

Research article



From aspiration to achievements: Exploring the motivational drives behind female graduate nursing students' pursuit of higher education in Ghana

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ABSTRACT

Background: The nursing and midwifery professions are predominantly female. In Sub-Saharan Africa, especially in Ghana, females have traditionally been perceived as homemakers who do not require higher education to play their roles. This phenomenon perpetuates gender inequality, underutilises talents, and denies women opportunities for personal and professional growth.

Aim: This study explored the motivational factors influencing the uptake of higher nurse education among female nurses in a resource-constrained setting.

Methods: An exploratory, descriptive qualitative approach was adopted with purposive sampling method to recruit 20 nurses pursuing a postgraduate programme in nursing from October to November 2022. Inductive thematic analysis approach was used to analyse the data.

Result: Two main themes and six subthemes were developed from the data. Female graduate students believe the reasons to pursue higher nursing education are attributed to one's workplace, friends and family's demands. Participants pursuing higher education think it will earn them higher-paying jobs. Their primary motivation to pursue higher education was to earn titles like 'doctor', 'the degree nurse', and 'the specialist nurse'. Other motivations for some participants include the impact of their higher education, which ranges from workplace promotion to family prestige.

Conclusion: Ghanaian female graduate nursing students' motivation to pursue higher nursing education is threefold: personal gains, corporate gains, and family fame. Educational institutions need to assist these nurses with the requisite knowledge to excel in their areas of work, get the maximum benefit they expect from schooling, and make their families and communities proud as expected.

1. Introduction

Traditionally, in Sub-Saharan Africa (SSA) settings, women's societal role has been perceived as a mother, wife, babysitter, and homemaker. These traditional roles of women have prevented them from pursuing higher education despite the benefits of higher education (Ahmed and Hyndman-Rizk, 2020; Vaughn et al., 2020). However, a school of

thought believes that only when women acquire higher education can they become good homemakers, wives, and mothers (Parker, 2015). Unfortunately, in most SSA contexts, most women abandon their professions and education to care for children and keep their homes as wives and grandmothers to help their husbands achieve higher academic positions (Devine et al., 2023; Abu, 2023). Most women have suffered this marginalisation globally, especially in most parts of Africa (Uduji,

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2020). Consequently, the number of women occupying higher professional and academic positions is far less than their male counterparts (Uduji, 2020). Though there are several professions where the number of men outnumbers women, the same cannot be said of the nursing professions, which is predominantly female-dominated.

Over the years, nurse education has improved globally through advanced curricula, technology integration, and increased access to specialised and interdisciplinary training. There have also been enhanced professional standards, research opportunities, and leadership development, empowering nurses to meet evolving healthcare demands (Macdiarmid et al., 2021b; Morton, 2019). The kind of nursing care demanded from nurses has changed compared to the era of Florence Nightingale during the Crimean War (Opere and Mill, 2000). After the introduction of formal nurse education, the profession has seen tremendous improvement, and currently, nurses are educated to the doctorate level in most countries across the globe (Santainés-Borredá and Camaño-Puig, 2021).

Higher nurse education produces highly competitive nurses who influence policies, act positively to bring good health outcomes, and broaden the individual nurses' scope of work and job opportunities (Drasiku et al., 2021; Kavanagh and Sharpnack, 2021). It has also ensured that nurses are well-equipped to provide the high-quality care expected of them (Smith et al., 2021), prepared them to be informed, lead, design healthcare service delivery policies, and make decisions that improve the well-being of all people (Mlambo et al., 2021). When nurses educate themselves to a higher level, they can critique their practice and research areas to promote health, alleviate suffering, and prevent illness (Rosseter, 2019). Nurses do not lose sight of how higher education would allow them to investigate issues such as politics and leadership that are decisive to their professional well-being (Barrett et al., 2021).

Several reasons may justify why a female nurse with numerous roles in the family and workplace will opt to further higher education despite barriers such as family roles, lack of study leave, expensive school fees, complex program packages, and the non-availability of needed courses in some jurisdictions (Macdiarmid et al., 2021b). The motivation to acquire higher education could be facilitated by tuition reimbursement, flexible programme schedules, and commitment to work progress (Cant and Levett-jones, 2021; Macdiarmid et al., 2021b; Smith et al., 2021). However, the inability to access bursaries has made prospective nurses rethink when applying for higher education. Lack of financial support puts qualified nurses off pursuing higher education and prevents others from continuing their studies (Abu-qamar et al., 2020).

Notwithstanding the challenges discussed concerning barriers to higher education, there is an increasing demand for higher nurse education worldwide, with an impressive response that has expanded educational institutions and caused most people to travel near and far to seek higher knowledge in nursing. The rationale and the motivation for higher nursing education among nurses are less examined. The study, therefore, explored the factors influencing the pursuit of higher nursing education in Ghana among nurses.

2. Methods and materials

2.1. Study design

An exploratory, descriptive qualitative design (Hunter et al., 2019) was used to explore the views of female nursing graduate students on their motivation to pursue higher nursing education from October to November 2022. This study was reported using the Standards for Reporting Qualitative Research checklist to increase research transparency and quality and limit the risk of inaccurate data reporting.

2.2. Study setting

This study was conducted at the Nursing and Midwifery Schools of

the University of Ghana, the Kwame Nkrumah University of Science and Technology, and the University of Cape Coast. The schools were chosen because they started higher nursing and midwifery education in Ghana, and most nurses and midwives are enrolled in the programme.

2.3. Study population

The population of interest was female graduate nursing or midwifery students pursuing Master of Philosophy, Master of Science, and Doctor of Philosophy degree programmes in nursing or midwifery education in universities in Ghana.

2.4. Inclusion criteria

Ghanaian female nurses admitted into any of the three universities pursuing a master's and above degree programme in nursing or midwifery.

2.5. Exclusion criteria

Nurses pursuing higher education in nursing and midwifery with either study leave or scholarship were excluded from the study.

2.6. Sample size and sampling technique

A purposive sampling method was used, as it was best suited for this study because the researchers were interested in nurses possessing unique characteristics that could help them explore the phenomenon in its entirety. We aimed to achieve thematic saturation, and this was done based on a rigorous, iterative process of data collection and analysis, and finally resulted in a sample size of 20 participants. As Srivastava and Hopwood (2009) recommended, we continuously reviewed and compared our data to identify recurring patterns and themes. This approach aligns with established qualitative research methodologies, ensuring a thorough analysis (Guest et al., 2020).

