in the clinical settings,[30] as well as a poor understanding of each HCP's role and responsibility have been reported as affecting the opportunity to undertake IPE experiences[16, 31] that can affect also the future ability to cooperate with other members of a team.

Aimed at discovering IPE experiences during their undergraduate education, we have involved the largest sample of nursing students where the main socio-demographic characteristics were in line to those reported at the national level.[24] However, according to the findings, IPE occurrences were only partially affected by individual factors, whereas a greater influence has emerged in the clinical environment and geographical context where clinical rotations were attended. Regarding the latter, students have been exposed to different IPE occurrences across Italian regions, suggesting that different healthcare systems[25] have developed different IPC sensitivities at the ward level. High occurrences of IPE in some regions should be considered best practices for other regions, thus encouraging to share policies and/or interventions implemented. On the other hand, those regions where healthcare institutions have offered few IPE experiences to students should reflect on whether the care models leading the delivery of services are still based upon the traditional hierarchy across healthcare professionals in order to identify strategies that can promote teamwork. Moreover, given the IPE variability emerged across region, case studies are also suggested in order to understand policies and/or factors in those regions where students reported a greater IPE occurrence.

All factors measured with the CLEQI tool[24] detecting the quality of learning processes enacted by the student in the actual context were positively associated with the high likelihood of IPE occurrences. The clinical learning environment is composed of different psychosocial, organizational, cultural, and interactive factors in addition to physical space and the teaching/learning components that all promote the learning of competences, [32] including interprofessional ones. Specifically, the odds of reporting IPE experience in the last rotation was positively affected by the perceived quality of the clinical learning environment. A unit gain in the quality of the environment corresponds to odds in the IPE occasions of around 1.5 times as compared to the baseline. The perceived quality of the clinical environment has already been associated with the type, quality, and amount of interactions between students and the nursing staff,[33] suggesting that a good-quality environment can also increase the quality of interprofessional interactions, thus promoting IPE occasions.

Similarly, the odds of reporting IPE experience in the last rotation was also positively affected by the environments encouraging students to be independent in their learning processes as self-directed learners. Self-directed learning has been documented as encouraging self-evaluation;[34] by evaluating

their own learning needs and searching for different strategies to address them, students can be encouraged also to collaborate with other health care professionals, e.g. as a source to understand the nature of patients' problems[16] thus learning from other disciplines.[35]

Perceiving higher learning opportunities as well as high-quality and safe nursing care delivered in the ward also increased the perceptions of IPE opportunities. Having the chance to learn a range of technical and non-technical skills (e.g., communication) is deeply intertwined with IPE because students can increase their confidence in searching for multidisciplinary collaboration.[29] Moreover, teamwork, cooperation, and shared discussions across HCPs[16] have all been documented as fundamental in promoting the quality of care and patient safety: students experiencing their clinical learning in units based upon these principles can discuss with their supervisors various care processes,[36] they can be involved in or witness IPC during meetings, and they can also be involved in integrated care planning.[16] On the other hand, those units with poor attention at patient safety and quality of care can have a few IPC opportunities: as a consequence, a missed interprofessional involvement of students can limit the opportunity of IPE.[28, 36]

Furthermore, the quality of tutorial strategies increased the likelihood of IPE experiences, thus suggesting that those nurses responsible for clinical teaching can create opportunities to expose students to interprofessional contacts. However, the contribution of these factors to IPE is limited; in line with this finding, tutorial models delivered at the ward level have not influenced students' IPE experiences, given that the different options (e.g., being supervised by a clinical nurse or staff) are all inside the nursing profession. Provision of a more complex model of nursing student supervision, and also involving other HCPs, should be further studied for its ability to increase IPE. According to available evidence,[37] only student exposure to the team can increase understanding of interprofessional processes of care, thus allowing the development of strong interprofessional skills.

Finally, the increased competencies acquired during the students' last clinical training was positively associated with the perception of IPE experiences, suggesting that environments allowing the acquisition of greater clinical competencies are presenting an odd of exposure to IPE 2.41 times larger than the benchmark level; in contrast, those units offering fewer competence acquisitions have resulted in limited interprofessional collaboration experiences.

At the individual level, only male gender emerged as negatively associated with IPE experiences suggesting that male students should be more supported in developing interdisciplinary skills compared to female students; however, the reasons behind these findings[38] should be further explored.

Limitations

Students were asked to self-report their IPE occurrences in their most recent clinical rotations, not in their entire nursing rotations or, for example in the academic setting, such as in simulation laboratories

or in classroom. Moreover, their perception regarding the occurrence (from 'never' to 'always') has been based on their personal judgment and further studies are encouraged to measure quantitatively the experiences of IPE. Furthermore, no data have been collected on the interprofessional collaboration theoretical core contents across nursing programmes that could have promoted different IPE expectations among students; similarly, the quality of interprofessional collaboration examples witnessed in the clinical practice was not assessed. What students see about the team in clinical practice may not be ideal (e.g. when reinforcing hierarchies) and should be thoughtfully debriefed ideally within an interprofessional student group and with a facilitator skilled in surfacing these issues.

Also, some relevant data such as healthcare professional profiles available at the unit level (e.g., only nurses and physicians) and the team-to-students' ratio, as well as the role of the students (e.g., supernumerary or fully involved in nursing care), were not collected.

We used only one question to explore IPE occurrence by providing some examples of interprofessional collaboration to increase clarity and consistency in data collection; however, the type and quality of these IPE experiences have not been investigated. In the attempt of discovering the explanatory variables, we have used the CLEQI[24] tool which measures the quality of the clinical environment while no data with regards to the quality of the academic environment have been collected. In addition, the cross-sectional design must be used with caution when considering emerged factors in the multilevel analysis as predictors of IPE according to students' perception, since other study designs would have been preferable to answer causative questions. Finally, the multilevel analysis results show that students' perceptions of IPE opportunities is only partially explained by the considered model (the pseudo-R^2 is 0.15). Consequently, future research is recommended to capture other significant factors not identified in this study. Moreover, future studies should also target the barriers preventing IPE occasions among nursing students by also involving other healthcare professionals, aimed at acquiring a complete picture of IPE throughout healthcare professionals in Italy.

Conclusions

A large number of nursing students ranged in their perceptions from 'never' to 'only a little' IPE experiences, thus suggesting that nursing education seems to remains mainly inside the nursing profession. Graduate nurses are not always trained to interact with other HCPs, thus suggesting that interprofessional collaboration is still challenging both in current practice, where a few occasions are offered to students and in future practice, given that interprofessional competencies are also based upon the quality of education offered before graduation. The limited opportunities to develop teamwork skills to transfer into future practice for a large number of next-generation healthcare

workers may also prevent the complete transition from hierarchical approaches to collaborative approaches, which have been recommended as providing the best patient care.

Associated factors have emerged mainly at the clinical context levels where students attend their clinical rotations, and at the regional levels, suggesting that IPE is influenced by a collaborative culture promoted at the ward level and by the policies developed at regional levels, inspiring both healthcare institutions and the nursing programmes. Nurse academicians should include in their agenda strategies aimed at developing IPE opportunities both at the university and at the clinical levels. Specifically, learning environments should be periodically assessed for their ability to offer students the opportunity to develop collaborative skills. Moreover, benchmarking policies at the regional level, aimed at promoting a higher sensitivity concerning the positive correlation between interprofessional teamwork and patient safety are recommended. Differently, individual factors have shown a limited contribution to IPE occurrences, suggesting that male students should be more encouraged to collaborate with other health care professionals.

