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Viewpoint

The role of fitness trainers in combating sedentary lifestyles

Ali Raza ^{a,*}, Aneeqa Mansoor ^b^a Fitness Trainer, Shapes Private Limited, Pakistan^b Health Services Academy, Pakistan

* Correspondence: arshabbir1997@gmail.com; Telephone: +923174646116



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Extract

The role of fitness trainers is crucial in reducing the burden of noncommunicable diseases (NCDs) associated with physical inactivity and sedentary lifestyles. The importance of regular physical activity in improving general health outcomes is widely acknowledged worldwide. Despite this fact, one-third of adults and four-fifths of adolescents still do not adhere to these recommendations. In Pakistan, the role of fitness trainers in disease prevention is highly relevant where NCDs such as diabetes are highly prevalent. Unfortunately, the fitness industry is one of the neglected industries of Pakistan with limited professional growth opportunities, uncertain career paths, low pay employment, and a shortage of certified fitness trainers who can barely meet the community's healthcare needs in combatting sedentary lifestyles. To maximize the impact of this industry, there is a dire need for stronger partnerships between fitness professionals and healthcare service providers, in addition to the integration of disease management and preventive health training modules into certification programs. Thus, fitness trainers equipped with the required skill sets can play a significant role in improving the public health outcomes of the general population.

Keywords

Fitness trainers; Noncommunicable diseases; Public health; Sedentary behavior

Physical activity is beneficial for health and well-being. According to the World Health Organization (WHO), 150 minutes of moderate- and 75 minutes of vigorous-intensity physical activity per week are recommended for adults, whereas 60 minutes of moderate-to-vigorous physical activity are recommended for adolescents daily [1,2]. These recommendations are crucial in addressing the global surge in noncommunicable diseases (NCDs), such as hypertension, diabetes, cardiovascular disease, and cerebrovascular strokes, associated with physical inactivity and sedentary lifestyles, which are major contributors to mortality [3,4]. A sedentary lifestyle in individuals involves waking behaviors with an energy expenditure of 1.5 metabolic equivalents (METs) or lower, typically associated with prolonged periods of sitting, reclining, or lying down [5].

Globally, more than one-third of adults and four-fifths of adolescents fail to meet the recommended levels of physical activity [6]. The physical activity profile of Pakistan is consistent with global statistics, with 85% male and 89% female adolescents and 24% male and 43% female adults reporting being physically inactive [7]. Moreover, in Pakistan, cardiovascular disease is the major contributor to 60% of all deaths due to NCDs, while the country ranks third in the world in terms of the highest age-adjusted diabetes incidence [7,8,9]. This situation emphasizes the need for public health interventions to promote exercise and an active lifestyle, which can marginalize the economic burden of NCDs on individuals as well as the healthcare system [10].

To address this issue, the fundamental need is to maintain the optimal level of physical activity to eradicate the sedentary lifestyle among the general population. Notably, the fitness industry of Pakistan has expanded over the years, with an annual growth rate of 0.69%, and is projected to capture the market volume of US\$2.07 million by 2029 [11]. This is an opportunity for fitness trainers, who can play a significant role in improving the health outcomes of people visiting fitness facilities such as gyms, wellness centers, fitness and health clubs, sports complexes, and boutique fitness studios [12,13].

Despite the potential role of fitness trainers, the fitness industry has not yet explored their full potential to address public health needs. Fitness trainers are expected to take various roles, including teachers, coaches, nutritionists, and counselors; however, many of them lack the formal training needed to effectively address clients' complex healthcare needs. The gap between the educational qualifications of fitness trainers and the demand for their services has raised serious concerns about their credibility, professionalism, and safety standards in industry [14].

The literature suggests that fitness trainers often face challenges such as limited professional growth opportunities, uncertain career paths, low pay employment, and unclear roles, all of which contribute to high turnover rates in the industry [15]. Despite several challenges, fitness trainers, which are key resources for promoting physical activity, are considered frontline workers for fighting against NCDs such as hypertension and obesity [16]. However, their contribution in the field of public health can be improved significantly by giving them recognition, providing enhanced support, arranging professional training, and defining their role in health promotion.

Collaborations between fitness trainers and healthcare providers such as doctors, physiotherapists, pharmacists, nurses, and dietitians could be a holistic approach to promote the health and wellbeing of the population [17]. For example, tailored exercise programs can be devised for individuals with specific health conditions, such as diabetes or heart disease. Similarly, the role of fitness trainers is not limited to physical health but also includes mental well-being, which is integral to overall health. Fitness trainers can also collaborate with mental health practitioners, such as psychologists, psychiatrists, and counselors, to design programs that address anxiety, depression, and stress and promote mental well-being [18]. Therefore, collaborative integration of fitness trainers into public health initiatives could increase their role in disease prevention [19].

To utilize the full potential of fitness professionals in improving public health, there is a dire need for stronger partnerships between fitness trainers and healthcare service providers, in addition to the integration of disease management and preventive health training modules into certification programs. By equipping fitness trainers with the skills to address challenges such as diabetes and obesity, they can contribute to reducing the disease burden, particularly in countries such as Pakistan [20]. Moreover, it is crucial to make substantial investments in their training and provide them with formal recognition within public health systems. Finally, collaborative efforts between fitness trainers and healthcare providers can devise a more effective approach to disease prevention and health promotion, ultimately enhancing global well-being.

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Original Article

Indigenous men's perspectives on long-acting reversible contraceptives: a qualitative study of relationship dynamics and infidelity fears

David Ditaba Mphuthi ^a, Ronald Arineitwe Kibonire ^{a,b,*}

^a College of Human Sciences, School of Social Sciences, Department of Health Studies, University of South Africa, South Africa

^b Department of Community Health, Kabale University School of Medicine, Kabale University, Uganda

* Correspondence: 12749966@mylife.unisa.ac.za; Telephone: +256782680067



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Abstract

Annually, approximately 74 million women worldwide face unintended pregnancies, which are particularly prevalent in low- and middle-income countries (LMICs), notably Africa. Effective contraception is crucial for mitigating the substantial risks to maternal and child health posed by unintended pregnancies. Long-acting reversible contraceptives (LARCs) play a pivotal role in addressing these risks by facilitating pregnancy spacing and reducing maternal mortality rates. However, challenges persist in their global adoption, particularly in regions such as Uganda, where inadequate male partner support contributes to low usage rates, thereby exacerbating the associated health risks. The objective of this study was to examine how women's use of LARCs affects relationship stability and fears of infidelity among rural Ugandan men in Nyamweru subcounty, Rubanda District, to develop strategies for increasing LARC use. This qualitative study focused on understanding the perspectives of indigenous Bakiga men in the Nyamweru subcounty, Rubanda, Uganda, regarding LARCs. Fifteen participants were purposefully selected from areas characterized by low LARC usage, high fertility rates, and elevated maternal mortality. In-depth focus group discussions and in-depth interviews with men aged 20 – 49 aimed to explore their perceptions of and beliefs about LARCs. Data saturation guided sample size determination to ensure comprehensive exploration of the perceptions. Analysis revealed prevalent misconceptions among indigenous Bakiga men regarding LARCs, including beliefs that their use makes women more attractive to other men and increases the likelihood of extramarital affairs and relationship breakups. These misconceptions reflect men's insecurities about their partners' contraceptive choices. Dispelling misconceptions and addressing insecurities surrounding LARCs among indigenous men are essential for improving the support and acceptability of LARCs by women. Tailored interventions, such as behavior change communication, proper health education, and counseling on LARCs, are crucial for fostering acceptance among men and advancing reproductive health outcomes.

Keywords

Long acting reversible contraceptive (LARCs); Rural women; Indigenous men; Qualitative research in reproductive health; Unintended pregnancies

1. Introduction

Unintended pregnancies constitute a major public health concern worldwide, affecting approximately 74 million women annually in low-resource countries, with Africa accounting for approximately one-quarter of these cases [1]. Factors contributing to this issue include insufficient support from male partners, limited access to contraception, lower levels of maternal education, and economic constraints [2]. Although not all unin-

tended pregnancies are unwanted, they can result in various health complications for both mothers and children, including illness, malnutrition, abuse, neglect, and increased risks of maternal and infant mortality [3].

Moreover, unintended pregnancies often result in high fertility rates, increased school dropout rates, and limited job opportunities, perpetuating the cycle of poverty [4]. A considerable portion of unintended pregnancies end in unsafe abortions, which are a leading cause of maternal morbidity and mortality, especially in LMICs, accounting for approximately 61% of cases [5]. These consequences can have intergenerational effects, with a significant percentage attributed to the lack of modern contraceptive use, particularly in these regions, which is estimated at 86.8% [6,7].

Estimates suggest that without modern contraceptive methods, unintended pregnancies could result in approximately 25 million unsafe abortions and approximately forty-seven thousand maternal deaths annually [8]. Shockingly, the global maternal mortality rate remains high, with a substantial number of deaths occurring in sub-Saharan Africa, including Uganda, accounting for approximately 70% of maternal deaths [9]. Moreover, complications from pregnancy and childbirth, such as severe bleeding, infections, and unsafe abortions, contribute significantly to maternal mortality rates, accounting for approximately 75% of cases [9].

1.1. The situation in Uganda

In Uganda, nearly half of pregnancies are unintended, with a significant portion occurring among teenagers, estimated at approximately 60% [10]. Unsafe abortions, often stemming from unintended pregnancies, account for a significant burden of maternal mortality, accounting for approximately 60% of this burden [11]. Districts such as Rubanda in southwestern Uganda experience alarmingly high maternal mortality ratios, emphasizing the urgent need to prevent unintended pregnancies as a crucial strategy for reducing maternal deaths, with a maternal mortality ratio of approximately 541 deaths per 100,000 live births [12]. This involves addressing the unfulfilled demand for family planning by enhancing access to modern contraceptive methods, including long acting reversible contraceptives (LARCs), such as implants, and intrauterine devices (IUDs), which are highly effective options [13].

Despite their cost effectiveness, the utilization of long acting reversible contraceptives (LARCs) remains limited. Implants constitute only 17.3% of the contraceptive methods used, whereas IUDs account for a mere 4.1% within the family planning spectrum [14]. In regions such as Rubanda district, specifically the Nyamweru subcounty, which is characterized by high maternal mortality ratios, complications from pregnancy and childbirth, including hemorrhage and hypertensive disorders, contribute significantly to mortality rates [15]. Encouraging the use of contraceptives, especially LARCs, could mitigate these complications, thereby reducing mortality ratios and total fertility rates [5]. However, despite their potential benefits, methods of contraception, such as LARCs, are underutilized compared with the national average [5]. In Rubanda, LARC uptake stands at 14%, with a rural total fertility rate of 4.8 [14,15,16].

Owing to their perceptions and beliefs, the limited acceptance of LARCs, particularly among indigenous men in the Nyamweru subcounty in Rubanda district, contributes to their low uptake [17,18,19]. This resistance mirrors trends observed globally [20,21,22].

Consequently, this study aims to understand the attitudes and beliefs of rural indigenous Ugandan men in Rubanda district, Nyamweru subcounty, regarding LARC usage, particularly with respect to how it affects relationship stability and fears of infidelity, to develop strategies for enhancing utilization.

2. Materials and methods

This qualitative study provides a comprehensive understanding of the viewpoints of rural indigenous men residing in the Nyamweru subcounty of Rubanda district regarding the utilization of LARCs by their female partners.

2.1. Study design

The study employed a constructive phenomenological qualitative data collection method, which aims to capture individuals' life experiences and the significance they attribute to those experiences [23].

2.2. Study setting

The study was conducted in Nyamweru subcounty, which is located in Rubanda district within the Kigezi region of southwestern Uganda. This selection was made because of the secluded rural environment, where the use of LARCs is limited and there are higher rates of both fertility and maternal mortality. Notably, the adoption of contraceptives, particularly more affordable LARCs, is considerably lower in Rubanda district than the national average of 21.4% [14,24].

2.3. Study population

The participants included rural indigenous men residing in the Nyamweru subcounty of Rubanda, defined as individuals born and living in the study area.

2.4. Sampling and participant selection

Purposive sampling was employed to select the participants. Ten participants engaged in focus group discussions, and five took part in in-depth individual interviews. The participants who were reluctant to take part in focus group discussions were given the option to participate in face-to-face interviews. The sample size was determined by data saturation, meaning that no new information emerged from additional participants [24,25,26].

