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Nursing Students' Motivation, Awareness, and Knowledge of Women's Health: A Norwegian Quasi-Experimental Study

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Abstract: Background: The knowledge of sex and gender differences in disease are crucial for nursing students. Methods: This quasi-experimental study assesses nursing students' motivation, awareness, and knowledge related to women's health before and after a pathology course for first-year nursing students, using a pre–posttest design (pretest: n = 312, posttest: n = 156). Results: More than 90% of students were motivated to learn about sex and gender differences in pathology. Awareness increased significantly for the following topics: cardiovascular disease (CVD), osteoporosis, and breast cancer (BC). The knowledge level was low for CVD and high for BC, where the knowledge level increased significantly for BC. Having another first language predicted CVD (B −2.123, 95% CI −3.21 to −1.03) and osteoporosis (B −0.684, 95% CI −0.98 to −0.39) knowledge negatively, while age group (≥21 years) predicted menstruation (B 0.179, 95% CI 0.03 to 0.33) and BC (B 0.591, 95% CI 0.19 to 1.00) knowledge positively, in the total sample (pre- and postdata, n = 468). Conclusion: There is a lack of pathology knowledge among nursing students, especially related to CVD and symptoms of heart attacks in women. To ensure equality in health for women, these perspectives should be systematically integrated into the nursing students' curriculum in the future.

Keywords: sex differences; women's health; knowledge; nursing; student; education; pathology; cardiovascular disease; breast cancer

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1. Introduction

Health outcomes are strongly influenced by sex and gender differences; however, the differences between women and men regarding health have been largely overlooked over the years [1]. During the 1970s, women's health was a social movement aiming to highlight women's needs, and not a priority in the scientific and medical fields [2]. at present, the phrase women's health has entered the United Nations (UN) Sustainable Development Goals, and is addressed by several of the goals, e.g., 3: good health and well-being, 5: gender equality, and 10: reduced inequalities [3].

Gender is a social determinant of health, entangled with sex differences [4,5], and both gender (socially constructed roles and behaviors) and sex (the biological attributes of females and males) affect molecular and cellular processes, response to treatments, health, and disease [5]. Gender can be a barrier to health-seeking behavior where patients' anticipation of stigma can result in delays in seeking a diagnosis and, hence, treatment (e.g., lung cancer) [6]. Stigma can also be a barrier across a range of health conditions [7], and cultural values can especially introduce novel stressors influencing psychosocial needs and adaptation for women [8]. In addition, a persistent social gradient in health among girls and women across different ages has been observed [9]. Even in Norway, persistent inequality is seen in morbidity, access to health services, experiences with health services, and health outcomes according to the socio-demographic characteristics among women in all phases of life [9].

Sex differences in disease were demonstrated during the COVID-19 pandemic, where the female sex was independently associated with a lower risk of any cardiovascular

complications, in a large registry-based study of 11,167 adults admitted to hospitals with COVID-19 between March 2020 and May 2021 [10]. Sex differences exist regarding body composition, sex hormones, and lipid levels, where women have a higher body fat percentage [11] and higher HDL cholesterol compared to men [12]. The amount of sex hormones in women changes over their lifespan, where ovarian hormones, such as estrogen, can play a protective role regarding cardiovascular disease (CVD), at least until menopause [13]. However, parity and giving birth can increase women's cardiovascular risk, while lactation has been found to decrease the risk [14–17]. In addition, health challenges can affect women disproportionally owing to biological, gender, and other social determinants [18]. Even though women are the key to sustainable development, the achievement of sexual and reproductive health is still an unmet goal, and the response to non-communicable diseases (NCDs) is, to date, not commensurate with their burden among women [18]. Among women, NCDs, such as cardiovascular disorders and cancer, are the leading causes of death and disability worldwide. Still, several misconceptions about women's health exist, despite the evidence about the magnitude of NCD-related burden among women, leading to persistent inaction [18]. Such inequalities are associated with a higher cardiac risk factor in women, including a higher prevalence of systemic inflammatory rheumatologic diseases, mental stress/depression, polycystic ovarian syndrome, and factors related to reproductive health (e.g., pregnancy-induced hypertension, preeclampsia, and gestational diabetes) [19–21].

Several studies have reported sex and gender differences in the management and outcomes of acute myocardial infarction (ACS) [22–30], where women experience delays in time before treatment (i.e., door to balloon/symptom to balloon) [31–34], and are less likely to be treated invasively compared to men [25,26,30]. In recent decades, there has been a growing incidence of acute myocardial infarctions (AMIs) in young people, especially in women [35], where women with diabetes mellitus 2 (DM2) seem to have a higher risk of developing ACSs compared to men [36].

Nurses are the backbone of the modern medical infrastructure and play an essential role in prevention, treatment, and patient care. Knowledge of sex and gender differences in disease is crucial in the nursing students' curriculum. However, these perspectives are not systematically integrated into health professional education in Norway [37]. Knowledge of women's health and their specific disease symptoms is crucial to adopt a clinical response [38]. To integrate these issues into future education programs, it is important to find out more about the students' knowledge concerning these issues.

Previously, studies have examined nursing students' level of knowledge [39–41] and found knowledge gaps [41] and misconceptions [42]. However, the nursing students' level of knowledge has not been explored in Norway.