2.7. Data collection procedure and tool

A semi-structured interview guide was prepared based on the data collection objectives of the study. Before data collection started, an ethical clearance was secured to collect data. Graduate nursing and midwifery students in Ghana were contacted through their course representatives, who told them the rationale for the study to help recruit potential participants. The researchers exchanged phone numbers with course representatives to help link up with those interested in participating in the study. When participants were identified, the researcher thoroughly checked their backgrounds to ensure they met the inclusion criteria. Afterwards, they were informed of the study's objectives, and the information sheet was explained to them in clear, simple language that they could understand. Arrangements were made with participants who agreed to take part in the study regarding the convenience of place and time for either face-to-face or telephone interviews to be scheduled. Before every interview, participants were made to give verbal (virtual interview) or written consent forms (face-to-face interviews). They were told their right to withdraw from the study anytime they wished without any consequences. All interviews were audiotaped with participants' consent, and field notes were taken for non-verbal cues.

2.8. Data analysis

Data analysis was completed alongside data collection. The recorded interviews were transcribed verbatim and analysed using Braun and Clarke's six-phase thematic analysis guide (Braun and Clarke, 2012). The study was done both inductively. Two researchers read the transcripts thoroughly many times to better understand the entire data set. The data were assigned codes and organised into meaningful pieces to reduce the

data into small portions. Codes expressing the same idea were organised to form subthemes, and analogous subthemes were combined to form main themes. Four authors reviewed the themes and subthemes generated from the data set and modified them based on a consensus reached among the research team. NVivo software version 11 was used to manage the data.

2.9. Methodological rigor

The researchers followed Guba and Lincoln's (1989) four criteria for ensuring the trustworthiness of qualitative research. After data collection, credibility was ensured through consultation with study participants to ensure the data's accuracy, interpretation, and analysis (member-checking). The researchers gave a detailed description of how data were obtained to maintain its dependability. An audit trail was maintained regarding all study processes to ensure their confirmability. The researchers ensured that they documented sampling strategies and context-specific factors to ensure transferability and, thus, applicability to similar settings. A thick contextual description of the study's setting, process, and participants was provided to enhance transferability, enabling researchers to determine whether the findings would be helpful in other contexts. Also, to ensure reflexivity, the participants recruited for the study were not known to the researchers. These researchers were students but were not known by the participants.

2.10. Ethical consideration

Ethical clearance and approval were obtained from the Institutional Review Board of the Noguchi Memorial Institute of Medical Research, University of Ghana (NMIMR 009/22-23). Permission for the study was obtained from the institutions where participants were recruited. The study was explained to participants in simple language, including their right to opt out of the study at any point they feel uncomfortable continuing. Informed consent was obtained from participants who agreed to participate in the study, and those who met face-to-face signed a consent form before data collection began. The participants were assured of confidentiality and anonymity by eliminating possible participants' identifiers such as real names.

Table 1 Demographic characteristics of participants.

No.	Age	Marital status	No. of children.	Programme of study	Academic Institution	Area of Practice	Specialisation	Years of Experience	Rank	Full Study Leave
P1	45	M	3	MPhil Nursing	KNUST	Education	Gen. Nursing	22	PHT	No
P2	39	M	4	MPhil Nursing	UG	Practice	Pediatric	14	SNO	No
P3	43	M	3	PhD Nursing	UCC	Education	Gen. Nursing	21	DCHT	No
P4	39	S	0	M'Phil Paedis	UG	Practice	Pediatric	16	SNO	No
P5	37	M	2	MPhil Nursing	UG	Practice	Gen. Nursing	12	SNO	No
P6	37	M	3	MPhil Nursing	UG	Practice	Midwifery	11	PNO	No
P7	41	M	3	MPhil Nursing	UG	Education	Gen. Nursing	19	Lecturer	No
P8	38	M	3	MPhil Nursing	UG	Education	Gen. Nursing	11	PHT	No
P9	44	M	5	MPhil Nursing	UG	Practice	Gen. Nursing	18	PNO	No
P10	31	M	1	M'Phil N	KNUST	Practice	Gen. Nursing	7	SNO	No
P11	36	M	2	M'Phil Paed	UG	Practice	Gen. Nursing	13	SNO	No
P12	35	S	1	M'Phil N	UG	Practice	Gen. Nursing	13	SNO	No
P13	31	S	2	M'Phil N	UG	Education	Gen. Nursing	13	SNO	No
P14	44	M	3	M'Phil N	UG	Practice	Gen. Nursing	20	PNO	No
P15	34	M	1	MSc Nursing	UG	Practice	Gen. Nursing	10	PNO	No
P16	35	M	3	MPhil N	UG	Practice	Gen. Nursing	11	PNO	No
P17	46	M	4	MPhil N	UG	Education	Gen. Nursing	20	PHT	No
P18	27	S	0	MPhil N	UG	Practice	Gen. Nursing	4	SNO	No
P19	37	M	2	MPhil N	UG	Education	Gen. Nursing Gen.	15	PMO	No
P20	38	M	3	MPhil	UG	Education	Nursing	12	PNO	No

P – Participant; M – Married; S – Single; KNUST – Kwame Nkrumah University of Science and Technology; UG – University of Ghana; UCC – University of Cape Coast; PHT – Principal Health Tutor; SNO; Senior Nursing Officer; DCHT – Deputy Chief Health Tutor; PNO – Principal Nursing Tutor; PMO – Principal.

3. Results

A total of 20 nurses of various categories and ranks were interviewed. Their ages ranged from 27 to 46 years, and their ranks ranged from senior nursing officer to deputy director of nursing service grade. Based on where these nurses found themselves working, the names of their ranks change, but the different ranks fall within the range given earlier. Of the 20 participants, two were pursuing their program at the Kwame Nkrumah University of Science and Technology, one from the University of Cape Coast, and 17 were pursuing their programs at the University of Ghana. Four of the participants were single, and the rest were married. Eighteen of the participants had children ranging from 1 to 5, including two of those single. The participants' work experience was between 4 and 25 years. Details of participants' socio-demographic characteristics are displayed in Table 1.