2.5. Selection criteria

To participate in the study, men needed to meet the following criteria: they had to be aged 20 – 49 years, indigenous to Nyamweru subcounty in Rubanda District, and have lived there for at least two years. They also had to be either married or in a relationship with a woman of reproductive age. This age range was selected on the basis of data from the 2016 Uganda Demographic Health Survey, which indicated that most indigenous men in this age group are likely to be sexually active, married, or have female partners of reproductive age, making their female partners suitable candidates for LARCs. The participants were required to consent to being recorded during interviews and to be in a stable mental state.

In contrast, men who did not meet these criteria were excluded. The two-year residency requirement ensured that the participants had enough local experience to provide relevant insights into the community's views on LARCs. Furthermore, men who lacked basic knowledge about LARCs or were unable to communicate effectively in the local language were also excluded to ensure that the study gathered meaningful and informed perspectives.

2.6. Data collection method

This study employed phenomenological data collection techniques, including focus group discussions and in-depth interviews. The researcher, assisted by a trained research assistant, conducted the interviews. Research assistants were trained to ensure that ethical research guidelines were followed. Prior to the main study, pilot testing of the interview tool was performed to refine the questions and approach. The interviews followed distinct guidelines in line with ethics committee specifications but included similar questions. Both formats were utilized to accommodate participants uncomfortable with sharing views in group settings. All interviews were recorded with prior permission from the participants. The interviews were conducted in open yet isolated areas to ensure privacy and were translated into Rukiga, the local language. One session of focus group discussions involved 10 men and lasted approximately 68 minutes. It was conducted in an open yet private setting to ensure participant comfort and confidentiality. Additionally, five men participated in individual in-depth interviews and were selected to provide more detailed personal insights. Each interview lasted between 45 and 53 minutes.

2.7. Development of data collection tools

Prior to data collection, several tools were created, including open-ended interview guides for focus groups and in-depth interviews, as well as consent information sheets and informed consent forms. These tools were designed to promote participants' free expression and comprehension and were translated into Rukiga to enhance understanding. Ethical approval for these tools was obtained from the University of South Africa Ethics Committee (Registration Number: UNISA Rec-240816-052), the AIDS Support Organization (TASO) Ethics Committee in Uganda (Registration Number: TASO-2021-56), and final clearance was granted by the Uganda National Council for Science and Technology (UNCST) (Reference Number: HS2152ES).

Data collection employed qualitative methods, including focus group discussions and in-depth interviews. Focus groups provided a broad understanding of community attitudes and beliefs about long-acting reversible contraceptives (LARCs), whereas in-depth interviews offered detailed insights into individual experiences and concerns. This approach ensured a comprehensive and nuanced exploration of participants' perspectives on LARCs.

2.8. Approval for data collection

Permission to collect data was obtained from various authorities, including the Uganda National Council for Science and Technology, the President's Office, and local leaders at the district and village levels. Local leaders facilitated participant identification on the basis of the inclusion criteria, ensuring objectivity in the selection process.

2.9. Data analysis

The researcher transcribed all the interviews meticulously by carefully listening to recorded conversations in a quiet environment to maintain accuracy. Comprehensive notes on data insights were made by memoing techniques, aiding in code and theme development. The data were manually coded by the researcher, ensuring the validation of themes, concepts, and categories before labeling similar text segments [27,28,29]. Additionally, an independent researcher served as a cocoder, and together, consensus was reached on the study themes, categories, and subcategories. Rigorous methods were employed to ensure the trustworthiness of the study.

3. Results

Table 1 above summarizes the themes and subthemes regarding the perceptions and belief systems of rural indigenous Bakiga men that guide the comparative analysis described below.

Table 1. Emerging themes from focus groups and individual interviews in Nyamweru Subcounty, Rubanda District.

Theme	Category	Subcategories
Belief systems	Fears	Domestic violence – 67%
		Extramarital affair concerns – 64%
		Diminished sexual responsiveness – 57%
		Women become attractive to other men – 51%
		Perceived reduced respect for husbands – 48%
		Separation of couples – 32%

3.1. Women's attractiveness, domestic violence and couple separation

The participants in the Nyamweru subcounty, Rubanda district, expressed concerns that LARCs could lead to marital discord, mainly instances of domestic violence, particularly when women took up these methods without spousal consent. One participant highlighted this, stating:

A woman using family planning (LARCs) becomes less inclined toward sexual intimacy with her husband. When coercion is attempted, conflicts arise, often resulting in the woman leaving her husband to become a single mother.

Few of the participants noted that women who use LARCs tend to have fewer children, which can make them more desirable to other men. If disagreements arise with their husbands, these women may be more inclined to leave and form new partnerships with whom they can have more children. This perception arises from the belief that women with fewer children appear more physically attractive to other men, thus making remarriage easier. As a result, participants expressed hesitation or resistance toward their wives' use of LARCs. This sentiment seemed particularly pronounced and was possibly influenced by cultural norms regarding marriage and divorce.

Women utilizing long-acting family planning methods may opt to leave marriages with few children, as they still look nice and get married to other men (FGD K4).

3.2. Extramarital affairs concerns

The study revealed that men believed that LARC usage by their wives provided a sense of security against pregnancy from extramarital affairs, potentially leading to adultery. Some quotes from the participants are as follows:

Knowing that she will not conceive from extramarital encounters owing to long-term family planning encourages infidelity.

Another participant said that:

Women on long-acting family planning are prone to infidelity, feeling protected from pregnancy.

3.3. Perceived reduced respect for husbands

The participants in the Nyamweru subcounty, Rubanda district, indicated a decrease with respect to husbands by women using family planning, including LARCs. Some participants expressed feelings of their wives being less attentive or caring toward them when using family planning, including LARCs. One participant shared:

When my wife started using those contraceptives, it felt like she was not as interested in what I had to say anymore. It is like she had lost respect for me (FGD-R1).

Another participant echoed this sentiment, stating:

I noticed that my wife became more distant when she started using those methods. It made me feel like she did not value our relationship as much (I-K11).

3.4. Diminished sexual responsiveness

In Nyamweru subcounty, situated within Rubanda district, there is a perception among men regarding LARCs and their purported impact on libido for both genders. Concerns are raised about LARCs diminishing women's sexual desire, thereby leading to a reduction in sexual activity between spouses. Additionally, some men express experiencing a decrease in their own libido when their partners opt for LARCs. Consequently, many individuals are hesitant to endorse LARCs for their partners because of the perceived adverse effects on libido. This discrepancy suggests that the lack of understanding of LARCs among men might contribute to these apprehensions. This underscores the importance of educating both men and women about the advantages and potential drawbacks of LARCs to increase their acceptance and utilization. The representative quotes from the participants include the following:

The utilization of LARCs renders our women impotent and unresponsive during intimate moments (FGD-R1).

Another participant stated:

My friends told me that women using LARCs exhibit decreased interest in sexual intercourse, appearing disengaged and unresponsive in bed" (I-K11).

4. Discussion

This study explored the perceptions of indigenous Bakiga men in the Nyamweru subcounty, Rubanda District, regarding long-acting reversible contraceptives (LARCs) and their implications for relationship dynamics. By examining the intricate interplay between contraceptive use and factors such as women's attractiveness, domestic violence, couple separation, concerns about extramarital affairs, perceived respect for husbands, and diminished sexual responsiveness, this research highlights critical issues affecting reproductive health and marital relationships. The findings resonate with literature from various African contexts, illustrating the shared challenges and misconceptions surrounding contraceptive use. This discussion aims to contextualize these findings within the broader scope of reproductive health and relationship stability, shedding light on the unique cultural dynamics that influence attitudes toward contraceptives and their impact on familial and romantic relationships.

4.1. Women's attractiveness, domestic violence and couple separation

This finding aligns with research conducted in Ethiopia [30], which highlighted women's fears of contraceptive use leading to infertility and subsequent abandonment by husbands. However, in the current study, men expressed apprehensions regarding their wives leaving them for other partners. Similarly, research conducted in Nigeria revealed instances where men expelled women employing contraceptives from their households, resulting in marital dissolution [31]. Additionally, another study in Kenya [32] highlighted similar concerns among men, leading to separation.

The findings from the study in Nyamweru underscore the significant impact of contraceptive practices on marital relationships, drawing upon evidence from various studies conducted across different regions, including Ethiopia, Nigeria, and Kenya. These studies consistently reveal concerns regarding the consequences of contraceptive use, such as fears of infertility, abandonment, and marital dissolution, voiced by both men and women. By synthesizing this body of evidence, this study highlights the broader implications of contraceptive methods for marital dynamics, reaffirming the importance of our findings in this context.

4.2. Extramarital affairs concerns

The apprehension of adultery by men in this study echoes findings from research in Kenya by Obare et al. [33], wherein participants feared that contraceptives might provoke suspicions of infidelity. Similar concerns were raised by women, who feared that using contraceptives might lead their partners to seek extramarital affairs. Mwaisaka et al. also noted this fear in their studies regarding infidelity [29]. Our study participants harbored reservations about their wives' LARC usage to prevent adultery and family conflicts, which aligns with findings suggesting that contraceptive use could increase women's attractiveness to other men.

4.3. Perceived reduced respect for husbands

This study in Rubanda is supported by a study performed by Boozalis et al. [30], who reported similar results, suggesting that certain contraceptives could indeed affect relationship dynamics, including shifts in respect. Additionally, a study in Ethiopia [34,35] reported similar perceptions among men in other cultural contexts, indicating a broader concern about the impact of contraceptives on relationship quality. This highlighted the importance of comprehensive discussions and education about the broader effects of contraceptives on both physical health and relationship quality.

4.4. Diminished sexual responsiveness

Research indicates that certain LARCs, such as the DMPA, implants, and vaginal rings, are linked with low libido in women, whereas no such association is observed with hormonal or nonhormonal IUDs [34]. The concerns voiced by men about diminished libido align with findings from studies conducted in Sweden among Somali men, hinting at a broader cultural perception [31]. However, the scarcity of literature corroborating reduced libido in men whose partners use LARCs suggests a possible psychological belief stemming from inadequate knowledge [35]. While some studies indicate an improvement in sexual life among LARC users [35,36], conflicting evidence exists regarding the effects of LARCs on libido. Therefore, it becomes imperative to educate individuals about LARCs comprehensively, addressing misconceptions and facilitating informed decision-making while managing potential side effects.

The study revealed significant concerns among indigenous Bakiga men regarding the use of long-acting reversible contraceptives (LARCs) and their impact on marital dynamics. Men expressed fears related to women's attractiveness, believing that contraceptive use could lead to infidelity and marital separation, mirroring findings from studies conducted in Ethiopia, Nigeria, and Kenya. These anxieties reflect broader cultural perceptions that contraceptives might undermine relationship stability. Furthermore, participants voiced apprehensions about diminished respect for husbands and potential impacts on sexual responsiveness linked to certain LARC methods. Despite varying evidence on the effects of LARCs on libido, these concerns highlight a gap in knowledge and understanding among men. Overall, the findings underscore the necessity of targeted education and communication strategies to address misconceptions about LARCs, ultimately fostering better support for women's reproductive health choices within the community.

The study involved only fifteen participants, which did not adequately represent the broader population of men in Uganda, thereby limiting the generalizability of the findings. Additionally, the focus on indigenous Bakiga men in the Nyamweru subcounty restricted the applicability of the results to other ethnic groups or regions in Uganda or Africa. As a qualitative study, the findings were based on subjective perspectives and could have been influenced by individual biases, making the results difficult to quantify or replicate. Furthermore, the study primarily examined men's views on long-acting reversible contraceptives (LARCs) without considering women's experiences and opinions, which are crucial for understanding the dynamics of contraceptive use.

5. Recommendations

Actively engaging men in health education and discussions about LARCs is crucial. This engagement should involve providing comprehensive information about LARCs, including their benefits, potential side effects, and how they work. Men should be encouraged to participate in family planning decisions and discussions with their partners, promoting shared responsibility for contraceptive choices. Additionally, targeted educational campaigns specifically tailored to men can help dispel misconceptions and address concerns surrounding LARCs. By actively involving men in the conversation and providing them with accurate information, the community can work toward promoting informed decision-making and acceptance of LARCs as a viable family planning option in Rubanda District.