Therefore, the aim of the present study was to explore nursing students' motivation, awareness, and knowledge related to women's health before and after a pathology course. More specifically, it aims to assess possible changes and assess if the students' age, previous knowledge of pathology, and first language are associated with the students' knowledge level in pathologies (i.e., CVD, osteoporosis, menstruation, and breast cancer) especially related to women's health.

2. Materials and Methods

2.1. Study Design

This quasi-experimental study adopted a pre–posttest design, where an online questionnaire was distributed among first-year nursing students in 2021, before and after their pathology course (Figure 1). The study was conducted using an electronic survey created in Nettskjema [43].

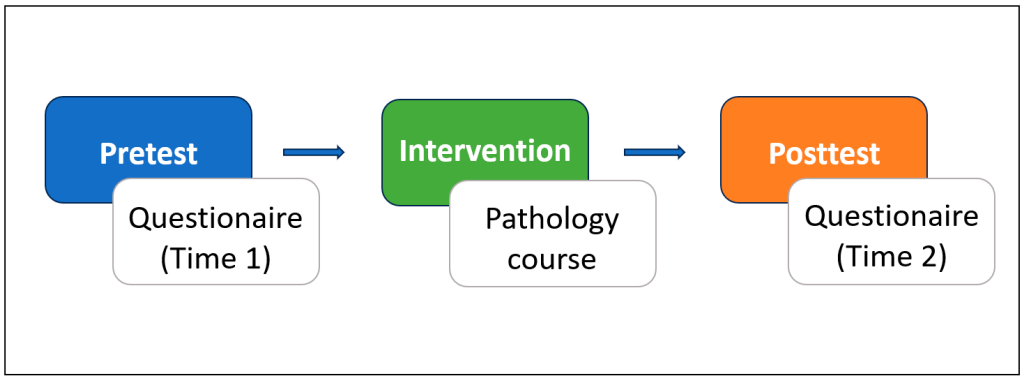

Figure 1. Research design of the study.

2.2. Settings

The course "Diseases and Health Deficits" (10 ECTS) was taught over seven weeks during the second semester of the Bachelor Program in Nursing after the students had learned about biochemistry, anatomy, and physiology in the first semester. As the COVID-19 pandemic forced educational institutes, including instructors and learners, to move online, the course was taught online on Zoom in the spring of 2021.

In the course, the students acquired knowledge of the most common diseases in medicine and surgery among children and adults, such as CVD, osteoporosis, and breast cancer. Knowledge of pathology and treatment was a precondition for the nurse's assessment, action, and decision processes. The teaching strategies used in the course were based on the principles of student active learning that have been shown to increase student learning outcomes [44,45]. The course's teaching and learning methods consisted mostly of lectures and seminars where the students worked in small groups of 3–5 students, supervised by educators and student assistants while solving the seminar tasks. The student assistants were near-peers, guiding students in the lower year (1–2 years), as a form of peer-assisted learning (PAL) [46,47].

The students answered the pretest questionnaire in the first week of the course and the posttest questionnaire in the last week.

2.3. Participants

The participants were first-year nursing students from Oslo Metropolitan University in Norway and were recruited in their second semester, and the only eligibility criterion was being a nursing student on the pathology course (n = 472). The students were invited by their seminar teachers, who placed a link to the questionnaire in the chat during the digital seminars on Zoom (Table 1).

Table 1. Response rate.

	Invited Participants	Included	Response Rate
Pretest	472	312	66.1%
Posttest	472	156	33.1%

2.4. Questionaire

The questionnaire was inspired by the study of Mosca et al., 2013 [48], and consisted of a short information text and closed questions. Knowledge was measured by a score where students received one point for a correct answer and zero points for a wrong answer for the following topics: CVD, osteoporosis, menstruation, and breast cancer. The questionnaire was divided into seven sections that included (i) participants' characteristics: age group, sex, first language, and previous education in pathology; (ii) self-perceived level of knowledge/awareness related to the four topics of CVD, osteoporosis, menstruation, and breast cancer: "Are you familiar with/how well do know . . .?" (not well/well); (iii) CVD

in women: "Which of these may be a symptom of a heart attack in women?" (Yes/No for each of the 23 possible symptoms); (iv) osteoporosis, bone density, and fractures: "Which statement are correct?" (Yes/No for each of the 7 possible correct statements); (v) menstrual cycle: "What are the characteristics of a normal menstrual cycle?" (Yes/No for each of the 6 possible correct statements); (vi) breast cancer: "Which statement is correct?" (Yes/No for each of the 10 possible correct statements); and (vii) one motivation question in the end: "Do you want to learn more about gender differences and health?" (Yes/No).

2.5. Ethical Considerations

This cross-sectional study was conducted using an anonymous electronic survey and did not require ethical approval. The participants signed an informed consent form in the questionnaire. The potential participants were informed about the study and the voluntary nature of participation in the information text at the beginning of the questionnaire. Only the students who agreed to participate were able to answer the questionnaire.

