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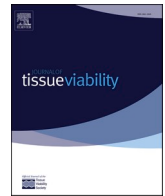
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Nursing students' knowledge, attitudes and learning occasions about pressure injuries at the time of graduation: A multi-method pre-post pandemic study

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ABSTRACT

Introduction: Pressure injuries (PIs) are a significant issue in healthcare system: nursing students are recommended to be prepared to assess the risk, prevent and manage them. However, despite the coronavirus disease-2019 (COVID-19) pandemic significantly affected nursing students' learning opportunities no data regarding their impact of PIs knowledge, attitudes and learning occasions have been documented to date.

Aims: To describe the post-pandemic knowledge and attitudes regarding PI prevention and management and to compare clinical learning opportunities in the field of PIs before and after the COVID-19 pandemic.

Method: A descriptive multi-method study involving students at the time of their graduation in the before (n = 114) and after the pandemic (n = 113). The Italian versions of the Pressure Ulcer Knowledge Assessment Tool (PUKAT-IT) and Attitude Toward Pressure Ulcer Prevention (APuP-IT) scales were used. Data regarding pre- and post-pandemic learning opportunities were retrospectively collected from the Student Portfolio of Skills.

Results: The average PUKAT-IT score was 57.92 % (cut-off 60 %), which indicates insufficient knowledge; the average APuP-IT score was 78.19 % (cut-off 75 %), which shows positive attitudes towards PI. Comparing the pre- and the post-pandemic groups, learning opportunities in PI risk assessment and prevention significantly decreased (overall 38.90 vs 32.27 and 35.26 vs 25.97, respectively) while those regarding the PI management remained stable.

Conclusion: In the post-pandemic times, nursing students' knowledge about PIs remains insufficient while their attitudes are adequate; the pandemic significantly reduced students' exposure to prevention and assessment learning opportunities during their internship, which suggests a need to update educational strategies to ensure appropriate knowledge and learning experiences in this field.

1. Background

Despite efforts to prevent pressure injuries (PIs) [1], their occurrence is still high among patients which raises concerns regarding the quality of care delivered [2]. A recent systematic review has reported that between 2008 and 2018, the PIs prevalence was 12.8 % worldwide, 14.5 % in Europe, 13.6 % in North America, 12.7 % in South America, 3 % in Asia, 12.6 % in the Middle East, and 9 % in Australia whereas in the Eastern Mediterranean Region has varied between 7 % and 44.4 % [3,4]. If not properly treated, PIs can lead to life-threatening conditions such as

sepsis, osteomyelitis and necrotising fasciitis and, ultimately, extended hospitalisation and significant healthcare costs [5–7]. Nurses play a crucial role in the prevention and management of PIs and are required to possess competencies to recognise patients at risk for developing PIs and to apply preventive strategies. Moreover, nursing care is essential for patients who have been diagnosed with PI to promote healing and prevent further complications [8,9]. Therefore, providing future nurses with sufficient knowledge in the field of PIs prevention and management is an education priority [10,11]. Monitoring nursing students' attitudes towards PIs has also been recommended to identify early on the

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facilitating or hindering factors that may affect the quality of care [12].

A recent meta-analysis has reported that the knowledge of nurses and nursing students about PIs prevention is often insufficient [9]. Nursing students possess less knowledge about PIs prevention than practicing nurses, potentially due to their limited clinical exposure [9,13] which suggests the need to continue monitoring their preparedness [9,14]. Studies have also documented, however, that both nurses and students have positive attitudes regarding PIs prevention [9,15,16], which is higher among the later although they do not possess the same level of knowledge [9]. However, students' knowledge and attitudes are influenced by various factors, including the academic year attended (as for example the 1st or the final year), the clinical experience progressively gained and the direct experience with patients with PIs [13,17].

During the coronavirus disease-2019 (COVID-19) pandemic, students' learning opportunities have been transformed significantly due to restrictive social distancing policies and public health measures [18]; for many months, clinical internships were suspended, and in-person theoretical courses switched to remote online classes to ensure continued learning [19,20]. Students have reported fewer learning opportunities and more concerns regarding what they may have missed in their education [21,22]. However, despite the importance of PIs as both clinical and public health concern, no studies examining the implications of the COVID-19 pandemic on students' knowledge and attitudes, as well on concrete clinical learning opportunities regarding PIs prevention and management, have been reported to date. Producing new evidence may inform nurse educators regarding strategies for effective training during future pandemics, as well as suggesting how healthcare services can shape the transition from the bachelor's degree to the workplace for newly post-pandemic graduated nurses. Overall, expanding the knowledge available may contribute to understand trends in attitudes and knowledge about PIs among the future workforce and, ultimately, may increase the quality of care.