6. Conclusions

The study conducted in Nyamweru subcounty, Rubanda District, revealed significant concerns surrounding LARCs among men. The participants expressed apprehensions about the potential impact of LARCs on marital relationships, including decreased sexual intimacy, attractiveness to other men, and diminished respect for husbands. These findings underscore the need for targeted interventions to address misconceptions and concerns surrounding LARCs within the community. Tailored behavior change communication and comprehensive community engagement initiatives are essential to ensure informed decision-making and promote the acceptance of LARCs as safe and effective family planning options in Rubanda District.

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Original Article

Ankle sprain risk and contributing factors among women wearing high heels at work

Sana Babar ^{a,*}, Aqsa Hafeez ^a, Muhammad Omer Rana ^b, Iqra Tabassum ^a, Mubariz Ali ^c, Rohaab Asghar ^d

^a Government College University Faisalabad, Pakistan

^b Lahore Medical & Dental College, Pakistan

^c CMH Kharian Medical College, Pakistan

^d Niazi Medical & Dental College, Pakistan

* Correspondence: drsanababarpt@gmail.com



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Abstract

High heel use in professional environments is a common occupational norm for women, particularly in the hospitality, retail, and fashion industries. However, extended and repetitive use may increase the risk of ankle injuries. The objective of this exploratory study was to examine the factors associated with a history of ankle sprain among women wearing high heels at work. A total of 203 participants were recruited from selected workplaces in Lahore, Pakistan, via a nonprobability convenience sampling technique. Data were collected through a structured questionnaire assessing sociodemographic information, footwear usage patterns, pain symptoms, occupational standing duration, and ankle sprain history. Chi-square analysis revealed significant associations between ankle sprains and heel height, duration of heel wear, type of heel, workplace footwear requirements, and the presence of pain during high heel use ($p < 0.05$). Women wearing heels ≥ 10 cm and those wearing stilettos were more likely to report a history of ankle sprain. Logistic regression analysis revealed that standing more than 4 hours per day (OR = 3.803), footwear requirements at work (OR = 3.534), and pain during heel use (OR = 9.893) significantly increased the odds of experiencing an ankle sprain, whereas increasing age (OR = 0.789) and being married (OR = 0.304) were associated with lower risk ($p < 0.05$). Ankle sprains led to productivity loss in more than 75% of the participants, with the majority missing 1–5 workdays. These findings highlight the occupational health risks of high heel use, with prolonged standing, footwear mandates, and early pain symptoms identified as key predictors of injury. Implementing preventive workplace measures—such as ergonomic footwear policies, scheduled standing breaks, and employee education—may help reduce ankle injury risk among women in professions requiring high heels.

Keywords

Ankle injuries; Risk factors; Shoes; Heel; Occupational health; Women, working

1. Introduction

Ankle sprain is one of the most frequently encountered musculoskeletal injuries and typically involves a partial or complete tear of one or more ligaments of the ankle joint, most often affecting the lateral ligament complex [1]. These injuries are common in both sports and daily activities, with an estimated incidence of 1.94 per 1,000 adolescents annually [2,3]. Inadequate or delayed management of acute ankle sprains may result in chronic ankle instability and a greater likelihood of recurrent injury episodes [4]. Young adult females, especially those in their teens and twenties, have been identified as a high-risk group, a trend often attributed to the frequent use of high-heeled shoes (HHSs) within this population [5].

High-heeled footwear is widely worn by women for aesthetic and occupational reasons, with more than half of female users reporting regular use [6]. These shoes modify lower limb biomechanics by elevating the heel, causing a forward shift in the body's center of gravity and compromising postural stability [7]. Studies have demonstrated that increasing heel height results in greater plantar flexion and inversion moments during gait, which predisposes individuals to lateral ankle sprains [8]. In addition, HHSs reduce stride length and impair muscular coordination, leading to further instability while walking [9]. Prolonged usage, such as wearing high heels for at least 5 hours per day on three or more days per week, may induce neuromuscular changes and alter pressure distribution across the foot and ankle, thereby compounding the risk of injury [10,11].

While several studies have addressed the biomechanical consequences of high heel use, focused research examining specific heel-related parameters and their direct associations with ankle sprain incidence, particularly in occupational settings, is lacking. Retrospective data from the United States reported more than 123,000 high heel-related injuries between 2002 and 2012, most of which involved the foot or ankle during nonsport activities [12]. In the Pakistani context, a study reported that 54% of female respondents had experienced ankle sprains, with a significant association between BMI and ankle injury ($p = 0.014$) [13]. The same study highlighted that heel-related variables, such as height and shoe style, were relevant contributing factors. Nonetheless, workplace-related exposure to high heels—including heel height, type, and wear duration—remains relatively underexplored [14,15,16].

In professional settings characterized by formal dress codes—such as hospitality, retail, and corporate environments—women are often required to wear high heels for extended periods. Prolonged exposure to such footwear may serve as a key occupational risk factor for ankle injuries. Despite this, empirical data addressing occupational risks associated with high heel use are sparse [16,17]. A recent review emphasized the adverse effects of high heels on gait and balance and stressed the need for preventive interventions tailored to workplace settings [18].

In light of these gaps, the objectives of this study are to examine the factors associated with ankle sprains among women wearing high heels in occupational settings; to explore the relationships between heel-related characteristics such as heel height, type of heel, and duration of wear and the occurrence of ankle sprains; to assess pain-related symptoms, balance issues, and confidence during high heel use; to evaluate occupational influences such as standing duration and footwear requirements on ankle injury risk; and to identify significant predictors of ankle sprain history through binary logistic regression analysis. These findings can inform evidence-based recommendations for minimizing occupational ankle injuries among women who wear high heels.

2. Methods

2.1. Study design and duration

An exploratory study design was employed and carried out over a period of three months, from June to August 2023.

2.2. Ethics approval

Prior to data collection, ethical approval was obtained from the Ethics Review Committee (ERC) of Hussain College of Health Sciences, Lahore, Pakistan (No. HCHS/2023/ERC/31). Written informed consent was obtained from all participants, and the confidentiality of their responses was ensured throughout the study.

2.3. Sample size calculation and sampling technique

The required sample size was estimated via the OpenEpi online sample size calculator, which assumes a 95% confidence level and a 5% margin of error. The calculation was based on a previously reported prevalence of 84.4% HHS usage among working women in a study conducted in Lahore [14]. The estimated sample size was 203. A nonprobability convenience sampling technique was adopted to recruit participants who met the eligibility criteria.

2.4. Study setting and population

The survey was conducted in Lahore, Pakistan, with a particular focus on the tourism and hospitality sector as well as the fashion and retail industry, given the high concentration of female employees within these domains and the relevance of high occupational heel use within these professional environments. For the tourism and hospitality sector, three major hotels—Avari Express Hotels, Pearl Continental Hotel, and Nishat Hotel—were selected. In the fashion and retail sector, selected outlets of leading brands, including Gul Ahmed, Breakout, and Khaadi, were included for data collection.

2.5. Inclusion and exclusion criteria

Women employed in the tourism and hospitality or fashion and retail sectors were eligible for inclusion if they were between 18 and 35 years of age, had a minimum of one year of occupational experience, and regularly wore high heels for at least one hour and up to a maximum of eight hours per shift, with five to six working days per week. Participants were excluded if they had a history of ankle surgery, recent lower limb conditions affecting balance or gait, or any prior lower limb fractures that could introduce structural bias. Additionally, individuals who did not provide informed consent or who expressed an unwillingness to participate were excluded from the study.

2.6. Data collection tool and procedure

Data were collected via a structured, self-administered questionnaire that was developed on the basis of an in-depth review of the literature and by adopting relevant content from previous studies on high heel usage and musculoskeletal health among working women [19,20,21].

The first section, sociodemographic indicators, included questions on age (in years), education level (in years), marital status (single, married), occupation (retail/sales associate, customer service officer, hospitality staff, fashion industry professional, office/administrative staff, executive/managerial, other), monthly household income (in PKR), and locality (rural or urban).

The second section, footwear preferences and usage patterns, captured participants' preferred footwear type (heeled or flat), frequency of high heel use (yes, no, or occasionally), preference for wearing heels on special occasions (yes/no), awareness of potential harmful effects of high heel use, continued usage despite awareness (yes, no, sometimes), and the most frequently performed activity while wearing high heels (standing, walking, sitting). This section also explored the duration of high heel use per shift (< 3 hours to ≥ 6 hours), type of heels commonly worn (wedge, block, stiletto, platform), heel height category (3 cm, 5 cm, 7 cm, ≥ 10 cm), and confidence associated with wearing high heels (yes/no).

The third section, pain and discomfort related to high heel use, focused on pain-related experiences. It included the self-reported presence and severity of pain experienced during or after wearing high heels (none, mild, moderate, severe), specific activi-

ties that worsen pain (e.g., prolonged standing, walking on hard or uneven surfaces, lifting while walking, brisk walking, or involvement in workplace duties), frequency of morning foot pain (never, occasionally, every day), and the degree to which pain impacts activities of daily living (no impact to severely limited). It also addressed whether participants avoided long-distance walking in heels and whether they perceived imbalance during high heel use.

The fourth section, work environment and requirements, inquired about the number of working days per week, average standing duration per shift (< 2 hours to > 6 hours), and whether specific types of footwear were required for their job roles. If so, participants were asked to specify whether high heels, safety shoes, or other footwear types were mandated.

The fifth section, ankle sprain history and outcomes, assessed whether participants had a history of ankle sprain (yes/no), type of sprain (inversion/eversion), and perceived cause (e.g., walking on uneven surfaces, slipping, sudden twisting, use of stairs, workplace hazards). The section also gathered information on the recurrence of sprains, frequency of sprains while wearing high heels at work (frequently, occasionally, rarely, never), healing time (less than a week to more than 4 weeks), occurrence of sprains in the past year, whether medical treatment was sought, and number of workdays or productivity lost due to ankle sprains (no impact, 1–5 days, 6–10 days, more than 10 days).

Eligible participants were approached at their workplaces, and upon providing informed consent, the questionnaires were distributed in person during working hours to minimize workplace disruption. The participants were briefed regarding the purpose of the study as well as instructions to complete the questionnaire by the principal investigator, and all completed responses were collected anonymously with the intent of maintaining participant confidentiality.

For binary logistic regression analysis, standing duration per shift was dichotomized into two categories: less than 4 hours and 4 hours or more.

2.7. Data analysis

Data analysis was conducted using Statistical Package for Social Sciences software (SPSS version 26, SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to summarize participant characteristics, footwear use patterns, pain symptoms, and ankle sprain history. A chi-square test was applied to assess associations between heel-related and occupational factors and a history of ankle sprain. Binary logistic regression was further used to identify significant predictors of an ankle sprain history on the basis of selected demographic, footwear, and occupational variables. A *p* value of less than 0.05 was considered statistically significant.

3. Results

The participants' sociodemographic and occupational characteristics are presented in Table 1. The mean age of the participants was 25.09 years ($SD \pm 3.25$), and they had an average of 12.74 years of education ($SD \pm 3.15$). Just over half of the participants were single (52.22%), whereas 47.78% were married. Most participants were employed in retail/sales (32.51%), hospitality (21.18%), or customer service roles (16.75%). Executive/managerial roles were the least common (7.39%), and only 4.43% of participants were classified under "Other" occupations. The average monthly household income was PKR 55,004.93 ($SD \pm 12,680.58$). The majority resided in urban areas (71.92%) rather than rural areas (28.08%). Over half (54.19%) reported working six days per week, whereas the remainder worked five days. The daily standing duration varied, with 36.95% standing for 5–6 hours and 28.57% standing for more than 6 hours. Only 13.79% of the participants

stood for less than 2 hours daily. Most participants (85.22%) were required to wear specific footwear at work. Among these ($n = 173$), 71.68% wore high-heeled shoes, 17.92% wore safe shoes/boots, and 10.40% wore other types.

Table 1. Sociodemographic and occupational characteristics of the participants.