2.6. Statistical Analysis

Descriptive statistics were used to examine the demographic data, such as the students' characteristics. Chi-squared tests were used for categorical variables and analysis of variance (ANOVA) for continuous variables. Total knowledge scores were calculated by adding the students' correct answers, where one correct answer counted as one point. Changes in correct answers were given in percentage point (pp). Linear regression models were fitted to examine the relationship between knowledge scores (cardiovascular, osteoporosis, menstruation, and breast cancer) as the dependent variable and age group, first language, and previous education in pathology as independent variables. p-values < 0.05 were considered statistically significant. All analyses were conducted using IBM SPSS Statistics software version 29.

3. Results

3.1. Participants' Characteristics

In this study, 312 students consented to participate in the pretest (response rate: 66%) and 156 students consented to participate in the posttest (response rate: 33%) (Table 2).

Table 2. Characteristics of the participants.

	Pretest (n = 312)	**Posttest (n = 156)**
Sex, n (%)		
Women	277 (88.8)	127 (81.4)
Men	32 (10.3)	29 (18.6)
Other *	3 (1.0)	0 (0)
Age group, n (%)		
<21 years	129 (41.3)	56 (35.9)
21–25	123 (39.4)	63 (40.4)
>25	60 (19.2)	37 (23.7)
Other first language, n (%)	91 (29.2)	39 (25.0)
Previous pathology, n (%)	52 (16.7)	29 (18.6)
University	13 (4.2)	12 (7.7)
High school	39 (12.5)	17 (10.9)
No	260 (83.3)	127 (81.4)
Learn more **, n (%) yes	299 (95.8)	144 (92.3)

* Other/do not want to report; ** do you want to learn more about gender differences and health? (yes/no).

In the pretest, 89% were women, while 81% were women in the posttest. Most of the participants were 25 years old or younger, and more than 80% of the participants had no previous education in pathology.

3.2. The Students' Motvation and Awareness

More than 90% of the students were motivated to learn about sex and gender differences in pathology (Table 2).

When the students were asked if they were familiar with (knew well) the four subjects (CVD, osteoporosis, menstruation, and breast cancer), almost 80% answered that they were familiar with the menstruation cycle before the pathology class, with a slight increase in the posttest after the pathology class, which was, however, not significant (Figure 2). The students' awareness increased significantly for the themes taught on the pathology course, CVD, osteoporosis, and breast cancer, where a statistically significant increase was seen for CVD ($p < 0.001$), osteoporosis ($p < 0.001$), and breast cancer ($p < 0.001$) in the chi-squared test. The small increase in the menstruation cycle was not surprising because this subject was presented in the biochemistry, anatomy, and physiology classes during the students' first semester. The largest increase in self-perceived knowledge level was seen for breast cancer, with a 42.1% increase in percentage points. For cardiovascular heart disease, the increase in percentage points was 26.3%, osteoporosis was 15.0%, and menstrual cycle was 2.4%.

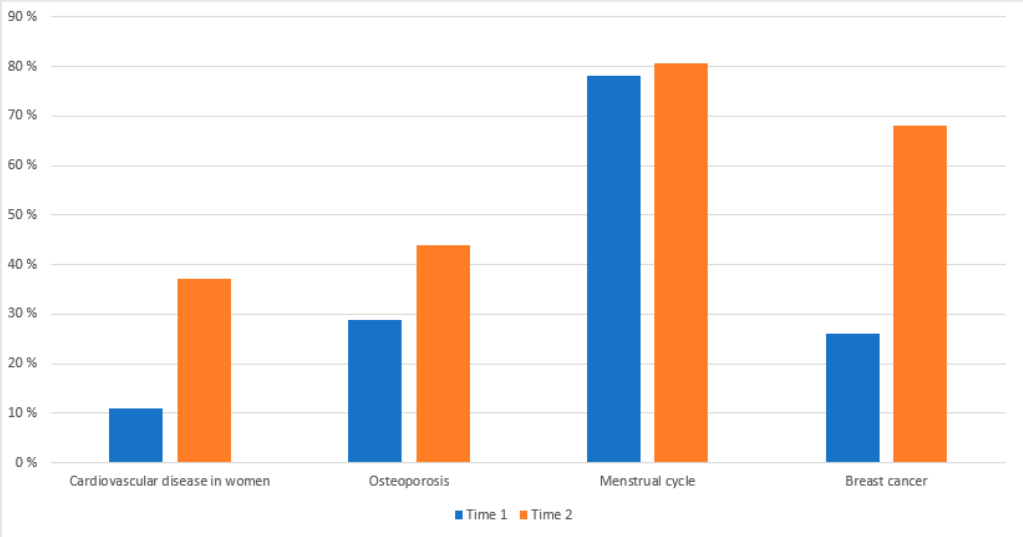

Figure 2. Self-perceived knowledge level (% of students answering with "I am familiar with/know well") in the pretest (Time 1, n = 312) and posttest (Time 2, n = 156), before and after the pathology course, respectively.