Data Statement

Technical appendix, statistical code, and dataset available from the Coordinating centre (Udine university, Alvisa Palese and Luca Grassetti).

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Table 1. IPE occasions as experienced by students during the most recent clinical rotation

	Never N = 666 (6.9%)	Only a little N = 3248 (33.8%)	To some extent N = 3653 (38.0%)	Always N = 2040 (21.3%)	*p*‡
Individual level					
Age, years, mean (95% CI)	23.2 (23-23.7)	22.9 (22.7-23.0)	22.79 (22.7-22.9)	23.0 (22.8-23.2)	0.015
Female (n=9596), n (%)	531 (80.0)	2561 (78.9)	2732 (74.9)	1479 (72.6)	<0.001
Civil status, n (%)					
Unmarried	629 (94.4)	3047 (93.8)	3460 (94.7)	1909 (93.6)	0.032
Married/cohabitant	26 (3.9)	164 (5.0)	138 (3.8)	107 (5.3)	
Divorced	3 (0.5)	110 (0.4)	14 (0.4)	9 (0.4)	
Widowed	2 (0.3)	1 (0.0)	1 (0.0)	3 (0.1)	
Missing	6 (0.9)	25 (0.8)	40 (1.1)	12 (0.6)	
With children, n (%)	26 (3.9)	138 (4.3)	174 (4.8)	90 (4.5)	0.636
Secondary education (n=9442), n (%)					
High school	450 (68.2)	2260 (70.8)	2507 (69.9)	1414 (70.3)	0.287
Technical school	25 (3.8)	149 (4.7)	160 (4.5)	76 (3.8)	
Professional school	112 (17.0)	490 (15.4)	596 (16.6)	320 (15.9)	
Teacher school	58 (8.8)	256 (8.0)	282 (7.9)	172 (8.6)	
Secondary school abroad	15 (2.2)	34 (1.1)	39 (1.1)	28 (1.4)	
Academic year attended (n=9579), n (%)					
First	183 (27.5)	1008 (31.2)	1123 (30.8)	595 (29.3)	<0.001
Second	249 (37.5)	1149 (35.5)	1251 (34.3)	633 (31.1)	
Third	233 (35.0)	1078 (33.3)	1272 (34.9)	805 (39.6)	
Academic experience (n=9515), n (%)					
None	428 (64.5)	2235 (69.3)	2538 (70.2)	1386 (68.9)	0.224
Graduated in other fields	38 (5.7)	130 (4.0)	154 (4.3)	98 (4.9)	
Uncompleted degree	191 (28.9)	829 (25.7)	894 (24.7)	512 (25.4)	
Other	5 (0.8)	31 (1.0)	30 (0.8)	16 (0.8)	
Previous work experience (n=9553), n (%)	248 (37.6)	1059 (32.8)	1254 (34.5)	740 (36.4)	0.017
Work experience during the degree (n=9526), n (%)	147 (22.2)	629 (19.6)	709 (19.6)	457 (22.6)	0.016
Previous clinical rotations, (n=9498), number, mean (95% CI)	5.05 (4.80-5.31)	4.85 (4.74-4.97)	4.87 (4.77-4.98)	5.01 (4.87-5.14)	0.216
Setting (n=9551), n (%)					
Only hospital	479 (72.1)	2249 (69.6)	1478 (68.3)	1300 (64.1)	<0.001
Only community setting	10 (1.5)	53 (1.6)	51 (1.4)	39 (1.9)	
Hospital and community	175 (26.4)	932 (28.8)	1097 (30.3)	688 (34.0)	
Length of the most recent clinical rotation, weeks, mean (95% CI)*	5.75 (5.52-5.98)	5.74 (5.64-5.83)	5.78 (5.69-5.86)	5.99 (5.88-6.10)	0.007
Tutorial model of the most recent clinical rotation (n=9563), n (%)* I was supervised by					<0.001
A clinical nurse	278 (42.1)	1570 (48.6)	1999 (54.9)	1249 (61.5)	
The nursing staff	335 (50.8)	1436 (44.4)	1386 (38.1)	647 (31.9)	
A nurse identified daily by the head nurse	6 (0.9)	37 (1.1)	29 (0.8)	21 (1.0)	
A nurse teacher	33 (5.0)	140 (4.3)	160 (4.4)	72 (3.6)	
The head nurse	8 (1.2)	50 (1.6)	66 (1.8)	41 (2.0)	
Degree competence learned in the most recent clinical rotation, (n=9577), mean (95% CI)*,†	1.50 (1.45-1.56)	1.83 (1.80-1.85)	2.15 (2.13-2.17)	2.50 (2.49-2.54)	<0.001
CLEQI factor scores, mean (95% CI)*,†					
Tutorial strategies quality	1.31 (1.25-2.37)	1.71 (1.68-1.73)	2.04 (2.02-2.06)	2.48 (2.45-2.50)	<0.001
Learning opportunities	1.40 (1.35-1.46)	1.71 (1.69-1.73)	2.02 (2.01-2.04)	2.46 (2.44-2.49)	<0.001
Self-directed learning	0.83 (0.78-0.89)	1.24 (1.21-1.26)	1.57 (1.55-1.59)	2.03 (2.00-2.06)	<0.001
Safety and nursing care quality	1.58 (1.53-1.63)	1.86 (1.84-1.88)	2.12 (2.10-2.13)	2.50 (2.48-2.52)	<0.001
Quality of the learning environment	1.33 (1.27-1.39)	1.76 (1.73-1.78)	2.11 (2.09-2.14)	2.50 (2.48-2.53)	<0.001
Overall CLEQI score*,†	1.29 (1.24-1.34)	1.66 (1.64-1.68)	1.98 (1.96-1.99)	2.40 (2.38-2.42)	<0.001
Regional level (n)					<0.001
Region 1 (701)	29 (4.1)	208 (29.7)	297 (42.4)	167 (23.8)	
Region 2 (469)	4 (0.9)	78 (16.6)	194 (41.4)	193 (41.1)	
Region 3 (943)	66 (7.0)	231 (24.5)	397 (42.1)	249 (26.4)	
Region 4 (2000)	129 (6.4)	720 (36.0)	745 (37.3)	406 (20.3)	
Region 5 (54)	2 (3.7)	17 (31.5)	20 (37.0)	15 (27.8)	
Region 6 (1094)	66 (6.0)	364 (33.3)	426 (38.9)	238 (21.8)	
Region 7 (1256)	72 (5.7)	398 (31.7)	482 (38.4)	304 (24.2)	
Region 8 (626)	51 (8.2)	193 (30.8)	262 (41.8)	120 (19.2)	
Region 9 (179)	14 (7.8)	57 (31.8)	71 (39.7)	37 (20.7)	
Region 10 (977)	86 (8.8)	412 (42.2)	332 (34.0)	147 (15.0)	

Region 11 (166)	18 (10.8)	75 (45.2)	53 (31.9)	20 (12.1)
Region 12 (207)	25 (12.1)	96 (46.4)	68 (32.8)	18 (8.7)
Region 13 (169)	21 (12.4)	67 (39.6)	64 (37.9)	17 (10.1)
Region 14 (407)	48 (11.8)	137 (33.7)	151 (37.1)	71 (17.4)
Region 15 (269)	35 (13.0)	105 (39.1)	91 (33.8)	38 (14.1)

* The more recent clinical experience was that under evaluation.
† On a 4-point Likert scale (0 = nothing; 3 = very much).
‡ Chi-square for dichotomous variables, analysis of variance and Kruskal-Wallis test for continuous variables.
CI, confidence interval; CLEQI, Clinical Learning Quality Evaluation Index; IPE, Interprofessional Educational experience; SD, standard deviation.