Variables		Frequency (%)
Age (in years) (Mean $\pm$ SD)		25.09 $\pm$ 3.25
Education (in years) (Mean $\pm$ SD)		12.74 $\pm$ 3.15
Marital status		106 (52.22)
		97 (47.78)
Occupation	Retail/sales associate – fashion outlet	66 (32.51)
	Customer service officer	34 (16.75)
	Hospitality staff	43 (21.18)
	Fashion industry professional	18 (8.87)
	Office/administrative staff	18 (8.87)
	Executive/managerial	15 (7.39)
	Other	9 (4.43)
Monthly household income (in PKR) (Mean $\pm$ SD)		55004.93 $\pm$ 12680.58
Locality of patients	Urban	146 (71.92)
	Rural	57 (28.08)
Number of working days per week	5 days	93 (45.81)
	6 days	110 (54.19)
Standing duration at work (per day)	Less than 2 hours	28 (13.79)
	2 – 4 hours	42 (20.69)
	5 – 6 hours	75 (36.95)
	More than 6 hours	58 (28.57)
Footwear requirement at workplace	Yes	173 (85.22)
	No	30 (14.78)
Type of job-required footwear ($n = 173$)	High-heeled shoes	124 (71.68)
	Safety shoes/boots	31 (17.92)
	Other	18 (10.40)

Table 2 shows the footwear preferences and usage patterns of the study participants. A majority of the participants (69.95%) preferred heeled footwear, whereas 30.05% preferred flatwear. Only one-third (33.50%) reported wearing high heels regularly, whereas 48.77% wore them occasionally and 17.73% did not wear them at all. High heels were commonly worn on special occasions by 84.24% of the participants. The most frequent activities performed on high heels included standing (44.33%) and walking (42.86%). The duration of high heel use varied, with 32.02% wearing them for 5–6 hours and 30.54% for 6 hours or more. Wedge heels (27.59%), block heels (25.62%), and stilettos (33.00%) were the most commonly worn types. In terms of heel height, 5 cm heels were most common (37.44%), followed by 7 cm heels (32.02%) and 10 cm or greater heels (16.26%). Most participants (67.49%) reported feeling confident in high heels. While 80.79% were aware of the harmful effects of high heel use, over half (56.65%) continued to wear them despite this awareness. Additionally, 68.97% reported avoiding long-distance walking when wearing high heels.

Table 2. Footwear preferences and usage patterns among participants.

Variables		Frequency (%)
Type of preferred footwear	Heeled footwear	142 (69.95)
	Flat footwear	61 (30.05)
Preference for wearing high heels regularly	Yes	68 (33.50)
	No	36 (17.73)

Variables		Frequency (%)
Preference for wearing high heels on special occasions	No, occasionally	99 (48.77)
		171 (84.24)
Most frequently performed activity while wearing high heels	Standing	90 (44.33)
	Walking	87 (42.86)
	Sitting	26 (12.81)
Duration of high heel use	Less than 3 hours	27 (13.30)
	3 – 4 hours	49 (24.14)
	5 – 6 hours	65 (32.02)
	6 hours or more	62 (30.54)
Type of high heels worn	Wedge heel	56 (27.59)
	Block heel	52 (25.62)
	Stiletto heel	67 (33.00)
	Platform sole heel	28 (13.79)
Heel height category	3 cm	29 (14.29)
	5 cm	76 (37.44)
	7 cm	65 (32.02)
	10 cm or more	33 (16.26)
Confidence associated with high heel use		137 (67.49)
Awareness of harmful effects of high heel use		164 (80.79)
Continued high heel use despite awareness of harm	Yes	115 (56.65)
	No	29 (14.29)
	Sometimes	59 (29.06)
Avoidance of long-distance walking in high heels		140 (68.97)

The pain symptoms and ankle sprain history of the participants are summarized in Table 3. Over 70% (71.43%) of the participants reported experiencing pain while wearing high heels. Among them, 33.99% rated the pain as moderate, 24.63% as mild, and 12.81% as severe, whereas 28.57% reported no pain. Pain was most frequently aggravated by walking on hard surfaces (20.00%), standing for long periods (18.62%), and walking on uneven surfaces (17.24%). Morning foot pain or pain when the participants got out of bed was reported occasionally by 53.69% and daily by 12.32% of the participants. Pain impacted daily activities in 71.43% of the patients—most commonly causing mild limitations (41.38%). Perceived imbalance while wearing high heels was reported by 56.16% of the participants. Ankle sprains affected 85.22% of the participants, with eversion injuries (53.18%) being slightly more common than inversion injuries (46.82%). Reported causes included walking on uneven surfaces (22.54%) and slipping in heels (20.81%). A history of recurrent ankle sprains was noted by 26.11% of the participants. While 9.36% experienced frequent sprains while working on high heels, 59.11% reported rare sprains, and 14.78% had never experienced sprains. Most ankle injuries (87.28%) healed within 4 weeks, although 10.98% required more than a month. Sprains occurred in the past year in 36.95% of cases, with an equal proportion seeking medical treatment. Ankle sprains led to productivity loss in 75.86% of the participants—most commonly, 1–5 days (40.89%), followed by more than 10 days (19.21%) and 6–10 days (15.76%).

Table 3. Pain, symptoms, and ankle sprain history among participants.

Variables		Frequency (%)
Presence of pain during high heel use		145 (71.43)
Intensity of pain during high heel use	Mild	50 (24.63)
	Moderate	69 (33.99)
	Severe	26 (12.81)
	No pain	58 (28.57)
Activities that worsen pain during high heel use (n = 145)	Standing for long periods	27 (18.62)
	Walking on hard surfaces	29 (20.00)

Variables		Frequency (%)
	Walking on uneven surfaces	25 (17.24)
	Walking briskly or in a hurry	16 (11.03)
	Lifting or carrying items while walking	9 (6.21)
	Wearing high heels for extended hours	11 (7.59)
	Transitioning from sitting to standing	18 (12.41)
	Involvement in workplace duties	3 (2.07)
	Other	7 (4.83)
Morning foot pain or pain when getting out of bed	Never	69 (33.99)
	Occasionally	109 (53.69)
	Everyday	25 (12.32)
Impact of pain on daily activities (ADLs)	Activities are not affected	58 (28.57)
	Activities are mildly limited	84 (41.38)
	Activities are moderately affected	38 (18.72)
	Activities are severely limited	23 (11.33)
Perceived imbalance while wearing high heels		114 (56.16)
History of ankle sprain		173 (85.22)
Type of ankle sprain experienced (n = 173)	Eversion	92 (53.18)
	Inversion	81 (46.82)
Reported cause of ankle sprain (n = 173)	Walking on uneven surfaces	39 (22.54)
	Slipping while wearing high heels	36 (20.81)
	Prolonged standing in high heels	29 (16.76)
	Sudden turning/twisting motion during work	29 (16.76)
	Running or brisk walking in heels	12 (6.94)
	Using stairs/escalators while wearing high heels	13 (7.51)
	Workplace hazard (e.g., wet floor, narrow space)	8 (4.52)
	Other	7 (4.05)
History of recurrent ankle sprains		53 (26.11)
Frequency of ankle sprains during high heel use at work	Frequently	19 (9.36)
	Occasionally	34 (16.75)
	Rarely	120 (59.11)
	Never	30 (14.78)
Ankle sprain healing time (n = 173)	Less than a week	3 (1.73)
	1-2 weeks	79 (45.66)
	2-4 weeks	72 (41.62)
	More than 4 weeks	19 (10.98)
Occurrence of ankle sprains in the past year		75 (36.95)
Sought medical treatment for high heel-related sprain		75 (36.95)
Productivity lost in the past year due to ankle sprains	No impact on productivity	49 (24.14)
	1 – 5 days	83 (40.89)
	6 – 10 days	32 (15.76)
	More than 10 days	39 (19.21)

Table 4 shows a statistically significant association between a history of ankle sprain and multiple heel-related and occupational factors. The participants with ankle sprains were more likely to wear heels ≥ 10 cm (17.92%) and for longer durations—34.10% wore them for 6 hours or more daily—than 10.00% of those without sprains ($p = 0.019$ and $p = 0.001$, respectively). Stilelet use was greater among those with sprains (35.84%) than among those without sprains (16.67%), whereas block heels were more common among those without sprains (46.67% vs. 21.97%; $p = 0.020$). Workplace footwear requirements were also significantly related, with 89.60% of those with sprains required to wear specific shoes compared with 60.00% without sprains ($p < 0.001$). Pain during high heel use was strongly associated—77.46% of sprain cases reported pain versus only 36.67% of nonsprain

cases ($p < 0.001$). Productivity loss due to ankle sprains also differed sharply; 89.02% of participants with a history of sprain reported productivity loss, whereas none of those in the no-sprain group reported any loss ($p < 0.001$).

Table 4. Associations between heel-related and occupational factors and ankle sprain history among participants.

Variable		History of Ankle Sprain		χ^2 Value	p Value
		Yes (n = 173)	No (n = 30)		
Heel height category	3 cm	20 (11.56)	9 (30.00)	9.991	0.019 **
	5 cm	63 (36.42)	13 (43.33)		
	7 cm	59 (34.10)	6 (20.00)		
	≥ 10 cm	31 (17.92)	2 (6.67)		
Duration of high heel use	Less than 3 hours	22 (12.72)	5 (16.67)	15.747	0.001 **
	3 - 4 hours	34 (19.65)	15 (50.00)		
	5 - 6 hours	58 (33.53)	7 (23.33)		
	6 hours or more	59 (34.10)	3 (10.00)		
Type of high heels worn	Wedge	50 (28.90)	6 (20.00)	9.882	0.020 **
	Block	38 (21.97)	14 (46.67)		
	Stiletto	62 (35.84)	5 (16.67)		
	Platform	23 (13.29)	5 (16.67)		
Footwear requirement at workplace	No	18 (10.40)	12 (40.00)	17.780	< 0.001 **
	Yes	155 (89.60)	18 (60.00)		
Presence of pain during high heel use	No	39 (22.54)	19 (63.33)	20.844	< 0.001 **
	Yes	134 (77.46)	11 (36.67)		
Productivity lost in the past year due to ankle sprains	No impact	19 (10.98)	30 (100.00)	110.636	< 0.001 **
	1–5 days	83 (47.98)	0 (0.00)		
	6–10 days	32 (18.50)	0 (0.00)		
	More than 10 days	39 (22.54)	0 (0.00)		

* Chi-square test applied; ** $p < 0.05$ considered statistically significant.

Table 5 summarizes the results of a binary logistic regression assessing predictors of ankle sprain. Increasing age was associated with significantly lower odds of ankle sprain (OR = 0.789, 95% CI: 0.676–0.921, $p = 0.003$), indicating that younger individuals had greater odds of experiencing ankle sprain. Compared with unmarried individuals, married participants had significantly lower odds of having sprained ankles (OR = 0.304, 95% CI: 0.105–0.881, $p = 0.028$). In contrast, participants who reported a workplace requirement to wear specific footwear were more than 3.5 times more likely to have a history of ankle sprain (OR = 3.534, 95% CI: 1.095–11.402; $p = 0.035$). Furthermore, the presence of pain during high heel use emerged as the strongest predictor, with nearly tenfold increased odds of ankle sprain (OR = 9.893, 95% CI: 3.445–28.408, $p < 0.001$). Similarly, participants who stood for more than 4 hours per day at work had significantly greater odds of having an ankle sprain (OR = 3.803, 95% CI: 1.336–10.821; $p = 0.012$). The model explained between 25.9% (Cox & Snell R^2) and 45.7% (Nagelkerke R^2) of the variance in ankle sprain history. Model fit was adequate, as indicated by the Hosmer–Lemeshow test ($p = 0.550$), which is greater than the conventional threshold of 0.05, suggesting no evidence of poor fit. The overall regression was statistically significant ($\chi^2(5) = 60.875$, $p < 0.001$), suggesting a reliable set of predictors for ankle sprain.

Table 5. Binary logistic regression for predictors of ankle sprain.