3.3. Participants' Knowledge of Women's Health

When the students were asked which of the following 23 symptoms might be correct for heart attacks in women, the most frequent correct answers were chest pain and heavy breath, where more than 90% answered correctly both in the pretest and the posttest, however with a 3% decrease in the percentage point (Table 3). The students' knowledge level of CVD symptoms was generally low and decreased for 14 of the 23 suggested symptoms (1 false) from the pretest to the posttest. In the pretest, <60% answered correctly for the symptoms of "pain in right shoulder" (33%), "digestive problems" (34%), "pain in right arm" (37%), "abdominal pain" (47%), and "jaw pain" (54%) in the pretest. In the posttest, the students' knowledge level decreased below 60% for an additional five symptoms: "pain in the upper abdomen" (59.1%), "vomiting" (57.8%), "neck pain" (58.8%), "back pain" (54.1%), and "fainting" (51.6%). The largest increase in correct answers (>5 pp) was seen for "sudden loss of vision in one or both eyes" (+7.7 pp) and "pain in the left shoulder" (+7.4 pp), and the largest decrease in correct answers was seen for "nausea" (−5.6 pp), "sweat" (−5.8 pp), "back pain" (−6.1 pp), "jaw pain" (−8.5 pp), and "fainting" (−9.5 pp).

Table 3. Correct answers for heart attack symptoms in women; n (%); pretest n = 312; posttest n = 156.

	Pretest n (%)	Posttest n (%)	Change *	*p*-Value
Sudden loss of vision in one or both eyes (No)	158 (61.2)	84 (68.9)	7.7	0.2
Pain in left shoulder (Yes)	181 (66.5)	99 (73.9)	7.4	0.1
Pain in right shoulder (Yes)	84 (32.8)	46 (37.1)	4.3	0.4
Abdominal pain (Yes)	128 (47.4)	66 (50.4)	3	0.6
Headache (Yes)	177 (65.1)	85 (66.9)	1.8	0.7
Dizziness (Yes)	240 (86.3)	120 (87.6)	1.3	0.7
Pain in right arm (Yes)	96 (36.6)	48 (37.8)	1.2	0.8
Pain in arm or shoulder (Yes)	255 (85.6)	127 (86.4)	0.8	0.8
Pain in left arm (Yes)	227 (79.9)	108 (80.0)	0.1	1.0
Fatigue (Yes)	212 (77.7)	100 (77.5)	−0.2	1.0
Pain in the upper abdomen (Yes)	161 (60.8)	75 (59.1)	−1.7	0.7
Vomiting (Yes)	165 (60.2)	74 (57.8)	−2.4	0.6
Palpitations (Yes)	229 (84.5)	110 (82.1)	−2.4	0.5
Heavy breath (Yes)	276 (93.6)	131 (91.0)	−2.6	0.3
Digestive problems (Yes)	86 (33.9)	38 (31.1)	−2.8	0.6
Feeling weak (Yes)	237 (85.6)	110 (82.7)	−2.9	0.5
Neck pain (Yes)	166 (61.9)	77 (58.8)	−3.1	0.5
Chest pain (Yes)	297 (97.4)	145 (94.2)	−3.2	0.08
Nausea (Yes)	243 (84.7)	106 (79.1)	−5.6	0.2
Sweat (Yes)	205 (73.7)	89 (67.9)	−5.8	0.2
Back pain (Yes)	165 (60.2)	73 (54.1)	−6.1	0.2
Jaw pain (Yes)	147 (53.5)	58 (45.0)	−8.5	0.1
Fainting (Yes)	160 (61.1)	65 (51.6)	−9.5	0.08

Pearson's chi-squared test; * percentage points.

For the osteoporosis statements, there is an increase in the correct answers for five of the seven statements; however, this is only significant for "Bone loss increases in menopausal women" (+8.1 pp, $p = 0.02$) (Table 4). The knowledge level is below 45% for "Delayed menarche (first menstrual bleeding) is a risk factor for low bone density" and "Disruptions in the menstrual cycle can contribute to an increased risk of fracture", both in the pretest and the posttest. There is a decrease in correct answers for the two false statements; however, this is only significant for "The contraceptive pill should be given in the absence of menstruation and low bone density in girls/young women" (−12 pp, $p = 0.01$).

Table 4. Correct answers to questions about osteoporosis, bone density, and fractures; n (%) and change (percentage points); (pretest n = 312; posttest n = 156).

	Pretest	Posttest	Change *	*p*-Value
Bone loss increases in menopausal women (Yes)	250 (84.5)	138 (92.6)	8.1	0.02
Delayed menarche (first menstrual bleeding) is a risk factor for low bone density (Yes)	109 (37.6)	65 (44.8)	7.2	0.1
Young women who lose weight can lose bone mass even if they exercise a lot (Yes)	181 (61.8)	100 (67.1)	5.3	0.3
Women have twice the risk of hip fractures after 50 years of age compared to men (Yes)	246 (84.0)	130 (89.0)	5	0.2
Disruptions in the menstrual cycle can contribute to an increased risk of fractures (Yes)	121 (41.7)	64 (44.4)	2.7	0.6
Osteoporosis is more common in men than in women (No)	227 (75.9)	110 (73.8)	−2.1	0.6
The contraceptive pill should be administered in the absence of menstruation and low bone density in girls/young women (No)	214 (73.5)	91 (61.5)	−12.0	0.01

Pearson's chi-squared test; * percentage points.

For the menstruation statements, the knowledge level was generally high, where more than 60% of the students answered correctly in the posttest. There was an increase in correct

answers for three of the five statements. However, a significant decrease in correct answers were seen for the statement: "Bleeding lasts up to 7 days at a time" (−7 pp, $p = 0.003$) (Table 5).