Table 2. IPE occurrence[a] as experienced by students during the most recent clinical rotation: a multilevel analysis

	Estimate	Std. Error	z value	Pr(>|z|)	OR	CI 95%	
(Intercept)	-2.904	0.333	-8.733	0.000	0.055	0.029	0.105
Individual level							
Age, years	-0.009	0.008	-1.118	0.264	0.991	0.975	1.007
Male gender vs female	-0.197	0.062	-3.183	0.001	0.821	0.727	0.927
Unmarried vs no	0.175	0.136	1.291	0.197	1.192	0.913	1.555
Year of nursing education attended, 1st	§						
Year of nursing education attended, 2nd vs 1st	-0.093	0.066	-1.402	0.161	0.911	0.800	1.038
Year of nursing education attended, 3rd vs 1st	0.076	0.070	1.074	0.283	1.079	0.939	1.238
Previous work experience yes vs no	0.097	0.063	1.544	0.123	1.102	0.974	1.246
Work experience during the degree yes vs no	0.051	0.069	0.738	0.461	1.052	0.919	1.206
Context of previous clinical learning experiences							
Only hospital	§						
Only community setting	-0.040	0.212	-0.190	0.849	0.961	0.634	1.455
Hospital and community setting	-0.035	0.064	-0.551	0.581	0.965	0.851	1.095
More recent clinical rotation, tutorial model							
I was supervised by a clinical nurse	§						
By the nursing staff	0.106	0.065	1.631	0.103	1.112	0.979	1.262
By a nurse identified daily by the head nurse	-0.435	0.271	-1.608	0.108	0.647	0.381	1.100
By the head nurse	0.190	0.135	1.407	0.159	1.209	0.928	1.575
By the nurse teacher	-0.212	0.197	-1.074	0.283	0.809	0.550	1.191
Length of the most recent clinical rotation, weeks, mean (95% CI)[†]	-0.001	0.010	-0.105	0.916	0.999	0.979	1.020
Degree competence learned in the most recent clinical rotation[†]	0.344	0.045	7.687	0.000	1.411	1.292	1.540
CLEQI factors							
Quality of the tutorial teaching strategies (0-3)[*,†]	0.179	0.059	3.053	0.002	1.196	1.066	1.341
Self–direct learning (0-3)[*,†]	0.395	0.045	8.874	0.000	1.485	1.361	1.620
Learning opportunities (0-3)[*,†]	0.342	0.064	5.341	0.000	1.408	1.242	1.597
Safety and nursing care quality (0-3)[*,†]	0.275	0.057	4.830	0.000	1.317	1.178	1.473
Quality of the learning environment (0-3)[*,†]	0.409	0.061	6.752	0.000	1.506	1.337	1.695
Regional level							
Region 1	§						
Region 2	0.557	0.227	2.453	0.014	1.746	1.119	2.726
Region 3	-0.471	0.172	-2.736	0.006	0.624	0.446	0.875
Region 4	-0.412	0.149	-2.768	0.006	0.662	0.495	0.887
Region 5	-0.318	0.394	-0.808	0.419	0.727	0.336	1.575
Region 6	-0.386	0.166	-2.328	0.020	0.680	0.491	0.941
Region 7	-0.334	0.163	-2.051	0.040	0.716	0.520	0.985
Region 8	0.023	0.185	0.124	0.901	1.023	0.712	1.470
Region 9	-0.153	0.281	-0.545	0.586	0.858	0.495	1.488
Region 10	-0.305	0.167	-1.833	0.067	0.737	0.531	1.021
Region 11	0.070	0.281	0.251	0.802	1.073	0.618	1.862
Region 12	-0.401	0.235	-1.708	0.088	0.670	0.423	1.061
Region 13	-0.286	0.269	-1.061	0.289	0.751	0.443	1.274
Region 14	0.411	0.220	1.865	0.062	1.508	0.979	2.324
Region 15	-0.590	0.278	-2.124	0.034	0.554	0.321	0.955

CI, confidence interval; CLEQI, Clinical LEarning Quality Evaluation Index; IPE, Interprofessional Educational experience(s); OR, odds ratio; Std. Error, standard error.

[a] 'always'+ 'some extent' vs. 'only a little' + 'never'.

§ reference group;[*] The most recent clinical rotation was that under evaluation.

† On a 4-point Likert scale (from 0= "never" to 3= "always").
Sigma indiv 0.169; AIC 9376.414; BIC 9629.481; LogLik -4652.207 (*df* 36); LogLik_null -5479.081 (df 2); Pseudo R^2 0.151

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6
Study design	#4	Present key elements of study design early in the paper	1
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6

	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6-7
Bias	#9	Describe any efforts to address potential sources of bias	8-9
Study size	#10	Explain how the study size was arrived at	6-7
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7-8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7-8
	#12b	Describe any methods used to examine subgroups and interactions	7-8
	#12c	Explain how missing data were addressed	7-8
	#12d	If applicable, describe analytical methods taking account of sampling strategy	7-8
	#12e	Describe any sensitivity analyses	n/a
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	9
	#13b	Give reasons for non-participation at each stage	6-7, 9
	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	table 1, 9

	#14b	Indicate number of participants with missing data for each variable of interest	table 1
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	tabe 1
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	See note 1
	#16b	Report category boundaries when continuous variables were categorized	See note 2
	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a
Key results	#18	Summarise key results with reference to study objectives	10-12
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	12
Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

Author notes

1. 9-10, table 2
2. 9-10, table 1 and 2

BMJ Open

Nursing students' interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study

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Nursing students' interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study

Running title

Nursing students' interprofessional educational experiences

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All the authors have no financial or other relationships to report.

Data Availability Statement

None

Author Contributions

All the authors equally contributed to the research's design; A. Palese, A. Brugnolli, L. Saiani, S. Terzoni, A. Destrebecq, I. Mansutti, L. Zannini, and V. Dimonte plus the SVIAT team; A. Palese, L. Grassetti and S. Gonella performed the data analysis and contributed to data interpretation; and A. Palese and S. Gonella drafted the manuscript. All authors critically revised the manuscript, agreed to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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Abstract

Objective: To explore nursing students' interprofessional education (IPE) experiences during their most recent clinical rotation and to explore the factors supporting IPE experiences.

Design: National cross-sectional study on data collected in 2016.

Setting: 95 Bachelor of Nursing Sciences programmes; 27 Italian Universities.