3.1. Themes and subthemes

The data generated two main themes and six subthemes. The main themes were: 1. Sources of motivation with subthemes: workplace demand, family pressure, and peer influence. 2. Perceived impact of higher nursing education with subthemes: personal accomplishment, practice improvement, and family prestige. The main themes and their corresponding subthemes are displayed diagrammatically in Fig. 1.

3.2. Thematic findings

Themes and Subthemes:

1. Sources of Motivation

This theme describes the varied reasons why people pursue higher nursing education. It also includes participants' zeal to pursue graduate programs. Despite the life difficulties female graduate students face with work and family life, they consider it worth acquiring a postgraduate degree for various reasons. According to the female graduate nursing students interviewed, the reason is that the world is moving faster. Because most of them occupy leadership positions, they want to move ahead of their peers and subordinates. In addition, some are targeting workplace positions and new jobs to hook onto.

a. Workplace requirement

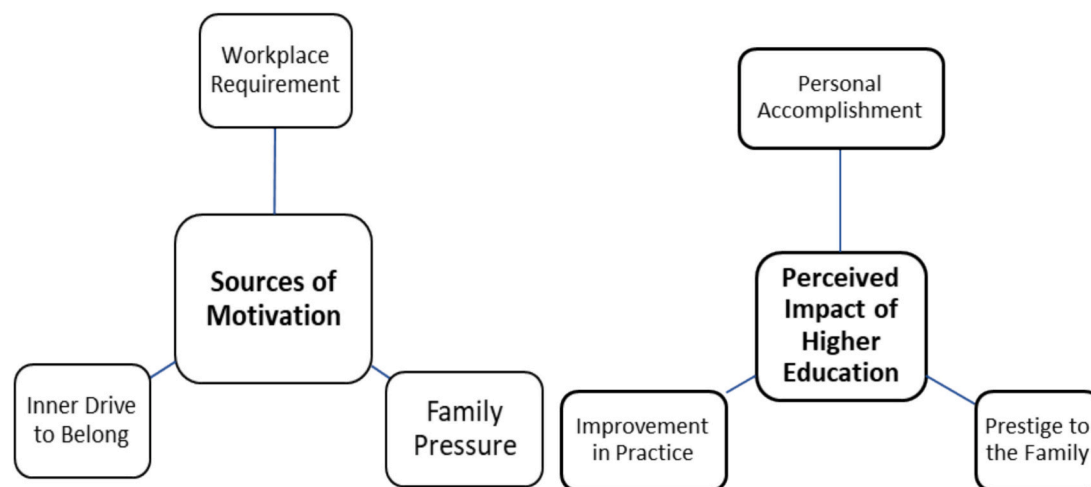


Fig. 1. Themes and sub-themes.

This subtheme discusses the desire to continue nursing education in response to occupational expectations imposed by employers or professional associations. Study participants stated that they worked in circumstances where a graduate degree was essential to advance in their careers. Regulatory agencies or nursing boards occasionally require nurses to acquire advanced degrees within a specific time frame to maintain professional standards.

“My workplace made it apparent that an advanced degree was required for job advancement. The firm regarded it as a necessity to assume leadership roles.” P5.

The participants realised that a higher degree was required to specialise in a specific nursing field or take on leadership responsibilities within their organisations. They believed that having a graduate degree would improve their professional reputation and increase their chances of getting better jobs.

“The nursing board in our region ordered that all nurses obtain a master’s degree within a particular timeframe. So it was more of a professional responsibility for me.” P1.

“I wanted to specialise in paediatric nursing, and the only way to do so was to pursue advanced study. Acknowledgement as an expert in paediatrics was essential. I fancy being called the specialist nurse” P11.

The necessity of the job provided a strong external motivation for people to pursue higher nursing education.

“I believed that having a higher degree would increase my credibility as a nurse and lead to greater career opportunities. It was a strategy to remain competitive in the job market.” P19.

b. Inner drive to belong

The subtheme “inner drive to belong” addresses the motives and goals of a community of highly trained nurses. The participants expressed appreciation and motivation for nurses who pursued additional education. They aimed to become a part of that community and significantly contribute to the nursing profession. Earning a higher degree in nursing would make one feel proud of one’s work and accomplishments.

“I’ve always respected nurses who hold advanced degrees. I wanted to be a part of that group and contribute to the profession on a higher level.” P17.

“When I engaged with nurses who had sought further education, their knowledge and skill impressed me. I wanted to be an MPhil holder or

nurse with an academic pedigree to impact the profession significantly. P20.

The participants believed that having a higher degree would allow them to have a more meaningful impact on patient care and better understand nursing practice.

“When I considered becoming a nurse, I felt a great sense of professional pride and success. It was a personal aim that drove me to continue my study.” P14.

Some participants’ innate drive to achieve and fit into societal groups motivated them to obtain advanced education. They wished to belong to academic groups in society, hence their quest to pursue higher education.

“I hoped that by pursuing a higher education, I would better grasp nursing and contribute more effectively to patient care. That innate will to succeed drove me to pursue higher education.”

P15

c. Family Pressure

This subtheme emphasises how family members’ expectations and influence can be a motivating factor for pursuing additional nursing education. The participants discussed how important education was to their families and how it served as a means of obtaining success.

Parents, in particular, expressed their desire for their children to succeed in their jobs and believed that attending college would help them develop professionally.

“My parents have always emphasised the value of education. They wanted me to succeed in my work and considered higher education a key to success.” P6.

Some participants were the first in their families to pursue nursing; they felt compelled to set a good example for their cousins, siblings, and future generations.

“As the first person in my family to pursue nursing, I faced many expectations. “I wanted to make my family proud and show them their sacrifices were worthwhile.” P1.

“My siblings and cousins viewed me as a role model. I wanted to set a good example and inspire them to follow their ambitions.” P11.

Children and spouses welcomed and recognised the long-term benefits a college education would give the family, and they also played a

supportive role.

"My spouse and children supported my desire to pursue higher education. They recognised the long-term benefits for our family and encouraged me to pursue it." P2.