Table 5. Menstrual cycle. What are the characteristics of a normal menstrual cycle? n (%) and change (percentage points); (pretest n = 312; posttest n = 156).

	Pretest	Posttest	Change *	*p*-Value
The length is 21–35 days (Yes)	169 (55.6)	97 (64.2)	8.6	0.08
It ends when the function of the ovaries decreases (Yes)	207 (68.5)	115 (76.7)	8.2	0.07
Involves large variations in both estrogen and progesterone (Yes)	220 (74.1)	115 (77.2)	3.1	0.5
It starts at about 12 years of age (Yes)	287 (94.4)	144 (94.1)	−0.3	0.9
Bleeding lasts for up to 7 days at a time (Yes)	290 (96.0)	137 (89.0)	−7	0.003

Pearson's chi-squared test; * percentage points.

For the breast cancer statements, the students' knowledge level was generally high, with low knowledge scores only for three of the ten statements in the pretest: "Having children at a young age reduces the risk of breast cancer" (24.2%), "Breast cancer often starts in the lymph nodes" (27.1%), and "Breast cancer often starts in the mammary glands" (39.2%). The correct answers increased for all ten statements, and there was a statistically significant increase in eight of the ten statements (Table 6).

Table 6. Breast cancer. Which statements are correct? n (%) and change (percentage points); (pretest n = 312; posttest n = 156).

	Pretest	Posttest	Change *	*p*-Value
Having children at a young age reduces the risk of breast cancer (Yes)	72 (24.2)	115 (76.7)	52.5	<0.001
Breast cancer often starts in the lymph nodes (No)	81 (27.1)	92 (61.3)	34.2	<0.001
Breast cancer often starts in the mammary glands (Yes)	116 (39.2)	99 (66.0)	26.8	<0.001
Physical activity has a preventive effect on breast cancer (Yes)	194 (64.9)	135 (90.0)	25.1	<0.001
Smoking increases the risk of developing breast cancer (Yes)	196 (66.2)	132 (87.4)	21.2	<0.001
Breast cancer only affects women (No)	209 (69.2)	130 (85.0)	15.8	<0.001
A healthy diet has a preventive effect on breast cancer (Yes)	236 (79.2)	139 (92.1)	12.9	<0.001
Alcohol increases the risk of developing breast cancer (Yes)	176 (59.1)	107 (70.9)	11.8	0.01
Breast cancer is the most common form of cancer in women (Yes)	274 (89.8)	142 (93.4)	3.6	0.2
Breast cancer can be transmitted from person to person (infection) (No)	306 (99.7)	152 (100.0)	0.3	0.5

Pearson's chi-squared test; * percentage points.

When looking at the total knowledge score (sum for each theme) before and after lectures on pathology in the different subjects (CVD, osteoporosis, menstruation, and breast cancer), there is a significant increase in the knowledge score only for breast cancer (Table 7).

Table 7. Total knowledge scores (correct answers) for each theme before and after the lectures on pathology (pretest n = 312; posttest n = 156).

	Pretest Mean (SD)	Posttest Mean (SD)	*p*-Value
Heart attack score	15.0 (4.25)	14.8 (4.47)	0.7
Osteoporosis score	4.6 (1.35)	4.7 (1.37)	0.3
Menstruation score	3.6 (0.82)	3.6 (0.74)	0.6
Breast cancer score	6.1 (1.89)	8.2 (1.78)	<0.001

One-way ANOVA test with time (pretest/posttest) as a factor.

3.4. Factors Predicting the Knowledge Scores

Linear regression models were fitted to examine the relationship between total the knowledge score as the dependent variable and age group, first language, and previous education in pathology as independent variables (Table 8).

Table 8. Prediction of the knowledge scores.

	Total			Pretest			Posttest		
	B	**95%CI**	***p*-Value**	**B**	**95%CI**	***p*-Value**	**B**	**95%CI**	***p*-Value**
CV score									
Age group ≥ 21 years	−0.002	−1.00 to 0.99	1.0	−0.503	−1.68 to 0.67	0.4	1.158	−0.72 to 3.04	0.2
Another first language	−2.123	−3.21 to −1.03	**<0.001**	−1.889	−3.15 to −0.63	**0.003**	−2.980	−5.24 to −0.73	**0.01**
Previous pathology	0.620	−0.69 to 1.93	0.4	0.097	−1.46 to 1.65	0.9	1.827	−0.66 to 4.31	0.1
Osteoporosis score									
Age group ≥ 21 years	−0.050	−0.32 to 0.22	0.7	−0.053	−0.38 to 0.27	0.7	−0.063	−0.54 to 0.42	0.8
Another first language	−0.684	−0.98 to −0.39	**<0.001**	−0.564	−0.92 to −0.21	**0.002**	−0.955	−1.52 to −0.39	**0.001**
Previous pathology	0.222	−0.13 to 0.57	0.2	0.204	−0.023 to 0.64	0.4	0.238	−0.36 to 0.83	0.4
Menstrual									
Age group ≥ 21 years	0.179	0.03 to 0.33	**0.02**	0.139	−0.06 to 0.33	0.2	0.257	0.01 to 0.51	**0.05**
Another first language	−0.006	−0.18 to 0.17	0.9	−0.118	−0.33 to 0.10	0.3	0.247	−0.04 to 0.53	0.09
Previous pathology	0.061	−0.14 to 0.26	0.6	0.033	−0.23 to 0.30	0.8	0.099	−0.21 to 0.41	0.5
Breast cancer									
Age group ≥ 21 years	0.591	0.19 to 1.00	**0.004**	0.566	0.12 to 1.01	**0.01**	0.299	−0.31 to 0.91	0.3
Another first language	−0.243	−0.71 to 0.22	0.3	0.062	−0.45 to 0.57	0.8	−0.720	−1.41 to −0.03	**0.04**
Previous pathology	0.422	−0.11 to 0.96	0.1	0.437	−0.16 to 1.04	0.2	0.238	−0.53 to 1.01	0.5