2. Aims

This study sought to (a) describe the post-pandemic knowledge and attitudes regarding PIs prevention and management and (b) compare clinical learning opportunities in the field of PIs before and after the COVID-19 pandemic among nursing students. The secondary aim was to explore the relationship, if any, between knowledge and attitudes, the learning opportunities and the perceived preparedness as reported by nursing students at the time of graduation.

3. Methods

3.1. Study design and setting

A descriptive multi-method study design [23] consisting of a cross-sectional and a retrospective study is reported here according to the Strengthening the Reporting of Observational Studies in Epidemiology Statement [24] (Supplementary Table 1).

The study was conducted in a Bachelor of Nursing Science (BNS) degree course on two campuses of the public University of Udine in north-east of Italy enrolling 180 students in the 1st year. The programme duration is three years, and it provides around 2800 theoretical and 1850 clinical hours, with on average nine clinical rotations, all attended in person. The standardised education delivered on PIs prevention and management is summarised in Table 1 and in Supplementary Table 2. However, during the pandemic, students received their theoretical education online in the 1st year, mixed (online and in person) during the 2nd year and in person during the 3rd year. Clinical rotations were rationed: only 4 weeks were allowed out of the 12 expected for the 1st year students; only 8 weeks out of 16 for the 2nd year; and only 11 weeks out of 24 for the 3rd year [25] (Table 1).

Table 1
Pressure injuries prevention and management nursing education pathway before and during the pandemic.

| Setting | BNS year | Main contents | Outcome measurement | Before COVID-19 | During COVID-19 |
|--|----------|---|---|-----------------------|---|
| Classroom PIs prevention and management: general contents | 1st | Fundamentals of nursing care 12 h | Written evaluation at the end of the course | Mandatory in presence | Online |
| Classroom PIs prevention and management: in specific conditions | 2nd | Dermatology 12 h | Written evaluation at the end of the course | Mandatory in presence | Mixed online/in presence |
| | 3rd | Nursing in critical care 24 h | Written evaluation at the end of the course | Mandatory in presence | |
| Skill lab | 1st | Management of I and II stages PIs with a wound care expert nurse 2 h | Practical evaluation in a simulated setting | Mandatory in presence | Rationed (reduced in the number of hours) In presence |
| | 2nd | Management of complex PIs (III and IV stages) with a wound care expert nurse 4 h | | | |
| Clinical rotations | 1st | 2 rotations, medical and surgical settings 480 h | When students are exposed to a learning occasion, this must be reported in the "Student Portfolio of Skills" in the following sections: - "Assessing the risk of PIs by using validated tools". - "Implementing interventions to prevent PIs". - "Assessing the stage and managing PIs". The Clinical Nurse provides his/her signature to certify the occurred learning occasion. | Mandatory in presence | Mandatory in presence but rationed ^a Mandatory in presence but rationed ^a Mandatory in presence |
| | 2nd | 3 rotations, specialized settings, 600 h | | | |
| | 3rd | on average 4 rotations in: intensive care, general or specialized hospital units, long-term/community care; additional rotations in maternal/child and psychiatric units 720 h | | | |

Legend: BNS, Bachelor of Nursing Science; COVID-19, Coronavirus-19; PI, Pressure Injury.

^a In the number of hours expected.

3.2. Data sources and inclusion criteria

For the cross-sectional study, all students enrolled in 2020 and graduated in 2023 ($n = 113$) – thus attending their education during the pandemic period (hereafter, post-pandemic group) – were eligible. Those (a) who filled in the *Student Portfolio of Skills*, (b) completed their education and were approaching their graduation at the time of the study (2023) and (c) agreed to participate, were involved in the cross-sectional design.

For the retrospective study, the *Student Portfolio of Skills* of 114 students who ended their degree in the pre-pandemic period were eligible; those portfolios archived at the university level and in which all sections had been completed by students who graduated in the academic year 2018/2019 were considered (hereafter, pre-pandemic group).

3.3. Instruments

Several tools [26] have been developed to allow comparable measures in the field of PIs knowledge and attitudes: among them, the Pressure Ulcer Knowledge Assessment Tool (PUKAT) and the Attitude Toward Pressure Ulcer Prevention (APuP) have been largely validated [10,11] and were therefore considered in our study. Specifically, the PUKAT, developed in 2010 by Beeckman et al. [10], in its Italian version (PUKAT-IT) [27] was used after having obtained formal authorisation. The tool consists of 26 multiple choice questions related to PIs prevention with multiple answers categorised in six themes (or dimensions): (a) aetiology and development, (b) classification and observation, (c) risk assessment, (d) nutrition, (e) reduction of the magnitude of pressure and shearing and (f) reduction of the duration of pressure and shearing. A mean knowledge score $\geq 60\%$ is considered satisfactory [10].