2. Perceived Impact of Higher Nurse Education

The theme describes the nurses' and midwives' motivation for pursuing higher education and the perceived expected impact it will have on them. According to the participants, higher nursing education will help them realise their dreams, be tolerant, and understand children. A few participants reported that they are schooling to learn new things to help improve and polish their practices since some ward practices are outmoded. Some also want authority in their field of work because people consult them for knowledge because of their expertise. Overall, the participants believe that being able to sacrifice and go through postgraduate education will help them build their knowledge, manage time, improve their research skills, and appreciate research. Those doing specialised programs also take pride in the brand they have as specialist nurses and believe that a lot is expected of them to improve practice because they work with doctors who are general practitioners. Participants from the training institutions also said they had changed their minds about handling students and improved PowerPoint presentations and teaching strategies.

This theme generated three subthemes: personal accomplishment, practice improvement, and family prestige.

a. Personal accomplishment

The participants of this study are moved to pursue higher education because they believe the nursing profession is moving on. The younger ones in the profession are progressing faster, so they must also move on to catch up. Some also said that being a leader in the workplace requires knowing more to be able to teach and answer questions that will be put to them at work.

"Nursing is growing faster, so if you sit in one place, it's like you are in the future. And before you realise your juniors will move ahead of you. These young ones come, and before you realise they are doing things even without study leave, you will be there, and they overtake you". P17.

"I know how the world is moving in our current country or modern Ghana; you can't stay in one place for the rest of your time. So, and you know the little ones are also coming up, you, as an in-charge, must always be a step ahead of the little ones or whoever is behind you. The in charge cannot be at the ward for the little ones to come and teach. They might have gone up all right, but you still have the upper hand. Most of the questions troubling them or bordering them will be put to you, so you need to be at the top and at least answer about 90% of the questions, and you cannot do that without reading, you can't do that without practice, you can't do that I mean, without schooling so you school small, you work small". P4.

The nurses said nobody asked them to further their education. They indicated that going higher in education has made them read a lot, widened their knowledge, and given them new ideas.

"Nobody asked me to. I took it upon myself, and because I was getting new ideas and new feelings, there was one thing that motivated me. Then, when I became a Programme Head too, I just learned new things, met things, explored areas, and tried to build the whole department, and even though it gave me stress, it motivated me, so anything education or bringing about something new motivates me". P8.

"...it has made me read a lot, at least now. Even though I know things, my level of knowledge has also increased. In academia, many things come out you have to read. You have to find out and are more informed than before". P3.

"once there is an opportunity for me to move up, I try to move up so that I will not fall behind. I hope you got that side". P7.

Some graduate students also said that to move to work in a different environment, they need higher knowledge and an additional certificate to qualify them for their targeted environment.

"...I am motivated ...because I know I have to move on in life, possibly not for my current workplace, but to see myself in another environment. Maybe I want to shift to another environment, but that environment would require me to be ready for the market. Anytime the environment brings itself, I already have the requirements, so I move to it like that. Yeah, so I'm self-motivated because I think it's not all about my current working place, but it's about me getting into the broader world and doing something more than what I'm doing now" P 17.

"Yeah, I have a plan of... I have a passion for teaching and am very good with the clinical side. So, I believe it will pave the way to my destination in the future" P 16.

Some graduate students' motivation to forge ahead is twofold: first, they are concerned about the certificate they will get at the end, and second, they are worried about their perception of life and their way of dressing.

"...there is a promising award or certificate, you know that at the end of it all, with all the stress, you are going to achieve something, so it is a way of motivation, and apart from that too, I'm begging to learn new things and to understand life in a way because there are some things that I didn't know or how I perceived it was different, I must say I have learned things that are not even about books alone even how even to dress and all that. I've learned a whole lot with my current education" P 19.

Promotion was one of the driving forces for female graduate students' desire for higher learning.

Acquiring higher degrees, in most cases, results in an upgrade or promotion.

"... when it comes to promotion, it came to a time I noticed that the juniors, thus the RGNs, were being promoted while we, the SRNs, will be there. You will be there, and the juniors will do degree courses and online masters. So, they will easily leave you behind if you are not vigilant. So, it's like how the educational system is going; if you are not vigilant, you will just be there". P17.

"...the good aspect is that now nursing training schools are gradually moving from training institutions to degree-awarding institutions, and I know that very soon they will start awarding the various institutions with degrees, and then as somebody pursuing a PhD, I know that at least I will be one of those people who will be used to starting that new program at the training colleges" P 3.

Apart from what the graduate students hoped to achieve with their certificates upon completion, they believe the programmes they pursue have impacted their lives significantly. The students recounted that the programmes have made them understand issues better and grow intellectually, socially, emotionally, and psychologically.

"...the knowledge I have had is helping me with my relationship with students and colleagues, and then it has broadened my mind to give me a better view of issues. Previously, some things would make me angry easily (laughs), but now I don't. I look at them and smile them off. So, I have grown emotionally, psychologically, and intellectually. In my family, too, it has helped me better understand my children and their challenges, even as little as they are in their schooling. Schooling is not easy (laughs), so when I have challenges with my assignment, I sympathise with my students when they also have challenges in school with their work. It has improved my relationship with other people. I have gained a lot from it". P1.

"I also see myself impacting knowledge because MPhil allows you to learn better leadership, get into politics, and understand people's views and the world in different dimensions. I care for kids, mothers, and fathers, so it is helping me in the school". P3.

“...I get the opportunity to relax to listen to people because I now believe that we have different experiences and values in life, so that is how we'll present our issues in different forms, and I am enjoying that atmosphere. So, the course has made me a better leader. I would have played this role as a leader better if I had used emotional intelligence earlier; it had a good impact on me. I realised that sometimes I get angry with how the school is moving on, my colleagues or something, but since I learned about this course... it has helped me.”. P7.

According to some graduate students, how the lecturers relate to them has also changed their mindset. They hope to treat others the same without being arrogant. They have also decided to publish whatever information they get to increase their knowledge.

“I am learning something from the lecturers; no matter their level of understanding, knowledge, or anything else, they are very nice to us. They respect us, don't see themselves above us, and treat us well. So naturally, you also learn that it's not like you have landed if you do an MPhil; no, you need to flow with people. I see people come from school and want to lord over others; we must relate well with people. I want to teach others my knowledge because my lecturer kept telling us that we can do much research and write things out so we can share. I've also had the opportunity to mix with people in my class who are very good, and I've learned a lot. The way we carry ourselves even when we came and now you can see a big difference”. P9.