Participants: Students who (a) were attending or just completed their clinical rotations lasting at least two weeks in the same unit, and (b) willing to participate in the study.

Primary and secondary outcome: measure the occurrence of IPE experiences in the most recent clinical rotation; the secondary outcome was to discover factors associated with IPE occurrence.

Measures: The primary outcome was measured using questions based on a 4-point Likert scale (from 0 = '*never'* to 3 = '*always'*). Explanatory variables were collected at both individual and regional levels with items included in the same questionnaire.

Results: 9,607 out of 10,480 students took part in the study. Overall, 666 (6.9%) perceived not having had any IPE experience, while 3,248 (33.8%), 3,653 (38%), and 2,040 (21.3%) reported having experienced IPE opportunities 'only a little', to 'some extent', or 'always', respectively. From the multilevel analysis performed using the generalized linear mixed model, factors promoting the occurrence of IPE experiences were mainly set at (a) the clinical learning environment level (high: learning environment quality, self-directed learning encouragement, learning opportunities, quality of safety and nursing care, and quality of tutorial strategies); and (b) the regional level, where significant differences emerged across regions. In contrast, male gender was negatively associated to the perception of having had IPE experiences.

Conclusions: A large number of nursing students experienced either 'never' or 'only a little' IPE opportunities, thus suggesting that nursing education tends to remain within the nursing profession. Limiting students' interprofessional exposure during education can prevent future collaborative approaches that have been shown to be essential in providing best patient care. In order to increase IPE exposure, it is necessary to develop strategies designed both at the singular unit and regional levels.

Keywords: clinical learning, interprofessional education, interprofessional cooperation, nursing students, student perception, teamwork

Article summary

Strengths and limitations of this study

- This is the first study examining the extent and associated factors of interprofessional education (IPE) experiences among nursing students.
- This is a national study involving a large number of nursing programmes, thus potentially affecting the generalizability of the findings.
- This is the first multilevel study in this context aimed at identifying the complexity of factors influencing IPE opportunities.
- A cross-sectional design was adopted to measure the primary outcome and associated factors at the same time; therefore, factors emerged as predictors of IPE experiences should be considered with caution.
- Data affecting IPE opportunities, such as study programs contents and healthcare professional profiles available at the unit level, were not collected.

Introduction

The need to increase proficiency in both health care and clinical pathways, especially with the aging population, has been documented as requiring improved collaboration and team-based models of care delivery[1] with interprofessional teams being in the best position to ensure quality and safe care.[2] In this context, interprofessional collaboration (IPC), defined as the degree of cooperation between nursing staff and other health care professionals (HCPs), spans a range of key dimensions, including shared goals, team identity, commitment, clear team roles and responsibilities, interdependence and integration among team members.[3]

From the patient's point of view, IPC has been documented as enhancing patient- and family- centred care, thus increasing patient-reported quality of care,[4] and preventing the occurrence of the most frequent adverse events.[5] From the healthcare professionals' point of view, IPC has been documented as improving communication among caregivers, increasing opportunities for shared responsibilities and effective participation in multidisciplinary decision-making[6,7] resulting in increased HCPs' satisfaction and well-being.[8]

Because of its relevance, different strategies aimed at increasing IPC have been documented to date. Among others, Interprofessional education (IPE), i.e. the opportunity to attend theoretical modules, courses and/or clinical training together (=nursing students and students in other health professions) in undergraduate programs, has been documented as effective in increasing future collaboration among HCPs.[9, 10]

Nurses have been shown to play a strategic role in IPC implementation by cooperating with a wide range of HCPs in all settings.[11] Given their role in promoting and enhancing IPC in daily practice,[2] it has become imperative for universities to provide nursing students with interprofessional knowledge and competences.[7] Different policies[12, 13] and evidence [14] have recommended that nursing students should be exposed early to IPE both at a didactic and clinical level. Thus, students who have been exposed to IPE can start their professional career and work effectively in a team;[15, 16] moreover, implementing their views by comparing their data and clinical thinking with other disciplines has been documented as promoting problem-solving and critical thinking abilities.[17] On the other hand, when IPE experiences are poor or take place at the end of the nursing program, the student's effectiveness as a member of a team after graduation can be significantly limited.[18]

Despite their relevance, IPE opportunities are not being regularly included in undergraduate programmes, and nursing students have reported only few opportunities to have meaningful contact with other HCPs during their education.[7] Nurses are often educated exclusively within their profession without having the chance to learn about other HCP roles and responsibilities.[7] As a consequence, students have been reported to be less proficient in teamwork competences[19] and in need of more support when starting their professional role requiring teamwork.[11] Factors threatening

the integration of IPE opportunities in clinical training have been established at the (a) organizational level, such as the lack of institutional collaboration; (b) managerial level, such as barriers in changing practices; (c) practical level, as for example the lack of time, and (d) at the cultural level such as different perceptions of teamwork, stereotyped behaviour, and the potential risk of dominance for one profession—usually physicians—over the others.[20, 21]

To date, despite its documented relevance, the degree of IPE opportunities experienced by nursing students has not been studied in large samples; above all, factors promoting IPE have not been identified at the national level where national healthcare policies and healthcare professional educational policies can both have an influence in promoting IPE and, consequently, future HCPs' cooperation. Therefore, the purpose of this study was to cover the gap in the available evidence by exploring nursing students' IPE experiences during their clinical learning and factors promoting IPE experiences.

Methods

Setting, study network and design

Nursing education in Italy is provided at the University level and the duration of the course is three years. Enrolment is allowed for candidates at the end of their secondary education, after having passed an examination based on a programme defined by the Italian law. Theoretical education is offered at the University level; clinical rotations are instead offered in the National Health care Services (NHS), after the first semester of the 1st year, and then in the 2nd and in the 3rd year for a total of 1,800 hours of education. The average number of clinical rotations ranges from two to five/year. At the time of the study, there were 208 Bachelor of Nursing Sciences (BNS) degrees in 43 universities, located in the 20 Italian regions.

On a preliminary basis, an Italian network was formed with the aim of evaluating nursing students' clinical education quality at all degrees and different research lines were established. Specifically, an open offer was sent to all BNS degrees to participate in the research network with a summary of the study protocol.[22] After two months, the invitation was closed, and the network consisted of 27 universities with 95 BNS degrees located in 15 regions.[22] Thereafter, the nation-wide, cross-sectional study took place and the findings have been reported here according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE).[23]

Participants

Eligible students were: (a) attending a BNS degree belonging to the national research network; (b) attending their clinical practical rotations lasting at least two weeks in the same unit; or (c) had just

completed their clinical rotation in the previous two weeks without having started a new rotation at the time of the survey; and (d) willing to participate in the study after being informed about its aims.

Primary outcome, explanatory variables and instruments

The primary outcome of the study was the IPE occurrence as experienced by students. This was assessed through the following question included in the questionnaire: 'Did you experience IPE occasions during your most recent clinical rotation?' Aiming at ensuring consistency in concept interpretation, some concrete examples of IPE were included in the questionnaire, e.g. working and/or learning at the bedside assessing patient needs; deciding clinical treatments with other HCPs, or with other students attending their education in different disciplines; participating in multi-professional meetings where integrated decisions are made. Participants were required to answer by using a 4-point Likert scale according to their experience: the possible answers were 0 = *never*; 1 = *only a little*; 2 = *to some extent*; and 3 = *always, when the situation requires.* The concept of '*when the situation requires'* was introduced at the end of each level of the Likert scale, aimed at helping students to rank the IPE occasions experienced as compared to those expected in the different circumstances of the specific clinical environment. The item was developed by the research team[22] and piloted to assess its clarity and understandability among 100 students and this data has not been considered in this report.