Variables	B	S.E.	Sig.	Exp (B)	95% CI for EXP (B)	
					Lower	Upper
Age (in years)	-0.236	0.079	0.003	0.789	0.676	0.921
Marital status (married)	-1.192	0.544	0.028	0.304	0.105	0.881
Footwear requirement at workplace (yes)	1.262	0.598	0.035	3.534	1.095	11.402

Variables	B	S.E.	Sig.	Exp (B)	95% CI for EXP (B)	
					Lower	Upper
Presence of pain during high heel use (yes)	2.292	0.538	< 0.001	9.893	3.445	28.408
Standing duration at work per day (> 4 hours)	1.336	0.534	0.012	3.803	1.336	10.821

* Exp(B) = odds ratio. ** CI = confidence interval. *** Variables with $p < 0.05$ were considered statistically significant. **** The overall model was statistically significant, $\chi^2(5) = 60.875$, $p < 0.001$. It explained 25.9% (Cox & Snell R^2) to 45.7% (Nagelkerke R^2) of the variance in ankle sprain history classification, with a -2 log likelihood of 109.176. The Hosmer and Lemeshow test indicated good model fit ($\chi^2(8) = 6.873$, $p = 0.550$).

4. Discussion

This study explored the associations of heel-related and occupational factors with self-reported history of ankle sprains among women in various workplace settings. This study revealed a high burden of ankle injuries among participants, particularly those who wore high-heeled footwear for extended durations, used stilettos, or worked in occupations requiring specific footwear. Younger age, pain during heel use, prolonged standing, and workplace footwear are significant predictors of ankle sprain. Despite substantial awareness of potential harm, many participants continued to wear high heels regularly, reporting symptoms such as pain, imbalance, and impaired daily function.

The pattern of ankle injuries identified aligns with prior research in countries such as the United Arab Emirates, Paraguay, and India, where studies have documented significant foot and ankle strain due to high-heeled footwear in occupational environments [22,23,24]. This evidence confirms that workplace conditions, combined with footwear-related choices, play a central role in musculoskeletal vulnerability. Studies have highlighted the biomechanical instability caused by heels ≥ 7 cm and prolonged standing, especially in the sales and hospitality sectors [25,26]. In our study, participants wearing heels for 6 hours or more and those experiencing pain during use were more likely to have ankle sprains, which is consistent with findings that instability, reduced proprioception, and accidental slips are major contributing mechanisms to high-heel injuries. This suggests a predictable risk pattern influenced by heel height and wear time, strengthening the causal argument for injury prevention strategies [27,28,29].

Workplace-specific shoe requirements emerged as a strong predictor of ankle sprain in our regression model. These findings support international findings from a study that emphasized the negative impact of enforced dress codes and footwear protocols on musculoskeletal health, especially among female employees [30,31]. The association between footwear mandates and ankle sprains in our study also aligns with the productivity loss outcomes reported by another study. In our sample, those with ankle sprains experienced noticeable work disruption, highlighting the occupational and economic implications of preventable injuries [32,33]. This intersection of policy, ergonomics, and health highlights the urgent need to integrate safety principles into uniform and footwear guidelines in high-demand sectors [34,35].

The strongest individual predictor of ankle sprain was pain experienced during heel use. These findings reinforce findings from studies demonstrating that pain is not only a symptom but also a warning signal of compromised mechanical alignment and reduced balance control [36,37]. Perceived imbalance, reported by more than half of the participants, further supports these biomechanical risks. Despite these symptoms, continued high-heel use is often tied to psychosocial factors such as self-confidence, fashion conformity, and perceived professionalism, particularly in formal or customer-facing roles [38]. These deeply embedded cultural and occupational expectations were consistently reported across multiple contexts, highlighting a need for behavioral interventions and awareness campaigns. Without addressing the societal pressures behind footwear choices, preventive efforts may have limited impact.

This study contributes novel insights by focusing on women in diverse occupational sectors and by employing multivariate analysis to identify predictors of ankle injury risk. However, it is limited by its exploratory design, which prevents causal inference, and by its reliance on self-reported data, which may be prone to recall bias. The absence of clinical validation or biomechanical assessment limits the objective confirmation of injuries. Nonetheless, its strength lies in addressing a relatively underexplored public health concern and identifying key modifiable factors. Future research should adopt longitudinal designs, incorporate clinical diagnostics, and examine policy interventions aimed at footwear ergonomics and occupational safety.

5. Conclusions

Our study revealed that occupational factors and footwear-related behaviors significantly increase the risk of ankle sprains among working women. High heel height, prolonged daily wear, long standing hours, and mandatory footwear requirements were key contributors. Pain during high heel use emerged as the strongest predictor, suggesting that early discomfort may serve as a warning sign. These findings emphasize the need for workplace policies and awareness strategies that encourage safer footwear choices without compromising professional standards.

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Original Article

Predictors of evidence-based pressure ulcer prevention behaviors among recently graduated nurses in tertiary care hospitals in Lahore

Rumaisa Alamgir ^a, Najma Parveen ^a, Shakeela Amir Hamza ^a, Sonia Rauf ^a, Bushra Nawaz ^a, Saeed Ur Rahman ^{b,*}^a Sheikha Fatima Institute of Nursing and Allied Health Sciences, Pakistan^b Zhengzhou University, China

* Correspondence: saeediann@gmail.com



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Abstract

Pressure ulcers (PUs) remain a critical and preventable challenge in hospital care, especially in resource-constrained settings. Despite formal training, early-career nurses often experience gaps in applying evidence-based PU prevention practices. This study identified the behavioral and contextual predictors of evidence-based PU prevention behaviors among recently graduated nurses in tertiary care hospitals in Lahore, Pakistan, by assessing their level of knowledge, attitudes, and self-efficacy, as well as the impact of clinical exposure, internship training, and perceived barriers to preventive practices. An exploratory design involving 135 BSN graduates who had completed their clinical internships within the past six months were recruited for the study using a purposive sampling method. Data were collected via a structured, self-administered questionnaire composed of validated tools, including the Pressure Ulcer Knowledge Assessment Tool 2.0, the Attitude toward Pressure Ulcer Prevention (APuP) scale, and constructs derived from the Theory of Planned Behavior framework. Descriptive statistics, Spearman correlations, and multiple linear regression were used for analysis. While participants showed moderately positive attitudes and self-efficacy, only knowledge of PU prevention emerged as a statistically significant predictor of evidence-based behavior ($p = 0.003$). Other factors, such as attitudes, perceived barriers, and clinical decision-making ability, did not significantly influence behavior. Despite high exposure to PU cases, most participants reported limited workshop participation and demonstrated low decision-making accuracy. This study highlights that factual knowledge, rather than attitudinal or perceptual factors, plays a pivotal role in shaping evidence-based PU prevention behavior among newly graduated nurses. This finding emphasizes the need for knowledge-intensive interventions and scenario-based training in early clinical practice. Further longitudinal studies are recommended to evaluate the impact of mentorship and institutional support on sustained preventive behaviors.

Keywords

Pressure ulcer; Evidence-based practice; Health knowledge, attitudes, practice; Nursing behavior; Clinical competence

1. Introduction

Pressure ulcers (PUs), also known as pressure injuries or decubitus ulcers, remain significant and preventable complications in healthcare settings globally [1]. These lesions result from sustained pressure over bony prominences, leading to ischemia, tissue necrosis, pain, and a heightened risk of systemic infection. The global prevalence of PUs in hospitalized patients ranges from 4% to 38%, and PUs are widely regarded as indicators of care quality, particularly in long-term and critical care settings [2]. In addition to

physical harm, PUs are associated with emotional distress, extended hospital stays, and increased healthcare costs [3].

In Pakistan, the prevalence of pressure ulcers has been reported to be 67%, yet prevention continues to be hindered by inadequate training, inconsistent application of preventive measures, and resource limitations across healthcare institutions [4,5]. Although most professional nurses are theoretically aware of risk factors and prevention guidelines, studies have consistently shown poor translation of knowledge into practice [5,6,7]. A study from Lahore reported that although more than two-thirds of nurses possessed average knowledge, only a small proportion effectively applied evidence-based techniques in clinical practice [8]. Among validated instruments, the Braden scale is the most widely used risk assessment tool for predicting PU development and guiding preventive strategies, and its utilization is considered essential for the early identification of at-risk patients [9].

Newly graduated nurses, despite completing their formal education and clinical internship, often encounter difficulties in confidently applying PU prevention protocols. Their ability to perform evidence-based care is influenced by factors such as limited access to updated clinical guidelines, lack of mentoring, perceived institutional barriers, and inconsistent exposure to evidence-based practices during training [10,11,12]. Unlike prelicensure students, these graduates are expected to function more independently, making their preparedness critical for patient safety outcomes.

Globally, there has been a noticeable shift in research from surface-level knowledge-attitude-practice (KAP) models to predictive frameworks that explore the psychological and contextual drivers of behavior, such as motivation, risk perception, social norms, and institutional influences, thereby providing deeper explanatory and predictive insights into why individuals adopt or resist certain practices. The theory of planned behavior (TPB), which incorporates constructs such as behavioral intention, perceived control, and self-efficacy, has been increasingly used to explain nursing actions in clinical settings [13,14,15]. Such models can more accurately identify gaps in practice and support tailored interventions.

In the local context, training programs such as the Punjab Institute of Cardiology's nursing skill workshops and periodic in-service training sessions conducted in tertiary hospitals, etc., have been shown to temporarily improve PU knowledge; however, barriers such as time constraints, workload, and inadequate institutional support still prevent consistent practices [16,17,18]. There is a need to move beyond assessing knowledge alone and to investigate behavioral, environmental, and institutional predictors that influence actual clinical behavior to design more effective and sustainable interventions.

Despite global evidence and national recognition of the issue, research in Pakistan remains limited with respect to early-career nurses, who have recently transitioned into practice. Existing studies are largely descriptive and do not use multivariate analyses to determine independent predictors of evidence-based behavior [19,20]. This highlights a gap in the understanding of not only the extent of knowledge and attitudes but also the behavioral and institutional factors influencing preventive practices among this group. Given the implications of PUs for both patient outcomes and healthcare quality indicators, addressing this gap is timely and essential. The primary objective of this study was to identify the predictors of evidence-based PU prevention behaviors among recently graduated nurses working in tertiary care hospitals. Specifically, it aims to assess their level of knowledge, attitudes, and self-efficacy, as well as the impact of clinical exposure, internship training, and perceived barriers to their preventive practices.

2. Methods

2.1. Study design and duration

This study employed an exploratory design to examine the determinants of evidence-based PU prevention behaviors. Data collection was conducted over a period of three months, from January to March 2023.

2.2. Ethics approval

Ethical approval was obtained from the Technical & Ethical Review Committee (TERC), Institutional Review and Research Advisory Board (IRRAB) of the Sheikh Zayed Medical Complex, Lahore (No. TERC/SC/Internal/2023/515). Ethical procedures were implemented in accordance with institutional research ethics approval, the National Bioethics Committee (NBC) Pakistan guidelines, and the Declaration of Helsinki. The participants were informed of the voluntary nature of the study, and informed written consent was obtained. Confidentiality and anonymity were maintained throughout data collection, storage, and reporting.

2.3. Sample size and sampling technique

The required sample size was calculated via G*Power 3.1 for a multiple linear regression model. Assuming a medium effect size ($f^2 = 0.15$), a significance level of $\alpha = 0.05$, power = 0.80, and 10 predictors, a minimum sample size of 118 was required [21]. To compensate for a 15% nonresponse rate, the final sample was adjusted to 135 participants.

The formula used was as follows:

$$N = [(8/f^2) + m + 1], \text{ where } f^2 = 0.15 \text{ and } m = 10.$$

A purposive sampling technique was used to recruit participants who met the inclusion criteria.

2.4. Study setting and population

The study was conducted at three tertiary care public hospitals in Lahore: Sheikh Zayed Hospital, Jinnah Hospital, and Services Hospital. The target population consisted of nursing graduates who had completed their Bachelor of Science in Nursing (BSN) and had successfully finished their one-year internship in accordance with the Pakistan Nursing & Midwifery Council (PNMC) guidelines within the past six months. These individuals had already been exposed to clinical care environments across multiple specialty units and had met all requirements for eligibility to sit the national licensing examination. This group was selected because of their recent and standardized exposure to patient care, PU management, and evidence-based nursing practices, thus ensuring reliable insights into postacademic behaviors.