Some graduate students said schooling strengthens their networks because they have met different people nationwide. They also said the lecturers' motivational words encourage them to move on to achieve something one day.

“...for my current education, I am networking with many people. When you look at our class, for instance, we have people across the entire country. So, I am networking with almost everybody in the country. And then, the faculty that is lecturing has so much information. So much networking”. P17.

“The lecturers will tell you that for all the information you are gathering, you will chop money when you finish if you are consistent and smart. So, coming to meet them to teach you and give you so much enlightenment is like you are encouraged to move on. It's a plus for me. And even the interaction with each other is a form of learning. Learning different cultures, behaviours, ontologies, and others is also a plus”. P4.

b. Improvement in practice

Apart from personal gains, the participants said they are also pursuing higher education to help improve nursing practice. The practice here is a more prominent term for nurses in the classroom and the clinical setting. Those from the educational sector think they have added knowledge to impart and learned new ways of presenting their syllabi content. However, those in the clinical setting also believe they have added knowledge to give care.

“...the kind of learning that has occurred or the things I have gotten from my lectures are significant to me. I am going to impact it on people. So, it is helping me a lot at the workplace. Sometimes, you come to the workplace, learn new things, and tell your colleagues about it, and they ask, how is this possible? Then you will say yes, that is how things are supposed to be done, and they will appreciate it like that.”

P2:

“...I am going back with new information. I am going back with new ways of doing things. Even when dealing with my project work, I know the angle. Now that I know many things like PowerPoint, I see different styles of PowerPoint I knew previously. So I can create a good PowerPoint presentation. Now, we are having lectures on Zoom. If you are doing your slides or presentations, things have changed slightly from what I knew. Now I am returning with new things I wasn't practising, even if I knew I wasn't practising, and now I will practice them”. P17.

Participants who occupy leadership positions indicated that they take bits and pieces from what they get from the lectures and relay them to their workplace platforms for their colleagues to read. They also jot things down and implement them as they deal with their followers.

“...right now, because of the knowledge I am getting, I sometimes send some of the information to my team. Even though I'm far from them and because of the course, I'm beginning to see different dimensions. So it's making me even to bring out more ideas. I always tell myself that if I had known this, things would have worked better as a leader. So, I try to jot things down, and I put those I have to share on the page for them to read, and some also call me. So, I feel happy about it, Ahaa, for my private job, and my students also enjoy me”. P7.

In the same way, those from the clinical sector think they have learned new things to improve on the old stuff being practised on the ward. Additionally, the graduate students with specialisation said most doctors they work with are general practitioners, and therefore, management of their hospitals look up to them to help with patient care.

“Some things we do at the ward are archaic or old-fashioned, so as you come, you learn new things. For example, as a pediatric nurse, many things are going on that are modern in the care of children; you can't be doing the old one, so as I said, that is the good thing about me moving forward. It encourages me to move a step further”. P4.

“... management looks up to you because you are a specialised nurse, so everything about your speciality, they know you have authority on that side or concerning that speciality, so medical officers, for them, they do general, I mean they are general practitioners, so you have the upper hand there, they do consult you, so you have to be a step ahead. Some of them are new, and they bring fresh ideas, but me, being the leader, need to be a step ahead”. P7.

“So when it comes to taking care of the babies, I have a few babies which I handle, and then I am even learning how to manage children with special needs” P11.

c. Prestige to the family

In addition to personal reasons and a quest to improve practice, some of the graduate students narrated that their families take pride in them for attaining the feat they have currently and even wish they go higher moving on to become PhD holders. Some of the participants' partners encouraged and supported them.

“I am motivated by my family. Last time, my child asked me, Mommy, when will you be called a doctor? She knows two of my friends who finished their PhDs, and they are called Drs, so it is like they are looking forward to seeing when their mom will be called a Dr. too, so that I will tell her very soon. It's like they want to see their mother get somewhere. When I hear these things, I am encouraged. Sometimes, they tell their friends that their mother is a nurse and teaches at a nursing training school”. P17.

“Truly, my husband encouraged me to return to school, and he has been very supportive. I have a good, understanding, supportive husband and mother”. P2.

One participant believed that acquiring higher education earns one respect from one's partner. Her spouse allows her to offer her opinion whenever issues are discussed.

“You know, trying to acquire a higher level of education even makes your spouse respect you a lot. My husband is proud of me because sometimes, when we go out there and share the knowledge, he will say, “Oh, my wife has something to share, and I feel it's a plus.” P14.

One factor motivating these graduate students to achieve higher education is that they want their siblings to follow in their footsteps. Some are also used as prestige symbols in their homes because they specialise in nursing.

“My other siblings are also a factor. I am not the senior-most, but I am ahead of them; they want to follow in my footsteps. When they look at me, my age, and the number of schools I have attended, they are motivated to follow in my footsteps. I haven't reached it yet; I still have more to go. And that motivates me”

, P17:

“my mom is a retired nurse, and I have a younger sister who is also a nurse offering an oncology nursing, so for me, the good thing is that at least we have other nurses in the house, and you bear the brand of a specialist Nurse. ...and in the house too, my mother will say this is my specialist nurse” P4.

A participant also indicated that having higher knowledge in nursing makes people consult you on health issues, especially friends and close family members.

“People consult me regarding issues concerning children because they know I have a higher qualification or knowledge. So, anything concerning children, for example, friends call when they are in trouble and other extended family members also call you to ask you things concerning their children's health” P11.

4. Discussion

Postgraduate students' motivation is vital for high-quality academic performance and practical learning. Though not all students exhibit the same level of motivation, resulting in differences in learning outcomes, variations in motivation are usually attributed to a diversity of factors, which include cultural, socioeconomic, and psychological issues (Kinsella et al., 2018); (Zahran, 2013). Knowing the factors impacting students' motivational drives is essential, especially in a professional educational context where difficulties with students' motivation appear to be predominant (Macdiarmid et al., 2021; Vázquez-Calatayud et al., 2021). Hence, this study explored the motivation behind female graduate nursing and midwifery students' striving to pursue higher education in nursing amidst the challenges they face as mothers, wives, employees without study leave, and breadwinners in Ghanaian universities.

Personal accomplishment, practice or work output improvement, and family prestige motivate nurses to pursue higher education. Other studies have found the motivation to pursue higher education, and it is noted from some of the studies how nurses are eager to pursue a doctor of philosophy (PhD) and master's degree programme (Razzak and Abdul., 2016).