The explanatory variables were collected at the individual and regional levels:

- at the individual level: we collected socio-demographic data (e.g., age, gender, marital status); previous secondary and academic education data; the academic year attended (1st, 2nd, or 3rd); the working experiences, both prior and during nursing education; and the previous clinical rotation experiences attended (in number) and in which settings. With regards to their most recent clinical rotation, participants were asked: (a) its duration in weeks; (b) the supervision model adopted by the unit, i.e. whether the student was under the supervision of a clinical nurse, the entire staff, a nurse identified by the head nurse, a nurse teacher, or a head nurse; (c) the perceived degree of competences learned (4-point Likert scale ranging from 0 = *none* to 3 = *very much*) and (d) the perceived quality of the learning processes as measured by the Clinical LEarning Quality Evaluation Index (CLEQI) tool.[24] The tool has been developed and validated at the national level for nursing programmes; because of its characteristics, it has been recommended as an essential tool to evaluate routinely each clinical rotation attended by students.[24] It is composed of 22 items divided into five factors, namely 'Quality of the tutorial strategies' (6 items), 'Learning opportunities' (6 items), 'Self-directed learning' (3 items), 'Safety and nursing care quality' (4 items), and 'Quality of the learning environment' (3 items). Each factor, as well as the overall

CLEQI score, can range from 0 – 'nothing' to 3 – 'very much', with higher scores indicating a higher quality of the learning processes enacted in the clinical setting as perceived by students.

- at the regional level: we recorded the region where the BNS degree attended by each participant students was offered. In fact, by law, nursing education is provided through lectures in academic settings, while clinical rotations take place in local healthcare organizations. Due to the federalisation of the healthcare system at the regional level,[25] Italy has different systems according to regional policies and rules that can affect nursing education.

After piloting the questionnaire with the purpose ensuring its feasibility and comprehensiveness, the data collection process was performed in the same period via paper and pencil or via Google Drive, according to local feasibility and resources.

Data analysis

The descriptive statistical analysis was performed by calculating frequencies and percentages, averages with standard deviations (SD) or confidence intervals (CI) at 95%. A bivariate analysis was performed, where the primary outcome was considered as a categorical variable forming four groups: students who experienced IPE opportunities as 'never', 'only a little', 'to some extent', and 'always'. Chi-square tests, ANOVA, and Kruskal-Wallis tests were used to explore the significant differences, if any, across groups.

On a preliminary basis, the intraclass correlation (ICC) was evaluated under fixed and random effect assumptions to identify cluster effects at different levels, specifically: (a) at the unit level attended by students during their clinical rotation, assuming that some units can offer specific IPE opportunities due to differences in culture and skill mix; (b) at the nursing programme level, assuming that BNS programme can have designed different strategies to promote IPE, and (c) at the regional level, since Italian regions have developed different healthcare systems after reforms federalising healthcare, with different regional policies affecting the culture of teamwork collaboration in the clinical settings attended by students.[25] The ICCs at the unit level were 0.07 (random effects) and 0.06 (fixed effects); at the nursing programme level they were 0.01 (both under random and fixed effects); and, at the regional level, they were 0.06 (random effects) and 0.03 (fixed effects), respectively, meaning that the possible alternative hierarchical structures were not relevant in the studied phenomenon.

Next, a multilevel analysis using the generalized linear mixed model was performed by calculating the odd-ratios (OR; CI 95%) and the pseudo R^2. The primary outcome was entered in the model as a dichotomous variable by aggregating options given by students 'always'+ 'some extent' vs. those reporting ''only a little' + 'never'. The model specification included the variables significantly associated with the outcome at bivariate analysis as explanatory variables. All analyses were

performed by using the SPSS Statistical Package version 24 and R Core Team.[26] Statistical significance was set at $p < .05$.

Ethical issues

The study protocol was approved by the University Ethical Committee of Milan University (Italy).[22] Participants gave their consent to participate in the study.

Patient and Public Involvement

Patients and public were not involved.

Bias control

At the national level, several strategies have been promoted to ensure a large participation of BNS by sending an open call invitation at different times, usually two weeks apart, thus preventing selection bias. Information bias was prevented by standardising the information provided to local researchers identified as responsible for the data collection in each participating nursing programme and by providing students with a precise description of study aims and data collection procedures on the first page of the questionnaire.

Aimed at preventing recall bias, students were invited to fill in the questionnaire during the last week of their clinical rotation or within two weeks from its end when they were not exposed to the next clinical rotation. Data was analysed by the coordinator centre (University of Udine) in a blind fashion to ensure anonymity in regards to the units, nursing programmes, and regions numbered consecutively (for example, region 1). Moreover, students were free to participate in the survey without any pressure or incentives.

Results

Primary outcome

Out of 10,480 eligible students, 9,607 participated in the study. A total of 666 (6.9%) students reported never having been involved in IPE opportunities; 3,248 (33.8%) reported experiencing 'only a little' opportunities; 3,653 (38.0%) reported experiencing these opportunities 'to some extent'; while the remaining 2,040 (21.3%) reported having 'always' experienced IPE, when required, during their most recent clinical rotation.

Bivariate analysis

At the individual level (Table 1), students who reported no experiences of IPE were more often female ($p < .00$), older ($p = .015$), unmarried ($p = .032$), with previous work experience ($p = .017$), and with a greater number of previous clinical rotations exclusively in a hospital setting ($p < .001$).

Specifically, with regards to the last clinical rotation, students who reported no IPE experiences attended a shorter-duration clinical rotation ($p = .007$) where they were more frequently supervised by the nursing staff ($p < .001$) and reported having learnt less competences ($p < .001$). They also reported lower average scores both in all factors (all p-values < .001) and in the total CLEQI score ($p < .001$; Table 1). On the other hand, students who reported to have always experienced IPE were more often attending their third year ($p < .001$) and were working during their nursing education ($p = .016$; Table 1).

At the regional level, 0.9% of students from region 2 and 13% from region 15 who were attending their nursing programmes reported no IPE experiences versus 8.7% of students in region 12 and 41.1% in region 2, who reported having always experienced IPE opportunities (Table 1). A significant difference across Italian regions has emerged regarding the IPE experienced by students.

Factors affecting IPE

The multilevel analysis performed using the generalized linear mixed model showed an acceptable value for the pseudo R^2 of 15.1%.

At the individual level, rotations reporting a high-quality learning environment (OR = 1.506, 95% CI [1.337, 1.659]), highly encouraged self-directed learning (OR = 1.485, 95% CI [1.361, 1.620]), and offered higher learning opportunities (OR = 1.408, 95% CI [1.242, 1.597]) all increased the likelihood of IPE occurrence. Moreover, an environment characterized by high safety and nursing care quality (OR = 1.317, 95% CI [1.178, 1.473]), where high-quality tutorial strategies were offered (OR = 1.196, 95% CI [1.066, 1.341]), and where students reported high competences learned (OR = 1.411, 95% CI [1.292, 1.540]) also promoted the likelihood of IPE occurrence. Male gender (OR = 0.821, 95% CI [0.727,0.927]) was instead negatively associated with IPE occurrence (Table 2).