2.5. Inclusion and exclusion criteria

The participants eligible for inclusion were male and female nursing graduates who had completed a Bachelor of Science in Nursing (BSN) degree and a one-year clinical internship at a PNMC-accredited institution within the last six months. Only those who had undergone formal rotations across key departments, such as medical, surgical, and critical care units, were considered. Informed consent and voluntary participation were prerequisites for inclusion. Individuals were excluded if they did not meet the recency requirement for internship completion or lacked comprehensive clinical exposure during their internship. Those who could not be contacted or declined participation during data

collection were also excluded. Finally, incomplete or improperly completed questionnaires were excluded from the final dataset.

2.6. Data collection tool and procedure

A structured, self-administered questionnaire consisting of 41 items was used to collect data from the participants. The instrument was developed via validated tools such as the Pressure Ulcer Knowledge Assessment Tool 2.0 (PUKAT 2.0) [22], the Attitude Toward Pressure Ulcer Prevention (APuP) scale [23], and constructs from the Theory of Planned Behavior (TPB) [24]. To ensure cultural and contextual relevance, the items were adapted for the Pakistani healthcare system and the early-career nursing workforce. Content validity was established through expert review, and internal consistency was assessed using Cronbach's alpha, which was calculated for all variables in this study.

Demographic and professional characteristics (9 items) captured respondents' age, gender, marital status, time since internship completion, monthly household income, clinical rotation exposure, attendance at a PU prevention workshop, hours of weekly patient care, and prior training or management experience related to PUs.

Knowledge of PU prevention (4 items) was used to evaluate the understanding of high-risk anatomical sites, the Braden scale components (sensory perception, moisture, activity, mobility, nutrition, and friction/shear), and basic clinical facts such as the effects of malnutrition and the optimal repositioning interval for at-risk patients.

Attitudes and perceived norms (5 items) were used to assess participants' agreement with the significance of PU prevention, its role in enhancing patient safety, peer and instructor influence, and confidence in the use of PU risk assessment tools.

Preventive practices and clinical behavior (8 items) were used to assess behaviors such as patient repositioning, documentation of skin status, use of risk assessment tools and moisture barriers, and patient education on mobility and skin health.

The multidisciplinary practice extension (3 items) further measured routine behaviors such as monitoring nutrition, using pressure-relieving devices, and interprofessional collaboration in prevention strategies.

A single clinical decision-making scenario (1 item) asked participants to choose the most appropriate response for managing an immobile elderly patient with a red, nonblanchable sacral lesion.

The perceived barriers (6 items) addressed systemic and operational obstacles, including insufficient training, lack of equipment, workload pressure, and limited interdisciplinary support.

Self-efficacy (5 items) focused on confidence in executing evidence-based PU prevention tasks, such as risk assessment, staging, independent care planning, patient education, and future preparedness.

The tool included multiple-choice, true/false, and 5-point Likert scale formats (ranging from "Strongly Disagree" to "Strongly Agree" and "Never" to "Always") tailored to each domain. The questionnaire underwent expert review by three senior nurses for content validity. A pilot test with 10 graduate nurses confirmed clarity and feasibility; these responses were excluded from the final analysis.

2.7. Study measures

The primary dependent variable, evidence-based PU prevention behavior, was computed as a composite of two domains: preventive practices and clinical behavior and multidisciplinary and clinical behavior. These two subscales were combined to reflect the breadth of clinical and collaborative PU prevention efforts, with higher scores indicating stronger adherence to recommended practices.

For interpretation, all the constructs were positively scored except for two specific cases. Perceived barriers, although positively scaled, reflect greater hindrance to prevention practices when scores are higher. Moreover, the clinical decision-making score was derived from a single case-based item and was scored as 1 for a correct response and 0 otherwise, with lower medians indicating limited clinical accuracy among participants.

2.8. Data analysis

All the data were analyzed via SPSS (version 27.00). Descriptive statistics, including means, standard deviations, medians interquartile ranges and frequencies, were used to summarize the demographic variables and core constructs related to PU prevention. The internal consistency of the multi-item scales was assessed via Cronbach's alpha. Bivariate correlations (Spearman's rho) were conducted to examine relationships between key independent variables and the composite dependent variable of evidence-based PU prevention behavior. Finally, multiple linear regression analysis was performed to identify significant predictors of evidence-based PU prevention behavior after confirming that assumptions of linearity, independence of errors, normality of residuals, homoscedasticity, and absence of multicollinearity were met; the latter was assessed via tolerance and variance inflation factor (VIF) values. Statistical significance was set at $p < 0.05$ for all analyses.

3. Results

Table 1 shows that most respondents were unmarried (77.33%) or female (87.41%), with a mean age of 25.19 ± 1.62 years. The majority had completed their internship within the last four months (39.26%) and reported an average of 45.59 ± 4.90 hours of patient care per week. Over half (56.30%) had received training on the Braden scale or a similar risk assessment tool, and a majority (84.44%) had managed patients with PUs. However, only 10.37% had attended a formal PU prevention workshop in the past year.

Table 1. Demographic and professional characteristics of the nurses (N = 135).

Variables		Frequency (%)	Mean $\pm$ S.D.
Age (in years)		-	25.185 $\pm$ 1.617
Gender	Male	17 (12.59)	-
	Female	118 (87.41)	-
Marital status	Single	99 (77.33)	-
	Married	34 (25.19)	-
	Other	2 (1.48)	-
Number of hours in patient care per week		-	45.585 $\pm$ 4.898
Time since internship completion	0–2 months	44 (32.59)	-
	3–4 months	53 (39.26)	-
	5–6 months	38 (28.14)	-
Monthly household income (in PKR)	< 30,000	31 (22.96)	-
	30,000 – 50,000	76 (56.30)	-
	>50,000	28 (20.74)	-
Training on the Braden Scale or similar PU risk tools	Yes	76 (56.30)	-
	No	59 (43.70)	-
Assessed or managed a patient with a pressure ulcer	Yes	114 (84.44)	-
	No	21 (15.56)	-
Attended PU preventive workshop in last 12 months	Yes	14 (10.37)	-
	No	121 (89.63)	-

The internal consistency for all the multi-item scales was strong, with Cronbach's alpha values ranging from 0.817-0.898. Table 2 presents descriptive statistics and internal consistency values for key constructs related to PU prevention. Nurses demonstrated a median knowledge score of 3.00 (IQR = 2.00) and reported generally positive attitudes (median = 5.80, IQR = 1.20) and self-efficacy (median = 5.40, IQR = 1.40) regarding PU prevention. Reported adherence to preventive practices (median = 4.25, IQR = 1.37) and multidisciplinary behaviors (median = 3.67, IQR = 1.33) was observed. Notably, the median score for perceived barriers (median = 5.17, IQR = 2.17) indicated that the participants reported considerable challenges with implementation. In addition, the clinical decision-making score was low (mean = 0.04 ± 0.21), suggesting limited accuracy in recognizing and responding to PU risk scenarios.

Table 2. Descriptive statistics and internal consistency of constructs related to pressure ulcer prevention among nurses.

Construct	Median (IQR)	Cronbach Value
Knowledge of pressure ulcer prevention	3.00 (2.00)	-
Attitudes toward pressure ulcer prevention	5.80 (1.20)	0.878
Self-efficacy	5.40 (1.40)	0.846
Preventive practices and clinical behavior	4.25 (1.37)	0.897
Multidisciplinary and clinical behavior	3.67 (1.33)	0.817
Perceived barriers	5.17 (2.17)	0.898

All the constructs are scored positively, where higher scores reflect a stronger presence or frequency of the measured variable. However, for perceived barriers, higher scores indicate a greater number of obstacles perceived by nurses that may impede pressure ulcer prevention.

Table 3 shows the bivariate correlations between attitudes, self-efficacy, perceived barriers, and knowledge of pressure ulcer prevention and evidence-based PU prevention behavior. Among the predictors, only knowledge of PU prevention showed a statistically significant positive correlation ($\rho = 0.266$, $p = 0.002$), indicating that greater knowledge was associated with better preventive behavior. Other variables—attitudes, self-efficacy, and perceived barriers—were not significantly correlated with the outcome.

Table 3. Bivariate correlations between predictors and evidence-based PU prevention behavior.

Independent Variables	Median (IQR)	Cronbach Value
Attitudes	-0.043	0.624
Self-efficacy	0.057	0.509
Perceived barriers	0.182	0.182
Knowledge of pressure ulcer prevention	0.266	0.002 **

* Spearman correlation (2-tailed). ** $p < 0.01$ was considered statistically significant. *** The dependent variable, evidence-based pressure ulcer prevention behavior, is a composite of preventive practices and clinical behavior and multidisciplinary and clinical behavior. **** Higher scores on perceived barriers indicate more obstacles to PU prevention.

Table 4 presents the results of a regression analysis identifying predictors of evidence-based PU prevention behavior. Among all the predictors, only knowledge of PU prevention emerged as a statistically significant predictor ($B = 0.256$, $p = 0.003$), indicating that increased knowledge was associated with better preventive practices. Other variables—including self-efficacy, attitudes and perceived norms, perceived barriers, and the clinical decision-making score—did not significantly contribute to the model. No issues of multicollinearity were detected, as indicated by acceptable tolerance and VIF values.

Table 4. Predictors of evidence-based pressure ulcer prevention behavior.

Predictor Variable	B	t	p Value	Tolerance	VIF
Self-efficacy	0.054	1.020	0.310	0.946	1.057
Attitudes and perceived Norms	-0.053	-0.989	0.325	0.940	1.063
Perceived barriers	0.070	1.465	0.145	0.980	1.020
Clinical decision-making score	0.450	1.420	0.158	0.954	1.048
Knowledge of pressure ulcer prevention	0.256	3.052	0.003 ***	0.976	1.025

* Linear regression analysis was conducted to examine the predictors of evidence-based PU prevention behavior. ** The dependent variable is a composite of preventive practices and clinical behavior and multidisciplinary and clinical behavior. *** Statistical significance was evaluated at $p < 0.05$. **** Model summary: $R = 0.328$, $R^2 = 0.108$, adjusted $R^2 = 0.073$, standard error = 0.74120, Durbin-Watson = 1.397.

4. Discussion

This study aimed to examine the predictors of evidence-based PU prevention behavior among recently graduated nurses in tertiary care hospitals. The findings highlight that while nurses demonstrated moderately positive attitudes, self-efficacy, and preventive behaviors, only knowledge of PU prevention significantly predicted their engagement in evidence-based practices. Other psychological and contextual factors, such as attitudes, perceived barriers, and clinical decision-making, showed no meaningful associations with practice behaviors. Despite high levels of reported exposure to PU cases, limited participation in structured prevention workshops and low decision-making accuracy suggest a gap between theoretical understanding and practical application.

The central role of knowledge in influencing PU prevention behavior supports prior international evidence emphasizing that clinical competence begins with a strong factual foundation. For example, studies conducted in Saudi Arabia and Europe revealed that nurses with greater PU-related knowledge were more likely to engage in regular repositioning, risk assessment, and the use of pressure-relieving devices [25,26]. Similarly, a study from Saudi Arabia identified inadequate PU knowledge as a key contributor to poor preventive adherence among nursing interns [27]. Our findings align with this pattern, suggesting that enhancing factual knowledge may be the most direct and feasible intervention to improve PU prevention behaviors among early-career nurses in Pakistan. A study from Pakistan demonstrated an inadequate level of knowledge among nurses for the assessment, classification and prevention of PUs [28]. However, another study highlighted better knowledge among nurses for PU prevention and management but mentioned a lack of human and material resources to hinder optimal healthcare delivery [29].

In this study, attitudes and perceived norms were not significantly associated with PU prevention behavior. This differs from findings in Western healthcare settings, where several studies have reported that nurses' positive attitudes and peer influence significantly predict adherence to PU prevention practices under the Theory of Planned Behavior [30,31]. The difference may be due to the transitional professional identity and role ambiguity faced by newly graduated nurses in the local healthcare system. In cultures where hierarchical and protocol-driven clinical environments are dominant, personal attitudes may be overpowered by institutional or supervisory mandates, limiting their impact on behavior.

The nonsignificant effect of perceived barriers is noteworthy, given that prior qualitative studies in LMIC settings frequently cite resource constraints, workload pressures, and lack of support as key deterrents to preventive practice [32]. It is possible that the early-career nurses in our sample either internalized these challenges as systemic norms or lacked the authority to influence change, thus decoupling perceived barriers from their reported behaviors.