Personal accomplishments, such as gaining more knowledge, promotion, occupying leadership positions, and getting better, new paying jobs, are what the study participants perceive as motivating them. According to them, these are what they will get from their education and, therefore, are encouraged to go to school at the postgraduate level. On the contrary, some nurses have reported in a study that their fight to acquire higher education did not earn them personal benefits but organisational gains (Doughty et al., 2021; Monday, 2018). Similarly, this study indicates that having higher education does not necessarily mean that some nurses will be promoted in the practice setting. This is primarily when the person did not get study leave before starting the study.

The nurses in this study indicated that advancing their education to the master's and PhD levels has widened their knowledge and understanding of issues, which agrees with earlier assertions of key nursing bodies. The national voice for academic nursing, together with the American Association of Colleges of Nursing (AACN), believes that education has a momentous impact on the knowledge and competencies of the individual nurse clinician, as well as all healthcare providers (Rosseter, 2019; Vázquez-Calatayud et al., 2021). It is posited also that clinicians with Bachelor of Science in Nursing degrees are well equipped to meet the demands of today's healthcare. Indeed, nurses with a first degree are prized for their leadership skills, critical thinking, health

promotion, case management, and capability to practice across settings (Rosseter, 2019). If first-degree nurses are tagged with all these accolades, then the nurses in the study who are studying at higher levels will surely do more. On the contrary, Drasiku et al. reported that practising nurses without any university degree see themselves as very knowledgeable and competent to the extent of wanting to engage in teaching university students in the clinical sector. This commonly happens in the clinical industry, where what is needed is the practical aspect, but this also calls for universities to look out for preceptors who have obtained at least a first degree (Drasiku et al., 2021).

Most countries around the globe are striving to create a highly educated nursing and midwifery workforce, including Brazil, Canada, Greece, Iceland, Portugal, Sweden, the Philippines, and Korea (Rosseter, 2019). Since these nurses are spending their time and money pursuing higher education, nurse executives, the military, federal agencies, healthcare foundations, leading nursing and midwifery organisations, and nurse advocacy groups all recognise this unique value that degree nurses have and bring to the nursing field. Consequently, scholars also entreat degree nurses to seek employers who will equally value their education level and distinct competencies (Rosseter, 2019).

A recent systematic review report indicates that nurses' perceptions of the implications of postgraduate education revealed improvements in personal knowledge and improvements in clinical outcomes, patient satisfaction, and overall healthcare service delivery. The review also suggests that advanced education in nursing should improve career opportunities for nurses and their progression in other endeavours (Abu-qamar et al., 2020). Equally, the nurses in this study also believed that higher education would open job opportunities for them and help improve the clinical outcomes of patients, teaching students, and administrative work. This finding is consistent with a study which found a significant and improved application of diagnostic explanation and reasoning in practical decision-making (Doughty et al., 2021). In a way, it has explicitly a bearing on patient outcomes; therefore, the study provided a stand that the value of higher education must be subjected to further research to inform future healthcare delivery and nursing workforce planning (Doughty et al., 2021). Similarly, Duffield et al. (2021) and Wilkinson et al. (2018) also found higher education to have a strong and positive effect on practice, highlighting the need for additional research to explore the influence of higher education on patient care and service delivery.

Family and friends influence many people's lives, including their choice of work and progression. Most choices are based on monetary gains, Prestige, or fame (Kossek et al., 2021). Jianfeng and Bing (2020) also highlight the role of power motive and social presence in social behaviour, as in the case of career choice. Similarly, Ion et al. (2022), Yu et al. (2022) and Romito (2023) argue that families influenced many students from childhood to become well-acknowledged professionals for family prestige. This finding is in tandem with what was found in this study, where participants' children and husbands urged their wives and mothers to go higher in education and acquire a doctorate title. Other studies found that parents influence their children to pursue courses they deem worthwhile, mainly when family members are engaged in medicine, nursing and other healthcare professions (Abu-qamar et al., 2020; Ilomo, 2021). On the contrary, in some settings, family influence has been rated low among nursing students because nursing is seen as a low-paying job with no prestige to the family, lacks career prospects, and parents tend to refuse their children from pursuing it (Wu et al., 2015).

In this study, some participants reported that their husbands and mothers brag about their status as nurses in their homes and take pride in them as nurse specialists, tutors, and administrators. Those who encounter difficulties in their programs get the maximum support from their families so they can forge ahead and achieve their aims. Relatedly, conflicting with what has been found, Wu et al. (2015) found that among most Swedish nursing students, there was a strong disagreement that recommendations from their families and friends had any influence on

their career choices. Additionally, parents were not supporting their wards, which were nursing students joining the nursing profession, because of concerns that nursing is a status and low-paying profession (Liaw et al., 2017).

It is reported that a family with a higher educational background may influence its generations to acquire higher education (Capsada-Munsech, 2020). Likewise, where there are nurses or healthcare professionals in the family, other family members are encouraged to be nurses or doctors for prestige and to achieve higher status. It is not surprising that one of the participants in the study said her mother, a retired nurse/midwife, boosts her daughters, who are both nurses (Sana and Al-Mahmoud, 2013).

Some participants' motivation is about getting the knowledge to help others through consultation, assisting family members, and helping the health sector grow. Indeed, several factors combine to motivate nurses to pursue higher education, which includes job security, job autonomy, monetary compensation, prestige, improvement in socioeconomic status, and family and friends' influence, just like what has been reported in the study (Wu et al., 2015).

4.1. Limitation

The study was limited by the small sample size, which limits generalizability. However, the study employed a thick and rich description of the study setting to enhance transferability. There was also a potential sampling bias due to purposive sampling, which could not fully capture diverse perspectives. A more comprehensive understanding of participants' motivation was ensured through data saturation. Again, since data collection and analysis rely heavily on the researchers' interpretation, there is a risk that personal beliefs and assumptions may influence the findings. Member checking was therefore done to ensure transparency when reporting the findings.

5. Conclusion

The findings of this qualitative study confirm the results of explorations in other disciplines that education at the postgraduate level improves individual knowledge and skills and improves patients' health outcomes. Higher educational programs for nurses to the postgraduate level can be considered an excellent approach to enhancing the knowledge and skills of nurses. Indeed, the development of higher-order skills, which higher education in nursing provides, can empower nurses to achieve higher positions where the experiences and opinions of nurses could be considered at a policy level.