The APuP developed by Beeckman et al. [11] in its validated and reliable Italian version (APuP-IT) [27] was also used after having obtained the formal authorisation. The tool consists of 13 items measuring subjective attitudes towards PIs through five factors: 0.714 concerning (a) personal competency to prevent PIs, (b) priority of PIs prevention, (c) impact of PIs, (d) responsibility for PIs prevention and (e) confidence in the effectiveness of prevention. Students were asked to express their answers using a 4-point Likert scale (from 1 = *strongly disagree* to 4 = *strongly agree*); high scores show positive attitudes, and a mean of $\geq 75\%$ is considered satisfactory [11]. The internal consistency of the tool as measured with Cronbach alpha in our data was 0.714.

The *Student Portfolio of Skills* as the standardised tool approved by the University council was also used in this study. According to the internal guidelines, students are recommended to report in the Portfolio each learning occasion as experienced in each clinical internship under the supervision of the Clinical Nurse. Students receive this tool at the beginning of the 1st academic year, with appropriate information regarding its aims, how to fill it in during the clinical rotations and how to keep it in a safe manner. At the end of their daily clinical internship, students are required to record each learning occasion in the tool by selecting those appropriate in the list provided and containing all those expected in the entire nursing programme: for example, there are specific items on the list concerning PIs, and students are required to flag that they experienced them during the shift (e.g. assessed PIs with the Braden scale) by reporting the date. Afterwards, the Clinical Nurse certifies the learning occasion by signing it; before graduation, students are required to return the Portfolio to the nursing programme.

In the context of our study, data regarding the following aspects were considered and extracted: learning experience in ‘Assessing the risk of PIs by using validated tools’, ‘Implementing interventions to prevent PIs’, and ‘Assessing the stage and managing PIs (I, II, III and IV stages [26])’.

Questions concerning the self-perceived preparedness to identify risk and to manage PIs effectively (from not at all, to greatly) were included in the final brief socio-demographic form collecting additional data (e.g. age, gender).

3.4. Data collection procedures and rigour

For the cross-sectional design, two experienced researchers were responsible for informing students about the aims of the study and ensuring their involvement and that they signed their informed consent forms; data collection tools were then sent via the EUSurvey platform [28] at the time of graduation. For the retrospective design, data reported in the *Student Portfolio Skills* for both the pre- and post-pandemic groups were accessed and extracted into Microsoft Excel and secured with a password to ensure confidentiality. Two researchers were involved in the process to check accuracy. Moreover, no missed data were detected, given that recording was mandatory in all tools.

3.5. Data analysis

Data was summarised as numbers and percentages or means and 95% confidence intervals (CIs). Differences in the number of learning occasions between the pre- and post-pandemic groups were explored with the Mann-Whitney U test according to the non-normal distribution of the continuous variables. Pearson correlations between individual variables, the overall scores on the PUKAT-IT and APuP-IT, the number of learning occasions and the perceived preparedness were also explored and values < 0.3 were considered low, 0.3–0.5 moderate and > 0.5 high [29]. Statistical significance was set at $p < 0.05$ and analyses were performed using Statistical Package for Social Science (SPSS) Version 25.

3.6. Ethical consideration

The study was approved by the Internal Review Board of the University of Udine, Italy (Prot. N 241/2023, CL13 5/2023). In the cross-sectional study, participation was voluntary, and anonymity was guaranteed; no rewards were offered, and students were allowed to withdraw from the study at any time without any consequence. For the retrospective study, the *Student Portfolio of Skills* were accessed after having anonymised them according to the study protocol.

4. Results

4.1. Cross-sectional study: post-pandemic knowledge and attitudes regarding PIs

A total of 97 students out of 113 eligible (85.8%) participated, with 77 (79.4%) being female and having an average age of 24.9 years (CI 95% 23.73–26.07). Most (69; 71.1%) were living with their families, and only seven (7.2%) reported having a child. A total of 64 (66%) students underwent secondary education at a high school reporting an average grade score of 78.61 (95% CI: 76.06–81.01) out of 100. Most participants had not reported previous university experience before attending the BNS (79; 81.5%). However, 44 (45.4%) had previous working experience, and 39 (40.2%) were still working while attending the nursing programme. Nearly all students (89; 91.8%) successfully completed the BNS in 3 years. Overall, 86 (88.7%) students reported that they were sufficiently or greatly prepared to identify the risk of PIs, whereas 70 (72.2%) reported feeling sufficiently or greatly prepared to manage them (Table 2).