Interestingly, clinical decision-making accuracy—assessed through a case-based scenario—was also not a significant predictor, even though most nurses reported high exposure to PU cases. This could indicate limitations in applying clinical reasoning and critical thinking skills to PU management, as evidenced by the low average decision-making score. Similar issues have been reported in studies, where clinical experience alone did not translate to effective bedside decisions owing to inadequate training in case-based judgment [33,34]. A study from Pakistan highlighted that the compatibility of nurses with PU management varied with level of experience, gender and working area speciality [35]. However, educational and interventional programs have proven to be effective in PU prevention and management [36].

A major strength of this study is its focus on recently graduated nurses—a critical yet often overlooked group in the PU prevention literature—offering insights into their preparedness and educational gaps. The use of composite behavioral outcomes and validated constructs grounded in behavioral theory adds conceptual strength. However, the study's design restricts causal inference, and reliance on self-reported behaviors introduces potential bias. The limited geographical scope (public tertiary hospitals in Lahore) and the use of a single-item clinical scenario to assess decision-making also constrain generalizability and depth. In addition, the study population was restricted to newly enrolled RNs with up to six months of postinternship experience, which may limit their ability to demonstrate the same confidence in applying knowledge as more experienced nurses do. Although PU prevention is included in the BSN curriculum (e.g., in pathophysiology and health assessment courses), the educational gap identified here is related to limited reinforcement through structured clinical training, simulation, and case-based practice, which are critical for translating theoretical knowledge into confident bedside applications. Future studies should explore longitudinal behavior changes and assess intervention effects through more objective clinical measures.

5. Conclusions

The study concluded that among recently graduated nurses, knowledge of PU prevention was the only significant predictor of evidence-based preventive behaviors. Attitudes, self-efficacy, perceived barriers, and clinical decision-making did not show meaningful associations with practice, highlighting a gap between theoretical preparation and practical application. These findings suggest that while early-career nurses may possess baseline awareness and positive orientations toward PU prevention, strengthening their applied knowledge through structured training remains critical. Future research should examine how knowledge and behavior evolve with clinical experience and assess the impact of targeted educational interventions.

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Original Article

Air quality, governance, and agricultural productivity: a comparative study of South Asia and Southern Europe with implications for social and public health resilience

Mirza Khawar Baig*, Waheed Anjum

Department of Economics, COMSATS University Islamabad, Lahore Campus, Pakistan

* Correspondence: mirzakhawar01@gmail.com



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Abstract

Agricultural productivity plays a vital role in ensuring food security, rural livelihoods, and environmental sustainability, particularly in regions facing ecological stress and institutional variation. This study offers a comparative analysis of South Asian and Southern European countries from 2000–2022, investigating how environmental quality, economic investment, and governance influence agricultural output. Using secondary panel data and the Driscoll–Kraay (DSK) estimator, the analysis addresses the challenges of cross-sectional dependence (CSD), heteroskedasticity, and autocorrelation. The findings show that in South Asia, gross fixed capital formation (GFCF) ($\beta = 0.577$, $p < 0.01$) and fertilizer use ($\beta = 0.113$, $p < 0.01$) are significant drivers of productivity. Crop residue burning (CRB), despite its environmental drawbacks, also has a positive association with productivity ($\beta = 0.227$, $p < 0.01$). However, stricter air quality regulations appear to constrain productivity ($\beta = -0.228$, $p < 0.01$), likely due to disruptions in conventional farming practices. Governance and surface air temperature (SAT) were not statistically significant in this region. In Southern Europe, productivity is positively linked with GFCF ($\beta = 0.362$, $p < 0.01$), fertilizer use ($\beta = 0.203$, $p < 0.10$), and SAT ($\beta = 0.238$, $p < 0.05$), suggesting a potential benefit from moderate warming. No significant effects were observed for governance, air quality performance (AQP), or crop burning, likely reflecting stronger institutions and regulatory stability. The model explains a greater proportion of the productivity variation in South Asia ($R^2 = 0.8744$) than in Southern Europe ($R^2 = 0.1456$). These results highlight the importance of region-specific strategies. South Asia requires policies that reconcile environmental regulation with agricultural output, whereas Southern Europe should prioritize climate adaptation and ecological safeguards. Aligning agricultural policy with public health, governance, and sustainability goals is essential for resilient food systems.

Keywords

Agricultural productivity; Air quality; Air pollution; Crop residual burning; South Asia; Southern Europe; Governance; Climate change adaptation

1. Introduction

Agriculture holds a vital position in the economies of South Asian nations, contributing significantly to both gross domestic product (GDP) and employment. For example, in 2020, India's agricultural sector contributed nearly 18% of its GDP and employed approximately 58% of the population [1,2]. Pakistan's sector makes up 19.2% of GDP and employs 42% of the workforce [3]. In Bangladesh, agriculture accounts for 13.35% of GDP [4]. Other countries in the region—including Nepal, Bhutan, Sri Lanka, and Afghanistan—demonstrate similar economic patterns, where agriculture remains a foundational element of national development and rural livelihood strategies. These statistics highlight

the critical role that agricultural productivity plays not only in economic growth but also in supporting food security, income stability, and public health across the South Asian region [5].

In contrast, the European Union (EU) boasts a more diversified economy, where agriculture plays a smaller role in GDP but remains vital for rural livelihoods and food security. For example, in 2020, Germany's agricultural sector contributed approximately 1.1% of its GDP, whereas France's share was 1.7%, reflecting their highly industrialized economies [6,7]. However, countries such as Spain and Italy rely more heavily on agriculture, with contributions of 2.8% and 2.1%, respectively [8]. Despite the lower percentage relative to South Asia, the absolute value of agricultural output in European countries remains significant due to advanced technologies and high productivity levels, which support food system resilience, rural employment, and dietary health across the region. Given the close ties between agricultural productivity, food security, and population health, understanding these drivers is essential for addressing not only economic performance but also equity in health and well-being.

Climate change further intensifies vulnerability in the agricultural sector. In South Asia, extreme weather events—floods, droughts, and cyclones—have devastated crops and rural communities, undermining food availability and increasing the risk of malnutrition and rural poverty [5,9]. For example, the 2010 floods in Pakistan displaced more than 20 million people and caused \$5 billion in agricultural damage [9]. Similarly, India has experienced recurring droughts and heatwaves that reduce crop yields [10]. In Europe, the 2003 heatwave caused crop losses of approximately €13 billion [11]. While European countries benefit from strong institutions and adaptive technology, these disruptions still threaten regional food security and rural economic health [12].

Governance and institutional quality are also key mediators of agricultural resilience. In South Asia, governance challenges such as corruption, weak regulatory enforcement, and limited administrative capacity hinder effective agricultural policy implementation [13,14]. These weaknesses exacerbate rural inequality and reduce access to critical services such as subsidies, extension programs, and climate adaptation tools [15]. Southern European countries, by contrast, perform better on indicators such as rule of law, government effectiveness, and regulatory quality [14], which strengthens their capacity for inclusive and sustainable agricultural development [12].

Air pollution is another critical factor with implications for both human and environmental health. In South Asia, air pollution—intensified by CRB and industrial emissions—has led to severe public health consequences, including high rates of respiratory and cardiovascular diseases [16,17]. The World Health Organization (WHO) estimates that air pollution contributed to 4.2 million premature deaths globally in 2016 [18]. While air quality is better managed in many European countries, pollution remains an ongoing concern for agricultural productivity and ecosystem health [19,20].

Although the relationships among air pollution, governance, and agricultural productivity have been studied individually, few efforts have examined how these elements interact to shape broader social outcomes. Existing research is often fragmented—focused on economic productivity or environmental impacts—while overlooking public health, rural equity, and institutional capacity as interlinked dimensions of agricultural systems. Comparative analyses between developing and developed contexts remain rare, despite the value of such insights in informing policy design. For example, countries in South Asia and Southern Europe differ widely in terms of governance quality, regulatory enforcement, and technological adoption, yet both face pressing challenges in balancing agricultural productivity with environmental sustainability and social well-being [14,21,22,23].

The justification for comparing these two regions lies in their shared exposure to climate variability, reliance on agriculture as a significant livelihood source, and the growing burden of air pollution that directly and indirectly affects agricultural productivity. South Asia represents a developing context with weaker institutional capacity but higher population pressures, while Southern Europe reflects a developed context where stronger governance and technological integration coexist with challenges of aging rural populations and environmental sustainability. This contrast allows the study to highlight how differences in socioeconomic structures shape resilience mechanisms, thereby offering broader lessons applicable across both similar and divergent contexts.

This study addresses these gaps by evaluating how air quality performance (AQP), governance quality, and technological investments influence agricultural productivity across South Asia and Southern Europe. By comparing two distinct regional contexts, the research highlights how institutional conditions mediate environmental and productivity outcomes—and how these dynamics, in turn, affect rural livelihoods and public health. The study conceptualizes agricultural productivity, measured through the gross production index (GPI), as being influenced by environmental stressors (air pollution, CRB, surface temperature), governance strength (measured by a composite index of institutional quality), and technological investment (proxied through fixed capital formation and fertilizer use). This framework enables a multidimensional investigation into how environmental regulations, institutional capacity, and resource inputs jointly shape agricultural resilience and, by extension, social and health-related outcomes in both developing and developed settings.

2. Methods

2.1. Data sources and study scope

This study uses panel data spanning the years 2000–2022, covering 16 countries divided into two regional blocs: South Asia (Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka) and Southern Europe (Austria, Belgium, France, Germany, Italy, Netherlands, Portugal, Spain, Switzerland). These regions were selected to reflect stark contrasts in governance structures, technological advancement, and environmental policies. All the data were sourced from reputable public databases, including the Food and Agriculture Organization (FAO), World Bank, Yale Environmental Performance Index (EPI), and World Bank Climate Change Knowledge Portal (WB-CCKP). The study examines agricultural productivity and its relationship with environmental, technological, and governance indicators.

Table 1. Description of variables and data sources.

Variables	Unit	Symbol	Source
Gross Production Index	Index	GPI	FAO
Air Quality Performance	Index	AQP	EPI 2000–2022
Surface Air Temperature	°C	SAT	WB-CCKP
Agriculture Gross Fixed Capital Formation	million USD	GFCF	FAO
Crops residue burning (Greenhouse gas emissions)	Kiloton (kt)	CRB	FAO
World Governance Index	Index	WGI	World Bank
Fertilizers by Nutrients	ton	FERT	FAO

Abbreviations: FAO = Food and Agriculture Organization; WB-CCKP = World Bank Climate Change Knowledge Portal; EPI = Environmental Performance Index.

2.2. Data construction and transformation

All the variables in this study were harmonized to ensure consistency across countries and years. Annual data were collected for each country and cleaned to remove inconsistencies or gaps. Where necessary, variables were adjusted or averaged (e.g., temperature) to standardize temporal comparability. The following sections explain the source and transformation of each variable used in the empirical model:

2.2.1. Gross production index (GPI)

The GPI serves as the dependent variable and captures the relative volume of agricultural output. Published by the FAO, this index is set to a base period (2014–2016 = 100) and aggregates the production volumes of various agricultural commodities, weighted by international reference prices. It offers a standardized measure of agricultural productivity across time and space [24].

2.2.2. Air quality performance (AQP)

The AQP data are derived from the Yale EPI, which consolidates 40 environmental indicators across 180 countries. AQPs specifically reflect a nation's capacity to mitigate air pollution and maintain healthy air standards. Higher scores indicate stronger air quality control efforts [25].

2.2.3. Mean surface air temperature (SAT)

The temperature data were retrieved from the World Bank's Climate Change Knowledge Portal. The monthly average temperatures from 1901–2022 were accessed, and annual means were computed for each country from 2000–2022 to reflect the climatic pressure on agricultural systems [26].

2.2.4. Gross fixed capital formation in agriculture (GFCF)

This variable, provided by the FAO, reflects the annual net investments in physical agricultural assets. It includes acquisitions of machinery, irrigation infrastructure, and on-farm improvements, minus disposals. GFCF serves as a proxy for technological modernization and long-term production capacity in agriculture [27].