CRedit authorship contribution statement

Merri Iddrisu: Methodology, Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Collins Atta Poku:** Methodology, Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Joyce B.P. Pwavra:** Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Anita O. Yawson:** Methodology, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Eva Mensah:** Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Stella Sarpomaa Oppong:** Methodology, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Millicent Aarah-Bapuah:** Data curation, Conceptualization, Writing – review & editing. **Veronica Adwoa Agyare:** Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Lydia Aziato:** Supervision, Writing – review & editing.

Ethical approval

Ethical approval was provided by the Institutional Review Board of

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Declaration of competing interest

The authors report there are no competing interests to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.nedt.2025.106580>.

Data availability

The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials.

References

- Abu, Katharine, 2023. The separateness of spouses: Conjugal resources in an Ashanti town. In: *Female and Male in West Africa*. Routledge, pp. 156–168.
- Abu-Qamar, Zaid, Vafeas, Caroline, Ewens, Beverley, Ghosh, Manonita, Sundin, Deborah, 2020. Postgraduate nurse education and the implications for nurse and patient outcomes : a systematic review. *Nurse Educ. Today* 92 (May), 104489. <https://doi.org/10.1016/j.nedt.2020.104489>.
- Ahmed, Rumana, Hyndman-Rizk, Nelia, 2020. The higher education paradox: towards improving Women's empowerment, agency development and labour force participation in Bangladesh. *Gend. Educ.* 32 (4), 447–465. <https://doi.org/10.1080/09540253.2018.1471452>.
- Barrett, Crystal, Mathews, Maria, Poitras, Marie-eve, Norful, Allison A., Martin-misener, Ruth, Tranmer, Joan, Ryan, Dana, Lukewich, Julia, 2021. International journal of nursing studies advances job titles and education requirements of registered nurses in primary care : an international document analysis. *Int. J. Nurs. Stud. Adv.* 3 (September), 100044. <https://doi.org/10.1016/j.ijnsa.2021.100044>.
- Braun, V., Clarke, V., 2012. Thematic analysis. In: Cooper, H. (Ed.), *APA Handbook of Research Methods in Psychology, Vol 2: Research Designs: Quantitative, Qualitative, Neuropsychological, and Biological*. American Psychological Association, pp. 57–71. <https://doi.org/10.1037/13620-004>.
- Cant, Robyn, Levett-jones, Tracy, 2021. Nurse education in practice umbrella review : impact of registered Nurses' continuing professional education informed by contemporary reviews of literature. *Nurse Educ. Pract.* 50 (November 2020), 102945. <https://doi.org/10.1016/j.nepr.2020.102945>.
- Capsada-Munsech, Queral, 2020. Overeducation, skills and social background: the influence of parental education on Overeducation in Spain. *Compare: J. Compar. Int. Ed.* 50 (2), 216–236. <https://doi.org/10.1080/03057925.2019.1579085>.
- Devine, Dymprna, Samonova, Elena, Bolotta, Giuseppe, Sugrue, Ciaran, Sloan, Seaneen, Symonds, Jennifer, Capistrano, Daniel, Crean, Margaret, 2023. Gendering childhood (s) and engagement with schooling in rural Sierra Leone. *Compare: J. Compar. Int. Ed.* 53 (1), 19–36. <https://doi.org/10.1080/03057925.2020.1868976>.
- Doughty, Lesley, Sinnema, Claire, Mckillop, Ann, Dixon, Robyn, 2021. Nurse education today: the impact of postgraduate education in transition to practice Programmes on new graduate Nurses' knowledge and skills : a pre- post survey design. *Nurse Educ. Today* 102 (April), 104888. <https://doi.org/10.1016/j.nedt.2021.104888>.
- Drasiku, Amos, Gross, Janet L., Jones, Casey, Nyoni, Champion N., 2021. "Clinical Teaching of University-Degree Nursing Students : Are the Nurses in Practice in Uganda Ready ?" 1–9.
- Duffield, Christine, Gardner, Glenn, Doubrovsky, Anna, Adams, Marg, 2021. Does education level influence the practice profile of advanced practice nursing? *Collegian* 28 (3), 255–260. <https://doi.org/10.1016/j.collegn.2020.08.006>.
- Guba, Egon G., Lincoln, Yvonna S., 1989. *Fourth Generation Evaluation*. SAGE.
- Guest, Greg, Namey, Emily, Chen, Mario, 2020. A simple method to assess and report thematic saturation in qualitative research. *PLoS One* 15 (5), e0232076. <https://doi.org/10.1371/journal.pone.0232076>.
- Hunter, David, McCallum, Jacqueline, Howes, Dora, 2019. Defining Exploratory-Descriptive Qualitative (EDQ) Research and Considering Its Application to Healthcare. *J. Nurs. Health Care* 4 (1). <http://dl6.globalstf.org/index.php/jnhc/article/view/1975>.
- Iloimo, Ruthina, 2021. The Role of Parental Involvement in Career Choice Decisions among Students of Higher Education Institutions in Tanzania.
- Ion, Irina Elena, Lupu, Radu, Nicolae, Elena, 2022. Academic achievement and professional aspirations: between the impacts of family, self-efficacy and school counselling. *J. Fam. Stud.* 28 (2), 587–610. <https://doi.org/10.1080/13229400.2020.1746685>.