Regarding the knowledge, students achieved a mean score of 57.92

Table 2
Characteristics of participants (n = 97).

| Variables | N (%) or mean (CI 95 %) |
|--|-------------------------|
| Age | 24.9 (23.73–26.07) |
| Gender | |
| Male | 20 (20.6) |
| Female | 77 (79.4) |
| Living | |
| Alone | 5 (5.2) |
| With the family | 69 (71.1) |
| With other students | 10 (10.3) |
| With my boyfriend/girlfriend | 10 (10.3) |
| Other (husband/wife/mother/father) | 3 (3.1) |
| Children | |
| Yes | 7 (7.2) |
| Number | |
| One | 5 (71.4) |
| Two | 2 (28.6) |
| Secondary school type | |
| High school | 64 (66.0) |
| Technical school | 18 (18.5) |
| Professional school | 15 (15.5) |
| Secondary school final grade out of 100 | 78.61 (76.06–81.01) |
| Previous university experiences | |
| No | 79 (81.5) |
| Previous university experience concluded | 4 (4.1) |
| Previous university experience interrupted | 11 (11.3) |
| Other | 3 (3.1) |
| Previous working experiences | |
| Yes | 44 (45.4) |
| Working experiences during bachelor | |
| Yes | 39 (40.2) |
| In the clinical care field | 11 (28.2) |
| Not in the clinical care field | 28 (71.8) |
| Nursing education attendance | |
| Regular | 89 (91.8) |
| Interrupted | 8 (8.2) |
| Do you feel prepared to identify the risk of PIs? | 2.98 (2.87–3.07) |
| Greatly | 12 (12.4) |
| Enough | 74 (76.3) |
| Not much | 9 (9.2) |
| Not at all | 2 (2.1) |
| Do you feel prepared to manage PIs? | 2.71 (2.59–2.81) |
| Greatly | 2 (2.1) |
| Enough | 68 (70.1) |
| Not much | 24 (24.7) |
| Not at all | 3 (3.1) |

Legend: N, number; CI, confidence interval; PIs, pressure injuries.

% (95 % CI: 55.90–59.87) correct answers (15.06/26) on the PUKAT-IT scale (Table 3); none of them obtained a score of 100 %. The lowest scores were reported in the preventive measure to reduce the amount of pressure/shear (44.63 %) and in aetiology and development (54.98 %) dimensions, while the highest scores were in the nutrition section (88.65 %).

Regarding attitudes, students reported an average score of 78.19 % (95 % CI: 76.69–79.68) on the APuP-IT scale (Table 3). The highest scores were reported in responsibility for pressure ulcer prevention (86.21 %) and in priority of pressure ulcer prevention (84.53 %), while the lowest appeared in personal competency to prevent pressure ulcers (68.55 %).

4.2. Retrospective study: clinical learning opportunities in the pre- and post-pandemic groups

The PIs learning occasions experienced as documented in the *Student Portfolio of Skills* for pre- (n = 114) and post-pandemic (n = 113) students were compared (Table 4). Overall, the average number of

opportunities to assess the risk of PIs using validated tools significantly decreased (pre-pandemic 38.90 [95 % CI: 29.83–36.70] vs post-pandemic 32.27 [95 % CI: 29.83–36.70], $p = 0.011$). This difference was significantly greater within the first of 2nd years of the BNS, and in the last clinical rotation of the 3rd year. Similarly, the opportunity to apply interventions to prevent PIs also significantly decreased (pre-pandemic 35.26 [95 % CI: 32.43–38.10] vs post-pandemic 25.97 [95 % CI: 22.44–29.51], $p < 0.001$), with significant differences in the 1st and 2nd years, but not in the 3rd year.

No significant overall differences emerged regarding the number of learning opportunities in assessing the stage and managing PIs, for each PI stage, when comparing the pre- and post-pandemic groups. However, the average number of occasions significantly increased during the final internship during the 3rd year (Stage I pre-pandemic 0.32 [95 % CI: 0.7–0.58] vs post-pandemic 1.19 [95 % CI: 0.69–1.70], $p = 0.003$; Stage II 0.13 [95 % CI: 0.01–0.28] vs 1.09 [95 % CI: 0.61–1.56], $p < 0.001$; Stage III 0.03 [95 % CI: 0.00–0.06] vs 0.96 [95 % CI: 0.47–1.45], $p < 0.001$; Stage IV 0.00 [95 % CI: 0.00–0.00] vs 0.65 [95 % CI: 0.25–1.06], $p = 0.001$).

4.3. Correlations

No significant correlations with PUKAT-IT and APuP-IT scale global scores were found for any of the individual variables. A low correlation emerged between the PUKAT-IT and the APuP-IT global scores (0.173, $p = 0.05$), whereas among the learning opportunities for assessing risks, applying prevention strategies and managing PIs, as recorded in the *Student Portfolio of Skills*, from low to high correlations have emerged (ranges between 0.291 and 0.663). A moderate correlation has emerged between the perception of being prepared to assess and to manage PIs (0.418, $p = 0.01$) and a low between the perceived preparedness to assess the risk of PIs and the APuP-IT total scores (0.231, $p = 0.01$) (Table 5).