At the regional level, students attending a nursing programme in region 2 were approximately 1.75 times more likely to have experienced IPE opportunities as compared to those in region 1 (OR = 1.746, 95% CI [1.119, 2.726]). On the other hand, students attending their nursing programmes in other regions (e.g., region 3, 4, 6, 7, and 15), reported a lower likelihood (OR from 0.554 to 0.716) of IPE occurrence as compared to region 1.

Discussion

This study explored nursing students' IPE experiences and promoting factors during the clinical rotations at the national level. IPE has been considered an effective educational strategy to increase

professional and collaborative competences, thus promoting IPC in the real context.[14, 27 28] It has been recommended that teaching non-technical skills—such as teamwork—should be offered early to healthcare students in their undergraduate core curriculum as cooperation across different professions is pivotal in providing high-quality and safe care.[2, 29] However, despite its wide recognition, Italian nursing students experienced a lack of interprofessional learning occasions, with 40.7% of them reporting 'never' to 'only a little' IPE opportunities during their last clinical rotation. Poor examples of IPC in the clinical settings,[30] as well as a poor understanding of each HCP's role and responsibility have been reported as affecting the opportunity to undertake IPE experiences[16, 31] that can affect also the future skill of cooperating with other members of a team.

Aimed at discovering IPE experiences during their undergraduate education, we have involved the largest sample of nursing students where the main socio-demographic characteristics were in line with those reported at the national level.[24] However, according to the findings, IPE occurrences were only partially affected by individual factors, whereas a greater influence has emerged in the clinical environment and geographical context where clinical rotations were attended. With respect to the latter, students have been exposed to different IPE occurrences across Italian regions, suggesting that different healthcare systems[25] have developed different IPC sensitivities at the ward level. High occurrences of IPE in some regions should be considered best practices for other regions, thus encouraging to share policies and/or interventions implemented. On the other hand, regions where healthcare institutions have offered few IPE experiences to students should reflect on whether the care models underlying the delivery of services are still based upon the traditional hierarchy across healthcare professionals in order to identify strategies that can promote teamwork. Moreover, given the IPE variability emerged across regions, case studies are also suggested in order to understand policies and/or factors in those regions where students reported a greater IPE occurrence.

All factors measured with the CLEQI tool[24] detecting the quality of learning processes enacted by the student in the actual context were positively associated with high likelihood of IPE occurrences. The clinical learning environment is composed of different psychosocial, organizational, cultural, and interactive factors in addition to the physical space and the teaching/learning components that all promote the learning of competences, [32] including interprofessional ones. Specifically, the odds of reporting IPE experience in the last rotation was positively affected by the perceived quality of the clinical learning environment. The perceived quality of the clinical environment has already been associated with the type, quality, and amount of interactions between students and the nursing staff,[33] suggesting that a good-quality environment can also increase the quality of interprofessional interactions, thus promoting IPE occasions.

Similarly, the odds of reporting IPE experience in the last rotation was positively affected by the environments encouraging students to be independent in their learning processes as self-directed

learners. Self-directed learning has been documented as encouraging self-evaluation;[34] by evaluating their own learning needs and searching for different strategies to address them, students can be encouraged also to collaborate with other HCPs, e.g., as a source to understand the nature of patients' problems[16] thus learning from other disciplines.[35]

Perceiving higher learning opportunities as well as high-quality and safe nursing care delivered in the ward also increased the perception of IPE opportunities. Having the chance to learn a range of technical and non-technical skills is deeply intertwined with IPE as students can increase their confidence in searching for multidisciplinary collaboration.[29] Moreover, teamwork, cooperation, and shared discussions among HCPs[16] have all been documented as fundamental in promoting quality of care and patient safety: students experiencing their clinical learning in units based on these principles can discuss with their supervisors various care processes,[36] they can be involved in or witness IPC during meetings, and they can also be involved in integrated care planning.[16] On the other hand, units with poor attention to patient safety and quality of care can have fewer IPC opportunities: as a consequence, missed interprofessional involvement of students can limit the opportunity of IPE.[28, 36]

Furthermore, the quality of tutorial strategies increased the likelihood of IPE experiences, thus suggesting that nurses responsible for clinical teaching can create opportunities to expose students to interprofessional contacts. However, the contribution of these factors to IPE is limited. In line with this finding, tutorial models delivered at the ward level have not influenced students' IPE experiences, given that the different options (e.g., being supervised by a clinical nurse or staff) are all inside the nursing profession. Provision of a more complex model of nursing student supervision also involving other HCPs should be further studied for its impact on IPE. According to available evidence,[37] only student exposure to the team can increase understanding of interprofessional processes of care, thus allowing the development of strong interprofessional skills.

Finally, the degree of competences acquired during the students' last clinical rotation was positively associated with the perception of IPE experiences; in contrast, units offering fewer competences have resulted in limited interprofessional collaboration experiences, indicating that IPE can also affect the achievement of learning outcomes.

At the individual level, only male gender emerged as negatively associated with IPE experiences suggesting that male students should be more supported in developing interdisciplinary skills compared to female students; however, the reasons behind these findings[38] should be further explored.

Limitations

Students were asked to self-report their IPE experiences in their most recent clinical rotations, not in their entire nursing education or, for example in the academic setting, such as in simulation laboratories or in the classroom. Moreover, their perception regarding the occurrence (from 'never'

to 'always') has been based on their personal judgment and further studies are encouraged to measure quantitatively the IPE experiences. Furthermore, no data has been collected on the interprofessional collaboration theoretical core contents across nursing programmes that could have promoted different IPE expectations among students; similarly, the quality of interprofessional collaboration examples witnessed in the clinical practice was not assessed. What students see about the team in clinical practice may not be ideal (e.g. when reinforcing hierarchies) and should be thoughtfully debriefed within an interprofessional student group and with a facilitator skilled in addressing these issues.

Also, some relevant data such as HCPs profiles available at the unit level (e.g., only nurses and physicians) and the team-to-students ratio, as well as the role of the students (e.g., supernumerary or fully involved in nursing care), was not collected.

We used only one question to explore IPE occurrence by providing some examples of interprofessional collaboration to increase clarity and consistency in data collection; however, the type and quality of these IPE experiences have not been investigated. In the attempt of discovering the explanatory variables, we have used the CLEQI[24] tool which measures the quality of the clinical environment while no data with regards to the quality of the academic environment has been collected. Additionally, the cross-sectional design must be used with caution when considering emerged factors in the multilevel analysis as predictors of IPE according to students' perception since other study designs would have been preferable to answer causative questions. Finally, the multilevel analysis results show that students' perceptions of IPE opportunities are only partially explained by the considered model (the pseudo-R^2 is 0.15). Consequently, future research is recommended to grasp other significant factors not identified in this study. Moreover, future studies should also target the barriers preventing IPE experiences among nursing students by also involving other HCPs, aimed at acquiring a complete picture of IPE throughout healthcare professionals in Italy.