- Jianfeng, Wang, Bing, D.a.I., 2020. The pursuit of fame at the expense of profit: the influence of power motive and social presence on prosocial behavior. *Acta Psychol. Sin.* 52 (1), 55. <https://doi.org/10.3724/SP.J.1041.2020.00055>.
- Kavanagh, Joan, Sharpnack, Patricia, 2021. "Crisis in Competency: A Defining Moment in Nursing Education." *OJIN: The Online J. Issues Nurs.* 26 (1). <https://doi.org/10.3912/ojin.vol26no01man02>.
- Kinsella, Danny, Fry, Margaret, Zecchin, Alison, 2018. Nurse education in practice motivational factors influencing nurses to undertake postgraduate hospital-based education. *Nurse Educ. Pract.* 31 (February), 54–60. <https://doi.org/10.1016/j.nepr.2018.04.011>.
- Kossek, Ellen Ernst, Perrigino, Matthew, Rock, Alyson Gounden, 2021. From ideal workers to ideal work for all: a 50-year review integrating careers and work-family research with a future research agenda. *J. Vocat. Behav.* <https://doi.org/10.1016/j.jvb.2020.103504>, 50th Anniversary Issue, 126 (April): 103504.
- Liaw, Sok Ying, Ling Ting, Wu, Chow, Yeow Leng, Lim, Siriwan, Tan, Khoon Kiat, 2017. Career choice and perceptions of nursing among healthcare students in higher educational institutions. *Nurse Educ. Today* 52 (May), 66–72. <https://doi.org/10.1016/j.nedt.2017.02.008>.
- Macdiarmid, Rachel, McClunie-Trust, Patricia, Shannon, Kay, Winnington, Rhona, Donaldson, Andrea E., Jarden, Rebecca J., Lamdin-Hunter, Rachel, Merrick, Eamon, Turner, Rosemary, Jones, Virginia, 2021a. What motivates people to start a graduate entry nursing Programme: an interpretive multi-Centred case study. *SAGE Open Nursing* 7. <https://doi.org/10.1177/23779608211011310>.
- Macdiarmid, Rachel, Turner, Rosemary, Winnington, Rhona, McClunie-Trust, Patricia, Donaldson, Andrea, Shannon, Kay, Merrick, Eamon, Jones, Virginia, Jarden, Rebecca, 2021b. What motivates people to commence a graduate entry nursing Programme: a mixed method scoping review. *BMC Nurs.* 20 (1), 1–12. <https://doi.org/10.1186/s12912-021-00564-9>.
- Mlambo, Mandlenkosi, Silén, Charlotte, McGrath, Cormac, 2021. Lifelong learning and Nurses' continuing professional development, a Metasynthesis of the literature. *BMC Nurs.* 20 (1), 62. <https://doi.org/10.1186/s12912-021-00579-2>.
- Monday, Kyle, 2018. Letter to the Editor, no. December, p. 4612. <https://doi.org/10.1016/j.mnl.2018.08.009>.
- Morton, Patricia Gonce, 2019. Trends in Higher Education and Recommendations for Nurse Educators 35, 425–428. <https://doi.org/10.1016/j.profnurs.2019.10.001>.
- Opare, Mary, Mill, Judy E., 2000. The evolution of nursing education in a Postindependence context - Ghana from 1957 to 1970. *West. J. Nurs. Res.* 22 (8), 936–944. <https://doi.org/10.1177/01939450022044890>.
- Parker, Patsy, 2015. The Historical Role of Women in Higher Education 5 (1). <https://doi.org/10.5929/2015.5.1.1>.
- Razzak, Nina Lutfi, Abdul., 2016. "Cultural Factors Impacting Student Motivation at a Health Sciences College in the Eastern Province of Saudi Arabia." *Cogent. Education* 3 (1). <https://doi.org/10.1080/2331186X.2016.1153214>.
- Romito, Marco, 2023. How working-class students choose higher education. The role of family, social networks and the institutional habitus of secondary schools. *Int. Stud. Sociol. Educ.* 32 (4), 1083–1105. <https://doi.org/10.1080/09620214.2021.2014932>.
- Rosseter, Robert, 2019. *The Impact of Education on Nursing Practice*, no. February.
- Sana, Al-Mahmoud, 2013. *The Commitment of Saudi Nursing Students to Nursing as a Profession and Career* 10 (2).
- Santainés-Borredá, Elena, Camaño-Puig, Ramón, 2021. Florence nightingale and the Spanish nursing School of Santa Isabel De Hungría (1896). *Int. J. Nurs. Knowl.* 32 (3), 199–205. <https://doi.org/10.1111/2047-3095.12313>.
- Smith, Tedra S., Holland, Aimee C., White, Tracie, Combs, Bryan, Watts, Penni, 2021. "The Journal for Nurse Practitioners By Faculty for Faculty A Distance Accessible Education Model : Teaching Skills to Nurse Practitioners." *TJNP. J. Nurse Pract.* 17 (8), 999–1003. <https://doi.org/10.1016/j.nurpra.2021.05.018>.
- Srivastava, Prachi, Hopwood, Nick, 2009. A practical iterative framework for qualitative data analysis. *Int. J. Qual. Methods* 8 (1), 76–84. <https://doi.org/10.1177/160940690900800107>.
- Uduji, Joseph I., 2020. The Impact of Corporate Social Responsibility Interventions on Female Education Development in the Rural Niger Delta Region of Nigeria 1, 45–64. <https://doi.org/10.1177/1464993420902593>.
- Vaughn, Ashley R., Taasoobshirazi, Gita, Johnson, Marcus L., 2020. Impostor phenomenon and motivation: women in higher education. *Stud. High. Educ.* 45 (4), 780–795. <https://doi.org/10.1080/03075079.2019.1568976>.
- Vázquez-Calatayud, Mónica, Errasti-Ibarrondo, Begoña, Choperena, Ana, 2021. Nurses' continuing professional development: a systematic literature review. *Nurse Educ. Pract.* 50 (December 2020). <https://doi.org/10.1016/j.nepr.2020.102963>.
- Wilkinson, J., Carryer, J., Budge, C., 2018. Impact of postgraduate education on advanced practice nurse activity – a National Survey. *Int. Nurs. Rev.* 65 (3), 417–424. <https://doi.org/10.1111/inr.12437>.
- Wu, L.T., Low, M.M.J., Tan, K.K., Lopez, V., Liaw, S.Y., 2015. Why not nursing? A systematic review of factors influencing career choice among healthcare students. *Int. Nurs. Rev.* 62 (4), 547–562. <https://doi.org/10.1111/inr.12220>.
- Yu, Shuo, Liu, Ying, Guo, Rui, 2022. 'How does my family affect me?' The family cultural capital impact on Chinese junior high school Students' academic achievement. *Think. Skills Creat.* 46 (December), 101146. <https://doi.org/10.1016/j.tsc.2022.101146>.
- Zahran, Zainab, 2013. Master's level education in Jordan: a qualitative study of key motivational factors and perceived impact on practice. *Nurse Educ. Today* 33 (9), 1051–1056. <https://doi.org/10.1016/j.nedt.2012.04.007>.