5. Discussion

The COVID-19 pandemic created unprecedented challenges for nursing students. This included changes to the theoretical courses, which were delivered online, and the suspension or rationing of clinical learning experiences, all of which has led to possible implications for the knowledge and attitudes achieved [30]. Several studies examined how the clinical learning opportunities of nursing students changed during the COVID-19 pandemic [21,25]. However, to the best of our knowledge, this is the first study to examine PIs knowledge and attitudes among the first generation of post-pandemic nursing students and the changes in the clinical learning opportunities compared to pre-pandemic cohorts, for which evidence is available [31].

The students involved at the time of their graduation revealed individual characteristics similar to those reported in previous studies at the European level [e.g., Refs. [32,33]]. Although they self-reported feeling either sufficiently or greatly prepared to prevent and manage PIs, the global average score on the PUKAT-IT tool, which measures such knowledge objectively, was 57.92 %, which indicates an insufficient level of knowledge. First, this gap between the perceived knowledge and that objectively reported suggest the need to increase students' reliability in self-assessing their professional growth, given the large use of self-reported competencies [34,35]. Second, comparing post-pandemic findings, our PUKAT-IT global score are in line with pre-pandemic data from Italian (51.1 %) [27], Australian (51.1 %) [13], Irish (58.5 %) [36] and other studies [9,37,38]. This seems to suggest that the actual level of knowledge possessed by nursing students has not changed over the periods. Analytically, knowledge about preventive measures to reduce the quantity of PIs (44.63 %), as well as regarding PIs aetiology and development (54.98 %), is insufficient, as documented in previous research [9,38], whereas knowledge about nutritional aspects reported the highest score (88.65 %), as in pre-pandemic data [13,27,36]. The

Table 3
Knowledge and attitudes regarding pressure injuries among students (n = 97).

| PUKAT-IT scale (number of items) | Mean (CI 95 %) ^a | Mean (CI 95 %) ^b |
|--|-----------------------------|-----------------------------|
| Theme 1: Aetiology and development (6) | 54.98 (50.69–59.10) | 3.29 (3.04–3.54) |
| Theme 2: Classification and observation (5) | 63.71 (58.96–68.04) | 3.18 (2.94–3.43) |
| Theme 3: Risk assessment (2) | 61.85 (55.15–68.04) | 1.23 (1.10–1.37) |
| Theme 4: Nutrition (1) | 88.65 (81.44–94.81) | 0.88 (0.82–0.93) |
| Theme 5: Preventive measure to reduce the amount of pressure/shear (7) | 44.63 (41.09–47.86) | 3.12 (2.85–3.36) |
| Theme 6: Preventive measure to reduce the duration of pressure/shear (5) | 66.59 (62.88–70.51) | 3.32 (3.13–3.51) |
| PUKAT-IT scale total scores (26) | 57.92 (55.90–59.87) | 15.06 (14.56–15.56) |
| APuP-IT scale (number of items) | Mean (CI 95 %) ^a | Mean (CI 95 %) ^c |
| Factor 1: Personal competency to prevent pressure ulcers (3) | 68.55 (66.47–70.63) | 8.22 (7.97–8.47) |
| Factor 2: Priority of pressure ulcer prevention (3) | 84.53 (82.22–86.84) | 10.14 (9.86–10.42) |
| Factor 3: Impact of pressure ulcers (3) | 75.25 (73.11–77.40) | 9.03 (8.77–9.28) |
| Factor 4: Responsibility for pressure ulcer prevention (2) | 86.21 (83.84–88.58) | 6.89 (6.70–7.08) |
| Factor 5: Confidence in the effectiveness of prevention (2) | 79.51 (77.23–81.78) | 6.36 (6.17–6.54) |
| APuP-IT scale total scores (13) | 78.19 (76.69–79.68) | 40.65 (39.88–41.53) |

Legend: PUKAT-IT, Pressure Ulcer Knowledge Assessment Tool – Italian version; APuP-IT, Attitude Toward Pressure Ulcer Prevention – Italian version.

^a Values standardised to 100.

^b Right answers level of agreement/total for each item.

^c Number of answers indicating an agreement.

scores for risk assessment (61.85 %), classification and observation (63.71 %) and preventative measures to reduce the duration of pressure (66.59 %) were adequate and higher than previously reported [13,14,38].

Students had high APuP-IT global scores (78.19 %), thus high attitudes regarding PIs, which is consistent with previous studies [9,15,16]. The only critical issue was the personal competency to prevent PIs (68.55 %), which considered one of reason contributing to professional behaviour that does not comply with PIs prevention guidelines [9]. Overall, students seem to have an appropriate attitude towards the willingness to assume responsibility and prevent PIs; however, low self-confidence and competency in their ability or education to prevent PIs emerged, as has been reported in pre-pandemic data [13,14,27]. This suggests the need to better integrate theoretical knowledge with clinical experiences.