Conclusions

A large number of nursing students felt they were exposed to IPE experiences 'never' to 'only a little' during their clinical rotation, thus suggesting that nursing education seems to remains mainly inside the nursing profession. The limited opportunities to develop teamwork skills to transfer into future practice for a large number of next-generation healthcare workers may also prevent the complete transition from hierarchical approaches to collaborative approaches, which have been identified as providing the best patient care.

Associated factors have emerged mainly at the clinical context level where students attend their clinical rotations, and at the regional level, suggesting that IPE is influenced by a collaborative culture promoted at the ward level and by the policies developed at regional levels, inspiring both healthcare institutions and nursing programmes. Nurse academicians should include in their agenda strategies

aimed at developing IPE opportunities both at the university and at the clinical levels. Specifically, learning environments should be periodically assessed for their ability to offer to students the opportunity to develop collaborative skills. Moreover, benchmarking policies at the regional level, aimed at promoting a higher sensitivity regarding the link between interprofessional teamwork and patient safety are recommended. Differently, individual factors have shown a limited contribution to IPE occurrences, suggesting that male students should be more encouraged to collaborate with other health care professionals.

Data Statement

Technical appendix, statistical code, and dataset available from the Coordinating centre (Udine University, Alvisa Palese and Luca Grassetti).

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Table 1. IPE occasions as experienced by students during the most recent clinical rotation

	Never N = 666 (6.9%)	Only a little N = 3248 (33.8%)	To some extent N = 3653 (38.0%)	Always N = 2040 (21.3%)	*p*‡
Individual level					
Age, years, mean (95% CI)	23.2 (23-23.7)	22.9 (22.7-23.0)	22.79 (22.7-22.9)	23.0 (22.8-23.2)	0.015
Female (n=9596), n (%)	531 (80.0)	2561 (78.9)	2732 (74.9)	1479 (72.6)	<0.001
Civil status, n (%)					
Unmarried	629 (94.4)	3047 (93.8)	3460 (94.7)	1909 (93.6)	0.032
Married/cohabitant	26 (3.9)	164 (5.0)	138 (3.8)	107 (5.3)	
Divorced	3 (0.5)	110 (0.4)	14 (0.4)	9 (0.4)	
Widowed	2 (0.3)	1 (0.0)	1 (0.0)	3 (0.1)	
Missing	6 (0.9)	25 (0.8)	40 (1.1)	12 (0.6)	
With children, n (%)	26 (3.9)	138 (4.3)	174 (4.8)	90 (4.5)	0.636
Secondary education (n=9442), n (%)					
High school	450 (68.2)	2260 (70.8)	2507 (69.9)	1414 (70.3)	0.287
Technical school	25 (3.8)	149 (4.7)	160 (4.5)	76 (3.8)	
Professional school	112 (17.0)	490 (15.4)	596 (16.6)	320 (15.9)	
Teacher school	58 (8.8)	256 (8.0)	282 (7.9)	172 (8.6)	
Secondary school abroad	15 (2.2)	34 (1.1)	39 (1.1)	28 (1.4)	
Academic year attended (n=9579), n (%)					
First	183 (27.5)	1008 (31.2)	1123 (30.8)	595 (29.3)	<0.001
Second	249 (37.5)	1149 (35.5)	1251 (34.3)	633 (31.1)	
Third	233 (35.0)	1078 (33.3)	1272 (34.9)	805 (39.6)	
Academic experience (n=9515), n (%)					
None	428 (64.5)	2235 (69.3)	2538 (70.2)	1386 (68.9)	0.224
Graduated in other fields	38 (5.7)	130 (4.0)	154 (4.3)	98 (4.9)	
Uncompleted degree	191 (28.9)	829 (25.7)	894 (24.7)	512 (25.4)	
Other	5 (0.8)	31 (1.0)	30 (0.8)	16 (0.8)	
Previous work experience (n=9553), n (%)	248 (37.6)	1059 (32.8)	1254 (34.5)	740 (36.4)	0.017
Work experience during the degree (n=9526), n (%)	147 (22.2)	629 (19.6)	709 (19.6)	457 (22.6)	0.016
Previous clinical rotations, (n=9498), number, mean (95% CI)	5.05 (4.80-5.31)	4.85 (4.74-4.97)	4.87 (4.77-4.98)	5.01 (4.87-5.14)	0.216
Setting (n=9551), n (%)					
Only hospital	479 (72.1)	2249 (69.6)	1478 (68.3)	1300 (64.1)	<0.001
Only community setting	10 (1.5)	53 (1.6)	51 (1.4)	39 (1.9)	
Hospital and community	175 (26.4)	932 (28.8)	1097 (30.3)	688 (34.0)	
Length of the most recent clinical rotation, weeks, mean (95% CI)*	5.75 (5.52-5.98)	5.74 (5.64-5.83)	5.78 (5.69-5.86)	5.99 (5.88-6.10)	0.007
Tutorial model of the most recent clinical rotation (n=9563), n (%)* I was supervised by					<0.001
A clinical nurse	278 (42.1)	1570 (48.6)	1999 (54.9)	1249 (61.5)	
The nursing staff	335 (50.8)	1436 (44.4)	1386 (38.1)	647 (31.9)	
A nurse identified daily by the head nurse	6 (0.9)	37 (1.1)	29 (0.8)	21 (1.0)	
A nurse teacher	33 (5.0)	140 (4.3)	160 (4.4)	72 (3.6)	
The head nurse	8 (1.2)	50 (1.6)	66 (1.8)	41 (2.0)	
Degree competence learned in the most recent clinical rotation, (n=9577), mean (95% CI)*,†	1.50 (1.45-1.56)	1.83 (1.80-1.85)	2.15 (2.13-2.17)	2.50 (2.49-2.54)	<0.001
CLEQI factor scores, mean (95% CI)*,†					
Tutorial strategies quality	1.31 (1.25-2.37)	1.71 (1.68-1.73)	2.04 (2.02-2.06)	2.48 (2.45-2.50)	<0.001
Learning opportunities	1.40 (1.35-1.46)	1.71 (1.69-1.73)	2.02 (2.01-2.04)	2.46 (2.44-2.49)	<0.001
Self-directed learning	0.83 (0.78-0.89)	1.24 (1.21-1.26)	1.57 (1.55-1.59)	2.03 (2.00-2.06)	<0.001
Safety and nursing care quality	1.58 (1.53-1.63)	1.86 (1.84-1.88)	2.12 (2.10-2.13)	2.50 (2.48-2.52)	<0.001
Quality of the learning environment	1.33 (1.27-1.39)	1.76 (1.73-1.78)	2.11 (2.09-2.14)	2.50 (2.48-2.53)	<0.001
Overall CLEQI score*,†	1.29 (1.24-1.34)	1.66 (1.64-1.68)	1.98 (1.96-1.99)	2.40 (2.38-2.42)	<0.001
Regional level (n)					<0.001
Region 1 (701)	29 (4.1)	208 (29.7)	297 (42.4)	167 (23.8)	
Region 2 (469)	4 (0.9)	78 (16.6)	194 (41.4)	193 (41.1)	
Region 3 (943)	66 (7.0)	231 (24.5)	397 (42.1)	249 (26.4)	
Region 4 (2000)	129 (6.4)	720 (36.0)	745 (37.3)	406 (20.3)	
Region 5 (54)	2 (3.7)	17 (31.5)	20 (37.0)	15 (27.8)	
Region 6 (1094)	66 (6.0)	364 (33.3)	426 (38.9)	238 (21.8)	
Region 7 (1256)	72 (5.7)	398 (31.7)	482 (38.4)	304 (24.2)	
Region 8 (626)	51 (8.2)	193 (30.8)	262 (41.8)	120 (19.2)	
Region 9 (179)	14 (7.8)	57 (31.8)	71 (39.7)	37 (20.7)	
Region 10 (977)	86 (8.8)	412 (42.2)	332 (34.0)	147 (15.0)	