Linear regression. Estimated change (regression coefficient B and 95% confidence interval) in various knowledge scores (cardiovascular disease, osteoporosis, menstrual cycle, and breast cancer) as the dependent variable, by an increasing knowledge score (univariate models). Statistically significant results in bold.

Negative associations were observed between having another first language and the CV score (B −2.123, 95% CI −3.21 to −1.03) and osteoporosis score (B −0.684, 95% CI −0.98 to −0.39) in the total sample population. These negative associations were also found in the pretest and posttest. In addition, there was a negative association between having another first language and breast cancer knowledge; however, this was only significant in the posttest (B −0.720 95% CI −1.41 to −0.03).

Positive associations were observed between being in an older age group (≥21 years) and increased knowledge scores both for menstrual cycle and breast cancer in the whole sample, compared to those <21 years old (B 0.179, 95% CI 0.03 to 0.33 and B 0.591, 95% CI 0.19 to 1.00, respectively). These associations and increase in the total knowledge score were only statistically significant for the menstrual cycle in the posttest and for breast cancer in the pretest.

4. Discussion

4.1. Motivation and Awareness Related to Women's Health

This study assessed nursing students' motivation, awareness, and knowledge related to women's health before and after a pathology course.

Most of the students were motivated to learn about sex and gender differences before the pathology course, even though the proportion slightly decreased throughout the pathology course. Motivation is a strong driver for learning [49], and nursing students' academic motivation is complex and shaped by cultural, social, and professional factors [50]. Nursing students in England and Norway described educational programs with rapid shifts between topics [51], which could explain why some of the students indicated that they had learned enough about sex and gender. Nevertheless, the high motivation for learning revealed in this study is positive, as motivation is associated with independent learning [50].

The awareness of the different topics (i.e., CVD, osteoporosis, menstruation, and breast cancer) increased during the pathology course, however not significantly for menstruation, which was not surprising because the topic was taught during biochemistry, anatomy, and physiology classes in the previous semester. The awareness of CVD was especially low and lower than the other topics, both before (11%) and after (37%) the pathology course. Mosca et al. (2013) assessed the trends in the awareness of CVD risk among women >25 years old between 1997 and 2012 and found that awareness improved [48]. The study observed that an awareness of CVD as the leading cause of death nearly doubled (56% vs. 30%; $p < 0.001$); however, the rate of awareness among Black and Hispanic women in 2012 (36% and 34%, respectively) was similar to that of White women in 1997 (33%). In 1997, women were more likely to cite cancer than CVD as the leading killer (35% vs. 30%), but in 2012, the trend reversed (24% vs. 56%). In addition, an awareness of atypical symptoms of CVD

improved, but was still low in 2012 [48]. Low CVD awareness was previously observed, especially among young women aged 15 to 24 years old (n = 331), in another US survey using data from 2012 [52]. In this study, most of the participants were 25 years old or younger, where more than 80% of the participants had no previous education in pathology. Gooding et al. (2020) found that perceptions of age, gender, and social norms contributed to low heart disease awareness among young women, when interviewing 35 young women aged 15–24 years (focus groups) recruited from primary care practices in Boston, MA, in 2018 [53]. The participants were surprised that heart disease was the leading cause of death for women, and associated heart disease with older people aged 40 years old and older, generally men [53].

4.2. Nursing Students' Knowledge Level Related to Women's Health

In this study, the students' knowledge level of CVD symptoms was low before the pathology class and decreased further from the pretest to the posttest. For breast cancer, the students' pre-knowledge was high both before the pathology class and after, and the total knowledge score for breast cancer increased significantly after the pathology course. This is in agreement with other studies that found that an awareness and knowledge of breast cancer improved after education interventions [54,55]. However, this was not observed for the other three topics (CVD, osteoporosis, and menstruation).

A diversity of studies has investigated nurses' and nursing students' CVD knowledge [39–41,56,57]. Badir et al. (2015) observed an overall high level of knowledge of CVD among nursing students (first- to fourth-year students) in Turkey; however, although students had high overall scores, a large percentage of the students had notably low knowledge for some of the items in the questionnaire (CARRF-KL), where 87% of the students did not know that heart disease could be identified based on common signs and symptoms. The study also revealed that years of education ($p < 0.001$), sex ($p < 0.001$), and high-school type ($p < 0.05$) were significantly associated with knowledge scores [41]. In a more recent Turkish study, Baykal et al. (2022) also observed a high knowledge level when assessing cardiovascular risk factors among 224 nursing students [56]. A more diverse form of knowledge was observed by Chow et al. (2017) among 385 senior nursing students in Hong Kong [39], and Wu et al. (2011) observed that Chinese nursing professionals and students lacked knowledge critical to guiding individuals with or at risk of CVD [40]. A low knowledge level of cardiac symptoms was also observed in another study assessing nurses' knowledge of cardiac symptoms. Newens et al. (1996) observed that 25% of nurses did not make a correct estimate of the symptoms, however nurses working in specialized cardiac wards and more experienced nurses had significantly higher scores [57].