The opportunities to learn about PI risk assessment and use measures to prevent PIs significantly declined between the pre- and the post-pandemic groups. The limitations imposed by the COVID-19 pandemic during the first two years of BNS limited the number of internships. Illness and quarantine-related absences and internship interruptions were also problematic, and appropriate attention was not devoted to the topic during the clinical rotations as other clinical issues were prioritised (e.g., preventing the spread of COVID-19 infections). These may all have reduced the learning occasions. The changes in service delivery for other clinical issues may also have played a role [39]. However, in both groups, the pattern of learning opportunities seems to be similar: more experience is gained in the 1st year, and a few or very limited opportunities occur in the 2nd and in the 3rd years, which suggests that PIs are widely considered a learning aim pertinent at the beginning of the nursing education. There was also an increase in clinical learning opportunities recorded in the 3rd year, and this may reflect that students recognised the lack of previous opportunities and were attempting to maximise their exposure before graduation [40,41]. Overall, post-pandemic students had seen and managed fewer PIs than the pre-pandemic group according to their self-reported perceived preparedness to recognise and handle PIs.

Knowledge and attitudes had a moderate correlation each other, as previously reported [13,14,27,42], which indicates that these dimensions are interconnected and that increasing knowledge may

improve attitudes and vice versa. Moreover, the increased number of learning occasions experienced for assessing and preventing PIs showed moderate correlations with the number of opportunities to manage PIs. Students well trained in prevention and assessment are also more often involved in managing PIs, which may also be due to their progressive awareness of this issue for the entire care process. Similarly, when students felt themselves prepared for prevention, they reported being more prepared for PIs management, which suggests that these two care phases are strictly connected also in the learning process. The emerged interconnections should be carefully considered while designing innovative teaching methodologies to overcome lacks in the students' preparedness that may have future negative impact on the quality of care [43].

5.1. Limitations

This study as a single centre study design, and although this has allowed the collection of data from students exposed to homogeneous education pathways [44], future multicentre studies are suggested. Second, we considered nursing students at the time of their graduation, when they were required preparation to face the graduation examination, which may have influenced the findings both positively on the knowledge possessed and negatively, on the perceived preparedness to undertake the future professional role. Future longitudinal studies may provide more accurate data.

6. Conclusions

Students at the point of their graduation after attending three years of nursing education during the pandemic self-reported sufficient to great preparedness in preventing and managing PIs; however, their actual knowledge as measured with a validated tool was, on average, insufficient. First, students must be coached to provide more reliable self-assessments and awareness of their competencies. Second, the changes in nursing education during the pandemic seem to have resulted in the same lack of knowledge regarding PIs as documented before the pandemic. The positive attitudes regarding PIs are an important resource, but the low self-confidence and competency that may prevent practical actions should be carefully considered for their potential

Table 4

Learning opportunities about pressure injuries during the clinical rotations as documented for each academic year attended in the *Student Portfolio of Skills* by pre- and post-pandemic students.