Region 11 (166)	18 (10.8)	75 (45.2)	53 (31.9)	20 (12.1)
Region 12 (207)	25 (12.1)	96 (46.4)	68 (32.8)	18 (8.7)
Region 13 (169)	21 (12.4)	67 (39.6)	64 (37.9)	17 (10.1)
Region 14 (407)	48 (11.8)	137 (33.7)	151 (37.1)	71 (17.4)
Region 15 (269)	35 (13.0)	105 (39.1)	91 (33.8)	38 (14.1)

* The more recent clinical experience was that under evaluation.
† On a 4-point Likert scale (0 = 'nothing'; 3 = 'very much').
‡ Chi-square for dichotomous variables, analysis of variance and Kruskal-Wallis test for continuous variables.
CI, confidence interval; CLEQI, Clinical Learning Quality Evaluation Index; IPE, Interprofessional Educational experience; SD, standard deviation.

Table 2. IPE occurrence[a] as experienced by students during the most recent clinical rotation: a multilevel analysis

	Estimate	Std. Error	z value	Pr(>|z|)	OR	CI 95%	
(Intercept)	-2.904	0.333	-8.733	0.000	0.055	0.029	0.105
Individual level							
Age, years	-0.009	0.008	-1.118	0.264	0.991	0.975	1.007
Male gender vs female	-0.197	0.062	-3.183	0.001	0.821	0.727	0.927
Unmarried vs no	0.175	0.136	1.291	0.197	1.192	0.913	1.555
Year of nursing education attended, 1st	§						
Year of nursing education attended, 2nd vs 1st	-0.093	0.066	-1.402	0.161	0.911	0.800	1.038
Year of nursing education attended, 3rd vs 1st	0.076	0.070	1.074	0.283	1.079	0.939	1.238
Previous work experience yes vs no	0.097	0.063	1.544	0.123	1.102	0.974	1.246
Work experience during the degree yes vs no	0.051	0.069	0.738	0.461	1.052	0.919	1.206
Context of previous clinical learning experiences							
Only hospital	§						
Only community setting	-0.040	0.212	-0.190	0.849	0.961	0.634	1.455
Hospital and community setting	-0.035	0.064	-0.551	0.581	0.965	0.851	1.095
More recent clinical rotation, tutorial model							
I was supervised by a clinical nurse	§						
By the nursing staff	0.106	0.065	1.631	0.103	1.112	0.979	1.262
By a nurse identified daily by the head nurse	-0.435	0.271	-1.608	0.108	0.647	0.381	1.100
By the head nurse	0.190	0.135	1.407	0.159	1.209	0.928	1.575
By the nurse teacher	-0.212	0.197	-1.074	0.283	0.809	0.550	1.191
Length of the most recent clinical rotation, weeks, mean (95% CI)[†]	-0.001	0.010	-0.105	0.916	0.999	0.979	1.020
Degree competence learned in the most recent clinical rotation[†]	0.344	0.045	7.687	0.000	1.411	1.292	1.540
CLEQI factors							
Quality of the tutorial teaching strategies (0-3)[*,†]	0.179	0.059	3.053	0.002	1.196	1.066	1.341
Self–direct learning (0-3)[*,†]	0.395	0.045	8.874	0.000	1.485	1.361	1.620
Learning opportunities (0-3)[*,†]	0.342	0.064	5.341	0.000	1.408	1.242	1.597
Safety and nursing care quality (0-3)[*,†]	0.275	0.057	4.830	0.000	1.317	1.178	1.473
Quality of the learning environment (0-3)[*,†]	0.409	0.061	6.752	0.000	1.506	1.337	1.695
Regional level							
Region 1	§						
Region 2	0.557	0.227	2.453	0.014	1.746	1.119	2.726
Region 3	-0.471	0.172	-2.736	0.006	0.624	0.446	0.875
Region 4	-0.412	0.149	-2.768	0.006	0.662	0.495	0.887
Region 5	-0.318	0.394	-0.808	0.419	0.727	0.336	1.575
Region 6	-0.386	0.166	-2.328	0.020	0.680	0.491	0.941
Region 7	-0.334	0.163	-2.051	0.040	0.716	0.520	0.985
Region 8	0.023	0.185	0.124	0.901	1.023	0.712	1.470
Region 9	-0.153	0.281	-0.545	0.586	0.858	0.495	1.488
Region 10	-0.305	0.167	-1.833	0.067	0.737	0.531	1.021
Region 11	0.070	0.281	0.251	0.802	1.073	0.618	1.862
Region 12	-0.401	0.235	-1.708	0.088	0.670	0.423	1.061
Region 13	-0.286	0.269	-1.061	0.289	0.751	0.443	1.274
Region 14	0.411	0.220	1.865	0.062	1.508	0.979	2.324
Region 15	-0.590	0.278	-2.124	0.034	0.554	0.321	0.955

CI, confidence interval; CLEQI, Clinical LEarning Quality Evaluation Index; IPE, Interprofessional Educational experience(s); OR, odds ratio; Std. Error, standard error.

[a] 'always'+ 'some extent' vs. 'only a little' + 'never'.

§ reference group;[*] The most recent clinical rotation was that under evaluation.

† On a 4-point Likert scale (from 0= 'never' to 3= 'always').
Sigma indiv 0.169; AIC 9376.414; BIC 9629.481; LogLik -4652.207 (*df* 36); LogLik_null -5479.081 (df 2); Pseudo R^2 0.151

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3

Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6
Study design	#4	Present key elements of study design early in the paper	1
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6-7
Bias	#9	Describe any efforts to address potential sources of bias	8-9
Study size	#10	Explain how the study size was arrived at	6-7
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7-8

Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7-8
	#12b	Describe any methods used to examine subgroups and interactions	7-8
	#12c	Explain how missing data were addressed	7-8
	#12d	If applicable, describe analytical methods taking account of sampling strategy	7-8
	#12e	Describe any sensitivity analyses	n/a
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	9
	#13b	Give reasons for non-participation at each stage	6-7, 9
	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	table 1, 9
	#14b	Indicate number of participants with missing data for each variable of interest	table 1
Outcome data	#15	Report numbers of outcome events or summary measures.	tabe 1

		Give information separately for exposed and unexposed groups if applicable.	
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	See note 1
	#16b	Report category boundaries when continuous variables were categorized	See note 2
	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a
Key results	#18	Summarise key results with reference to study objectives	10-12
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	12
Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which	2

the present article is based

Author notes

1. 9-10, table 2

2. 9-10, table 1 and 2