4.3. Sex Differences in CVD Need Attention

Globally, cardiovascular disease (CVD) is the leading cause of death in women of all ages [58], however few women are aware of this [48]. In spite of several studies identifying sex and gender differences in CVD, there is a lack of knowledge both among healthcare providers [59] and patients [60].

CVD in women is complex, and sex differences between women and men exist regarding body composition, sex hormones, and lipid levels, where women have a higher body fat percentage [11] and higher HDL cholesterol than men [12]. The amount of sex hormones in women changes over a lifespan, where ovarian hormones, such as estrogen, can play a protective role in, e.g., cardiovascular disease, at least until menopause [13].

Even though women and men share many of the conventional CVD risk factors, there are important sex differences, where a woman's reproductive history can reveal or influence cardiometabolic and cardiovascular trajectories, both in the short term and long term. In women, both early and late menarche, polycystic ovary syndrome, infertility, and adverse pregnancy outcomes, such as hypertensive disorders and gestational diabetes, are associated with increased future cardiovascular disease risks [61]. Also, parity and giving birth influence women's cardiovascular risk outcomes, where breastfeeding decreases

cardiovascular risk [14–17,61–63], and, especially, a longer duration of lactation (≥2 years) has been seen to reduce the risk of CHD by 23% [64]. In addition, menopause represents a period of accelerated risk, where timing, such as premature menopause, together with the symptoms and treatment of menopause each contribute to this increased cardiovascular risk [61]. There are also reported differences in cardiovascular risks between men and women, depending on the type of food they consume [65,66].

Women differ from men in several ways when it comes to acute myocardial infarctions (AMIs), and some knowledge of this is crucial for nursing students. Women with AMIs are generally older than men at hospital presentation, where the mean age of 73.9 vs. 66.5 years (SD, 12.4 vs. 13.2 years old) has been seen [30,67,68]. Women can also have other cardiovascular symptoms [69–71], displaying more prodromal symptoms, such as fatigue [72], without chest pain compared to men [67,71]. Women wait longer before they seek treatment for an AMI, delay their first point of medical contact for longer [33], and are less likely to receive a triage in the emergency department [34] and to be admitted to hospital compared to men [73]. In Norway, it has been observed that fewer women than men with AMIs underwent a coronary angiography (2013/2014) [74], which was also observed in a German [75], Israeli (<55 years) [76], and European study (2014–2017) [30]. In addition, women were found to have lower upper reference limits of cardiac troponin [77], which could contribute to the underdiagnosis of AMIs. Especially female patients with an STEMI experienced excessive delays due to prehospital and hospital delays compared to men [78]. Women who suffer ACSs are less likely to undergo percutaneous coronary interventions (PCIs) within the guideline-directed therapeutic window. An increased prevalence of non-obstructive coronary arteries in women (MINOCA or INOCA) can contribute to this outcome. A nationwide cohort study in England and Wales (2003–2013) comprising 691 and 290 AMI hospitalizations, respectively, observed that women received guideline-indicated care less frequently than men, and had significantly higher mortality [79], which was also seen in other studies [25,26,76]. In addition, women have a higher risk of in-hospital complications, such as bleeding [80], coronary perforation (3.7% vs. 2.9%, $p < 0.001$), vascular complications (1.0% vs. 0.6%, $p < 0.001$) [81], and major adverse cardiovascular events (MACEs) [82,83], in addition to an increased risk of cardiovascular mortality [84,85] compared to men. In a recent meta-analysis, a worse in-hospital outcome was reported among women in the treatment of STEMIs, with higher mortality (OR 1.91, 95% CI 1.84 to 1.99, $p < 0.00001$), repeated AMIs (OR 1.25, 95% CI 1.00 to 1.56, $p = 0.05$), strokes (OR 1.67, 95% CI 1.27 to 2.20, $p < 0.001$), and major bleeding (OR 1.82, 95% CI 1.56 to 2.12, $p < 0.00001$) [33]. A previous meta-analysis reported higher mortality at short-term (30 days), mid-term (1 year) and long-term (5 years) events in women who underwent coronary artery bypass grafting compared to men [86]. However, a recent meta-analysis reporting patients outcomes for chronic total occlusions revealed no significant difference in mortality between men and women: in-hospital mortality (RR = 1.50; 95% CI: 0.73 to 3.09) and long-term (≥6 months) all-cause mortality (RR = 1.10; 95% CI: 0.86 to 1.42) [80].

4.4. Pathology Knowledge Is Crucial for Nursing Students

There seems to be a significant knowledge gap within the medical community in understanding the pathophysiological differences related to women's health, especially CVD [87]. In addition, there are limitations in the formal curriculums in schools for health personnel, such as nursing education and medical schools [37,87,88]. This has resulted in persistent sex-specific gaps in the application of guideline-recommended prevention strategies, together with diagnostic and therapeutic adherence to CVD management in women [87].