| Learning opportunities | Pre-pandemic (n = 114) Mean (CI 95 %) | Post-pandemic (n = 113) Mean (CI 95 %) | p-value |
|---|--|---|--------------|
| Assessing the risk of PIs using validated tools | 38.90 (29.83–36.70) | 32.27 (29.83–36.70) | 0.011 |
| 1st year, 1st clinical rotation | 5.61 (5.02–6.19) | 4.34 (3.82–4.97) | 0.004 |
| 1st year, 2nd clinical rotation | 5.82 (5.21–6.44) | 4.46 (3.86–5.07) | 0.002 |
| 2nd year, 1st clinical rotation | 5.59 (4.90–6.28) | 4.10 (3.42–4.78) | 0.003 |
| 2nd year, 2nd clinical rotation | 5.29 (4.57–6.01) | 3.87 (3.19–4.54) | 0.005 |
| 2nd year, 3rd clinical rotation | 5.37 (4.67–6.07) | 4.16 (3.42–4.90) | 0.020 |
| 3rd year, 1st clinical rotation | 3.87 (3.13–4.60) | 3.88 (3.14–4.63) | 0.975 |
| 3rd year, 2nd clinical rotation | 3.67 (2.91–4.43) | 3.78 (3.06–4.50) | 0.832 |
| 3rd year, 3rd clinical rotation | 3.03 (2.33–3.72) | 2.60 (1.93–3.27) | 0.387 |
| 3rd year, 4th clinical rotation | 0.71 (0.26–1.16) | 2.08 (1.42–2.72) | 0.001 |
| Implementing interventions to prevent PIs | 35.26 (32.43–38.10) | 25.97 (22.44–29.51) | 0.000 |
| 1st year, 1st clinical rotation | 4.90 (4.26–5.54) | 3.50 (2.81–4.20) | 0.004 |
| 1st year, 2nd clinical rotation | 4.68 (4.02–5.33) | 3.93 (3.26–4.60) | 0.114 |
| 2nd year, 1st clinical rotation | 4.78 (4.08–5.49) | 2.66 (2.00–3.32) | 0.000 |
| 2nd year, 2nd clinical rotation | 4.43 (3.72–5.13) | 2.84 (2.16–3.52) | 0.002 |
| 2nd year, 3rd clinical rotation | 4.64 (3.79–5.49) | 3.13 (2.41–3.85) | 0.008 |
| 3rd year, 1st clinical rotation | 4.12 (3.44–4.81) | 3.04 (2.33–3.74) | 0.29 |
| 3rd year, 2nd clinical rotation | 4.32 (3.55–5.10) | 3.03 (2.31–3.75) | 0.16 |
| 3rd year, 3rd clinical rotation | 2.92 (2.22–3.62) | 2.06 (1.43–2.69) | 0.72 |
| 3rd year, 4th clinical rotation | 0.46 (0.10–0.83) | 1.78 (1.16–2.40) | 0.000 |
| Assessing the stage and managing PIs – I stage | 18.12 (16.19–20.06) | 15.20 (12.90–17.51) | 0.056 |
| 1st year, 1st clinical rotation | 2.80 (2.26–3.34) | 1.47 (1.04–1.90) | 0.000 |
| 1st year, 2nd clinical rotation | 2.79 (2.22–3.36) | 1.85 (1.39–2.31) | 0.012 |
| 2nd year, 1st clinical rotation | 2.17 (1.65–2.69) | 1.78 (1.25–2.31) | 0.301 |
| 2nd year, 2nd clinical rotation | 2.07 (1.57–2.57) | 1.69 (1.16–2.22) | 0.304 |
| 2nd year, 3rd clinical rotation | 1.95 (1.45–2.45) | 1.86 (1.31–2.41) | 0.813 |
| 3rd year, 1st clinical rotation | 2.43 (1.88–2.98) | 1.60 (1.06–2.14) | 0.033 |
| 3rd year, 2nd clinical rotation | 2.11 (1.53–2.68) | 2.12 (1.50–2.73) | 0.982 |
| 3rd year, 3rd clinical rotation | 1.49 (0.96–2.03) | 1.65 (1.06–2.23) | 0.699 |
| 3rd year, 4th clinical rotation | 0.32 (0.7–0.58) | 1.19 (0.69–1.70) | 0.003 |
| Assessing the stage and managing PIs – II stage | 12.89 (11.33–14.44) | 12.38 (10.51–14.25) | 0.680 |
| 1st year, 1st clinical rotation | 2.00 (1.512–2.48) | 1.25 (0.84–1.66) | 0.019 |
| 1st year, 2nd clinical rotation | 1.73 (1.29–2.17) | 1.73 (1.26–2.21) | 0.984 |
| 2nd year, 1st clinical rotation | 1.46 (1.06–1.85) | 1.20 (0.77–1.64) | 0.396 |
| 2nd year, 2nd clinical rotation | 1.32 (0.96–1.67) | 1.25 (0.85–1.65) | 0.801 |
| 2nd year, 3rd clinical rotation | 1.56 (1.09–2.03) | 1.31 (0.82–1.80) | 0.461 |
| 3rd year, 1st clinical rotation | 1.82 (1.33–2.30) | 1.38 (0.88–1.88) | 0.217 |
| 3rd year, 2nd clinical rotation | 1.67 (1.18–2.15) | 1.90 (1.33–2.48) | 0.533 |
| 3rd year, 3rd clinical rotation | 1.21 (0.79–1.63) | 1.27 (0.78–1.75) | 0.866 |
| 3rd year, 4th clinical rotation | 0.13 (0.01–0.28) | 1.09 (0.61–1.56) | 0.000 |
| Assessing the stage and managing PIs – III stage | 6.59 (5.97–7.06) | 8.01 (6.59–9.42) | 0.107 |
| 1st year, 1st clinical rotation | 0.96 (0.64–1.29) | 0.58 (0.31–0.84) | 0.065 |
| 1st year, 2nd clinical rotation | 0.84 (0.49–1.19) | 0.85 (0.41–1.28) | 0.983 |
| 2nd year, 1st clinical rotation | 0.71 (0.45–0.97) | 0.91 (0.51–1.31) | 0.400 |
| 2nd year, 2nd clinical rotation | 0.55 (0.31–0.79) | 0.76 (0.41–1.11) | 0.333 |
| 2nd year, 3rd clinical rotation | 0.65 (0.33–0.97) | 1.01 (0.59–1.42) | 0.174 |
| 3rd year, 1st clinical rotation | 1.06 (0.71–1.41) | 1.04 (0.59–1.50) | 0.953 |
| 3rd year, 2nd clinical rotation | 0.98 (0.54–1.42) | 0.95 (0.53–1.37) | 0.908 |
| 3rd year, 3rd clinical rotation | 0.80 (0.41–1.18) | 0.96 (0.50–1.42) | 0.603 |
| 3rd year, 4th clinical rotation | 0.03 (0.00–0.06) | 0.96 (0.47–1.45) | 0.000 |
| Assessing the stage and managing PIs – IV stage | 3.63 (2.85–4.42) | 4.65 (3.71–5.58) | 0.101 |
| 1st year, 1st clinical rotation | 0.47 (0.25–0.69) | 0.55 (0.20–0.90) | 0.718 |
| 1st year, 2nd clinical rotation | 0.54 (0.26–0.83) | 0.38 (0.19–0.57) | 0.350 |
| 2nd year, 1st clinical rotation | 0.23 (0.10–0.36) | 0.44 (0.18–0.70) | 0.148 |
| 2nd year, 2nd clinical rotation | 0.26 (0.10–0.43) | 0.35 (0.15–0.54) | 0.529 |
| 2nd year, 3rd clinical rotation | 0.59 (0.29–0.89) | 0.59 (0.26–0.92) | 0.982 |
| 3rd year, 1st clinical rotation | 0.61 (0.35–0.86) | 0.65 (0.29–1.00) | 0.853 |
| 3rd year, 2nd clinical rotation | 0.55 (0.20–0.91) | 0.69 (0.35–1.03) | 0.583 |
| 3rd year, 3rd clinical rotation | 0.38 (0.12–0.63) | 0.35 (0.16–0.53) | 0.841 |
| 3rd year, 4th clinical rotation | 0.00 (0.00–0.00) | 0.65 (0.25–1.06) | 0.001 |

Legend: PIs, pressure injuries. I, II, III and IV stage [26].

patients' implications. Therefore, more efforts should be taken to provide appropriate knowledge in recommended treatments, as well as strategies to promote self-confidence.

The opportunities to learn about PI risk assessment and prevention declined during the pandemic from those experienced before COVID-19,

while opportunities to learn about pressures management remained stable. Considering the relevance of prevention, these findings are alarming, as students seem to focus on managing PIs rather than prevention. More studies are needed to corroborate the findings emerged and establishing underlying factors in order also to design tailored

Table 5

Correlation matrix: learning occasions as documented in the *Student Portfolio of Skills*, knowledge/attitudes as assessed with PUKAT-IT/APuP-IT and perceived preparedness as reported by students at the time of graduation.

| Variables | Assessing the risk of PIs by using validated tools - total | Implementing interventions to prevent PIs - total | Assessing the stage and managing PIs I stage - total | Assessing the stage and managing PIs II stage - total | Assessing the stage and managing PIs III stage - total | Assessing the stage and managing PIs IV stage - total | Total PUKAT-IT | Total APuP-IT | Do you feel prepared to assess the risk of PIs? | Do you feel prepared to manage the risk of PIs? |
|--|--|---|--|---|--|---|----------------|--------------------|---|---|
| Assessing the risk of PIs by using validated tools | 1.000 | 0.539 ^b | 0.411 ^b | 0.482 ^b | 0.403 ^b | 0.389 ^b | -0.081 | -0.055 | 0.023 | -0.001 |
| Implementing interventions to prevent PIs | | 1.000 | 0.402 ^b | 0.459 ^b | 0.312 ^b | 0.291 ^b | -0.043 | -0.019 | 0.034 | -0.135 |
| Assessing the stage and managing PIs - I stage | | | 1.000 | 0.663 ^b | 0.539 ^b | 0.415 ^b | -0.114 | -0.005 | -0.069 | -0.124 |
| Assessing the stage and managing PIs - II stage | | | | 1.000 | 0.637 ^b | 0.477 ^b | -0.057 | -0.054 | -0.047 | -0.143 |
| Assessing the stage and managing PIs - III stage | | | | | 1.000 | 0.527 ^b | -0.059 | 0.046 | 0.041 | -0.094 |
| Assessing the stage and managing PIs - IV stage | | | | | | 1.000 | -0.033 | 0.024 | 0.039 | -0.038 |
| Total PUKAT-IT | | | | | | | 1.000 | 0.173 ^a | 0.165 | 0.026 |
| Total APuP-IT | | | | | | | | 1.000 | 0.231 ^b | 0.035 |
| Do you feel prepared to assess the risk of PIs? | | | | | | | | | 1.000 | 0.418 ^b |
| Do you feel prepared to manage PIs? | | | | | | | | | | 1.000 |

Legend: PIs, pressure injuries; PUKAT-IT, Pressure Ulcer Knowledge Assessment Tool – Italian version; APuP-IT, Attitude Toward Pressure Ulcer Prevention – Italian version.

I, II, III and IV stage [26].

^a p = 0.05.

^b p = 0.01.

strategies. However, it is recommended that educators design new methodologies to compensate the lacks emerged by promoting PIs attractiveness among students (e.g., virtual reality, gaming) and shifting the focus from the management of PIs to their effective prevention.

Declaration of competing interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jtv.2024.08.012>.

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