Nurses are the backbone of the modern medical infrastructure and play an essential role in prevention, treatment, and patient care. Knowledge of sex and gender differences in disease are crucial in nursing students' curriculum. However, these perspectives are not systematically integrated into health professional education [37].

In Norway, a recent mapping of medicine, nursing, psychology, social care, and physiotherapy education showed that sex and gender were only mentioned in medical courses and mainly in connection with reproduction, sexual health, and venereal diseases [37], which was also seen in the Pathology Competencies for Medical Education in the US [88].

To ensure that nursing students have sufficient competence to ensure equal health services to all groups in society, knowledge and competence targeting gender and women's health should be included in the learning outcome descriptions at a national level to ensure a comprehensive understanding across theoretical and clinical courses. In addition, educational institutions should employ researchers and teachers with special expertise of gender and women's health to ensure that the students acquire knowledge in the area [37].

4.5. Pedagogical Strategies Related to Pathology Teaching

In this study, there was a lack of CVD knowledge in particular among the students. Other studies that presented both an awareness and knowledge of the area improved after education interventions [54,55]. If this lack of knowledge was highlighted before the pathology class, the lectures and seminars could have been adjusted to the students' pre-knowledge; however, this was not performed in this setting.

Students pre-knowledge can be used to adjust lectures and seminars, just like when using Just in Time Teaching (JiTT), a technique where the instructor uses students' responses to tailor the class to the students' specific needs [89,90]. However, this was not the case for the pathology course. JiTT can be used to optimize students' learning outcomes and increase students' motivation and control over their own learning [89]. The strategy of JiTT is to address what lies between teaching and learning, in the space between the students' experience outside the classroom and inside the classroom [90]. Here, the students provide feedback to the teacher, often after completing a pre-class assignment, which can be delivered online. Classroom teaching is then set up according to the students' feedback [89,90]. Testing or retrieval practice have been found to promote long-term retention and can be used beneficially both with open-ended responses (e.g., cued or free recall) and multiple-choice questions. However, the use of multiple-choice questions can have an additional benefit as they can stabilize information that is stored in the memory but is temporarily inaccessible due to marginal knowledge [91]. Furthermore, pretesting (especially without feedback) can be a more active method that optimizes learning [92]. In the flipped classroom model, students can take more responsibility for their learning and are also able to participate actively in discussions in the classroom [93]. Students can also find that a flipped classroom approach is a pleasant experience, compared to a traditional lecture [94]. Flipped classrooms are recommended for use on health subjects [95,96]. In a Norwegian quasi-experimental study, a flipped classroom was found to lower the failure rate in dosage calculation exams with 22 percentage points [96]. However, the flipped classroom approach was found to be more effective when instructors used quizzes at the start of each in-class session [95].

4.6. Knowledge Gaps

To successfully achieve health equity for both sexes, the health disparities related to women's health need to be addressed to meet the United Nations (UN) Sustainable Development Goals [3,97]. The role of genetic, molecular, cellular, and physiological factors, social determinants of health (SDOHs), behaviors, and environment in women's health are only beginning to be understood, and it is urgent to address these gaps in the knowledge and care delivery to reduce sex-based disparities and achieve equity [98].

The irregularities in integrated curricula can be a factor in persistent disparities in the clinical care and outcomes experienced by women, compared with men. To close this gap, formal education for nurses and other healthcare personnel should include sex- and gender-specific aspects in their pathology courses, such as cardiovascular disease (CVD) risk factors, symptoms, treatments, and outcomes. In addition, further research is needed

to not only support the use of non-traditional pedagogy interventions in pathology [99], but also explore how sex and gender-specific aspects can be included in pathology.

4.7. Limitations

The major weakness of a quasi-experimental design is the lack of random assignments. It is therefore not possible to make causal inferences with certainty. However, this one-group pretest–posttest design, where the scores were measured before (pretest) and after (posttest) the intervention (pathology course), minimized the threat of internal validity and made comparison possible. Another limitation of this study was that other factors, beyond the control of the researcher, could have influenced the results, such as the control over possible confounding variables and things that could have happened between the pretest and the posttest. In addition, a limitation of this study was that the analyses in this study were performed at a group level because it was not possible to follow an individual student from the pretest to the posttest due to anonymity and there was a relatively low response rate in the posttest. However, low attendance rates are common with online questionnaires [100].

5. Conclusions

In this study, most of the nursing students were motivated to learn about sex and gender differences; however, a slight decrease was seen after the pathology course. The nursing students' awareness of the different topics (i.e., CVD, osteoporosis, menstruation, and breast cancer) increased during the pathology course, however not significantly for menstruation. The awareness was especially low for CVD, where only 11% reported to be familiar with heart disease in women before and 37% after the pathology course.

The CVD knowledge level was generally low, while the opposite was observed for breast cancer. Having another first language other than Norwegian predicted lower knowledge levels for CVD and osteoporosis, while age ($\geq$21 years) predicted breast cancer knowledge positively in the total sample. However, first language predicted a lower knowledge level for breast cancer after the pathology course.

Sex and gender perspectives concerning women's health should be better integrated into nursing education, where specific disease symptoms relevant for women should be integrated in order to adopt a clinical response for nursing students.

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