2.2.5. Crop residue burning (CRB)

CRB is measured by greenhouse gas (GHG) emissions, expressed in CO₂-equivalent kilotons, resulting from the open burning of crop residues. The emissions data—covering methane and nitrous oxide—are accessed through the FAO's Emissions Totals domain and are used as indicators of unsustainable land-clearing practices [28].

2.2.6. World governance index (WGI)

Governance quality is assessed via the World Bank's six worldwide governance indicators: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption. The average of these indicators forms the WGI score, which reflects a country's institutional capacity to enforce policies and support rural development [26].

2.2.7. Fertilizers by nutrients (FERT)

Fertilizer use is measured in tons of active nutrient ingredients: nitrogen (N), phosphorus (P₂O₅), and potassium (K₂O). These data from FAOSTAT highlight the input inten-

sity used to maintain soil fertility and enhance crop yield, excluding nonnutrient fillers [29].

2.2.8. Data scaling and normalization

Each variable's data are carefully curated and transformed by reputable organizations to provide accurate and comprehensive insights into various aspects of agricultural and environmental performance. The complete dataset is initially transformed by applying the natural logarithm to the values. The data are subsequently normalized via the min-max normalization method, which is defined as:

$$X' = (X - X_{\min}) / (X_{\max} - X_{\min}) \quad (1)$$

where X is the original value, $X_{\min}$ is the minimum observed value in the dataset, $X_{\max}$ is the maximum, and X' is the normalized value. This approach ensures uniform scaling and allows for comparative modeling across diverse units and distributions.

2.3. Model specification

This study employs a panel regression model to evaluate the effects of AQP, SAT, GFCF, CRB, WGI, and FERT on agricultural productivity, measured through GPI (Equation 1). The relationship is specified as:

$$GPI_{it} = \alpha_1 AQP_{it} + \alpha_2 SAT_{it} + \alpha_3 GFCF_{it} + \alpha_4 CRB_{it} + \alpha_5 WGI_{it} + \alpha_6 FERT_{it} + \varepsilon_{it} \quad (2)$$

where i and t denote the country and year, respectively. The model is estimated separately for South Asian and Southern European countries to reflect structural and institutional heterogeneity.

2.4. Econometric diagnostic and estimation procedure

The analysis began with the computation of descriptive statistics and a correlation matrix to examine the central tendencies and relationships among the variables. Multicollinearity was assessed via the variance inflation factor (VIF), which confirmed the absence of significant multicollinearity. To evaluate the presence of cross-sectional dependence (CSD), the Friedman and Breusch–Pagan LM tests were applied, both of which confirmed the existence of CSD in the panel data [30,31].

Given the presence of CSD, second-generation panel unit root tests were used to assess the stationarity of the variables. Specifically, cross-sectionally augmented Im–Pesaran–Shin (CIPS) and covariate-augmented Dickey–Fuller (CADF) tests were conducted, confirming stationarity at appropriate levels. White's test indicated the presence of heteroskedasticity [32], whereas Wooldridge's test confirmed first-order autocorrelation [33]. The Westerlund and Edgerton cointegration test was then employed, establishing the existence of long-run relationships among the variables [33].

To determine a suitable panel estimation technique, the Hausman specification test was used [34], which supported the use of a fixed effects model. Given the findings of heteroskedasticity, autocorrelation, and CSD, the final model was estimated via both Panel-Corrected Standard Errors (PCSE) and the Driscoll–Kraay (DSK) estimator. These methods adjust standard errors for serial correlation and CSD, providing robust inference. All variables were transformed for the fixed effects model as specified in Equation (2).

3. Results

3.1. Descriptive statistics and distribution

Table 2 shows the descriptive statistics for all the variables, highlighting regional differences in agricultural productivity and input measures. Across the panel of South Asian countries, the average GPI is 88.95 ± 18.61 , which is lower than the value of 98.33 ± 6.70 observed for Southern European countries, indicating relatively lower agricultural productivity in the former region. South Asia also exhibits more variability in productivity, highlighting uneven agricultural development across countries in that region. The SAT is considerably greater in South Asia ($19.74 \pm 6.33^\circ\text{C}$) than in Southern Europe ($11.27 \pm 2.90^\circ\text{C}$), reflecting climatic differences that may affect crop performance. Investment in fixed capital is also greater in South Asia (7532.46 ± 16205.21 million USD) than in Southern Europe (5784.49 ± 4666.75 million USD), although its high variability indicates inconsistent investment patterns. The CRB is more prominent in South Asia (862.44 ± 1478.59 kt) than in Southern Europe (97.04 ± 111.72 kt), suggesting regional differences in land-clearing practices. Fertilizer use in South Asia is significantly greater and more erratic ($4149604.00 \pm 8267632.50$ tons) than that in Southern Europe ($1047062.20 \pm 1109877.70$ tons), indicating less regulated or less efficient application. Moreover, governance quality, measured by the WGI, is notably lower in South Asia (-0.65 ± 0.60) than in Southern Europe (1.27 ± 0.36), and the AQP is also poorer (44.55 ± 17.78 vs. 69.29 ± 13.72), reflecting institutional and environmental disparities.

Table 2. Descriptive statistics for South Asian and Southern European Countries (2000–2022).

Variable	Mean $\pm$ SD	Minimum–Maximum	Shapiro–Wilk	Shapiro–Francia
<i>South Asian Countries (Observations = 161)</i>				
GPI	88.95 ± 18.61	48.94–125.81	0.00001	0.00004
AQP	44.55 ± 17.78	5.70–79.45	0.00000	0.00001
WGI	-0.65 ± 0.60	-1.96–0.58	0.00430	0.00845
GFCF	7532.46 ± 16205.21	9.66–71118.81	0.00000	0.00001
CRB	862.44 ± 1478.59	1.32–4836.10	0.00046	0.00124
FERT	$4149604.00 \pm 8267632.00$	0.00–32535600.00	0.01100	0.01971
SAT	19.74 ± 6.33	9.88–27.72	0.00966	0.01668
<i>Southern European Countries (Observations = 207)</i>				
GPI	98.33 ± 6.70	81.58–127.54	0.00249	0.00561
AQP	69.29 ± 13.72	28.79–99.94	0.00038	0.00104
WGI	1.27 ± 0.36	0.48–1.87	0.00014	0.00045
GFCF	5784.49 ± 4666.75	343.43–18020.30	0.00000	0.00001
CRB	97.04 ± 111.72	3.20–374.97	0.00004	0.00015
FERT	$1047062.00 \pm 1109877.00$	65174.17–4178000.00	0.00008	0.00027
SAT	11.27 ± 2.90	5.34–16.90	0.01485	0.02287

3.2. Multicollinearity diagnostics

Table 3 presents the VIF results for both regions. All the VIF values are below the conventional threshold of 10, with mean VIFs of 1.455 and 1.472 for South Asia and Southern Europe, respectively, indicating that multicollinearity is not a concern for either panel dataset.

Table 3. Variance inflation factor analysis for explanatory variables in South Asian and Southern European country samples.

Variable	South Asian Countries		Southern European Countries	
	VIF	1/VIF	VIF	1/VIF
AQP	1.155	0.866	1.556	0.643
WGI	1.028	0.972	1.797	0.556
GFCF	2.321	0.431	1.553	0.644
CRB	1.702	0.587	1.197	0.836
FERT	1.488	0.672	1.607	0.622
SAT	1.034	0.968	1.121	0.892
Mean VIF	1.455	-	1.472	-

3.3. Panel data properties and diagnostic tests

CSD was confirmed through both the Friedman and Breusch–Pagan LM tests, indicating that countries within each region experience common shocks or spillover effects (see Supplementary Table S1). Given the presence of CSD, it was essential to apply second-generation unit root tests. The CIPS and CADF results showed that most variables are stationary at levels or first differences, confirming the validity of further panel analysis (see Supplementary Table S2).

The correlation matrix presented in Supplementary Table S3 highlights strong and statistically significant relationships among key variables. For instance, in South Asia, GPI is highly correlated with GFCF ($r = 0.878$) and CRB ($r = 0.627$), reflecting the importance of capital investment and residue burning practices. In Southern Europe, GPI shows moderate positive correlations with SAT ($r = 0.272$) and GFCF ($r = 0.258$), suggesting that temperature variation and investment also play meaningful roles in that region.

Westerlund and Edgerton cointegration tests revealed no long-run cointegration among the variables in either region (Table 4), suggesting the absence of stable long-term equilibrium relationships.

Table 4. Westerlund cointegration test results for South Asian and Southern European countries.

Variable	South Asian Countries	Southern European Countries
Gt	-1.850	-2.811
Pt	-4.043	-7.528
Ga	-4.599	-7.901
Pa	-4.002	-7.803

Furthermore, Wooldridge and White's tests detected autocorrelation and mild heteroskedasticity (Table 5), necessitating robust estimation. The Hausman specification test confirmed that fixed effects estimation was appropriate (see Supplementary Table S1), justifying the use of the Driscoll–Kraay estimator for final model estimation.

Table 5. White's heteroskedasticity and Wooldridge autocorrelation test results.

	South Asian Countries	Southern European Countries
White's test for heteroskedasticity	4.850, $p = 0.0699$	0.676, $p = 0.4349$
Wooldridge test for autocorrelation	87.490, $p < 0.0001$	41.540, $p = 0.0365$

3.4. Regression results

Table 6 reports the final regression estimates via the DSK estimator. In South Asia, three predictors significantly influence agricultural productivity (GPI). The AQP showed a significant negative association ($\beta = -0.228$, $p < 0.01$), suggesting that air quality regulations might impose short-term trade-offs on output. Conversely, GFCF ($\beta = 0.577$, $p < 0.01$) and fertilizer use ($\beta = 0.113$, $p < 0.01$) were positively associated with productivity, indicating their role in increasing output. CRB also had a positive effect ($\beta = 0.227$, $p < 0.01$), potentially due to short-term nutrient recycling benefits. However, SAT and governance (WGI) were not significant in South Asia. In Southern Europe, GFCF ($\beta = 0.362$, $p < 0.01$), fertilizer use ($\beta = 0.203$, $p < 0.10$), and SAT ($\beta = 0.238$, $p < 0.05$) were significantly and positively associated with productivity. However, AQP, WGI, and CRB were statistically insignificant in this region. The R^2 value for South Asia (0.8744) far exceeds that for Southern Europe (0.1456), implying that the model better explains agricultural productivity variation in the former.

Table 6. Driscoll–Kraay fixed effects regression results for South Asian and Southern European countries.

GPI	South Asian Countries	Southeran European Countries
AQP	-0.2280 *** (0.0614)	0.0445 (0.1040)
WGI	0.0483 (0.0367)	0.0914 (0.0655)
GFCF	0.5770 *** (0.0400)	0.3620 *** (0.1110)
CRB	0.2270 *** (0.0397)	0.0670 (0.0642)
FERT	0.1130 *** (0.0417)	0.2030 * (0.1000)
SAT	0.0459 (0.0343)	0.2380 ** (0.0872)
Constant	0.1650 ** (0.0675)	-0.1020 (0.1180)
R-Squared	0.8744	0.1456
Observations	161	207
Countries	7	9

*, ** and *** represent the 10%, 5% and 1% significance levels, respectively. The p value is shown in parentheses.

4. Discussion

This study provides new evidence on how multiple environmental, economic, and institutional factors jointly affect agricultural productivity across two distinct regions—South Asia and Southern Europe. The comparative perspective offers a nuanced understanding of how development levels, governance structures, and agroecological contexts shape agricultural outcomes. Importantly, by incorporating variables such as the AQP and governance, this research extends beyond traditional economic assessments of productivity to address broader social and public health dimensions. In particular, air pollution, often exacerbated by practices such as CRB, has direct implications for community health and respiratory outcomes, especially in densely populated agrarian regions. Similarly, institutional quality influences not only economic coordination but also the equitable delivery of agricultural support services and health-adjacent infrastructure, such as clean water access, sanitation, and disaster preparedness. By linking agricultural

productivity to these wider systems, this study highlights the importance of integrating public health resilience and social welfare into policy frameworks aimed at sustainable agricultural development.

In South Asia, the significant negative effect of the AQP on agricultural productivity highlights the short-term trade-offs involved in environmental regulation. While improvements in air quality are essential for public health, they may restrict certain agromonic practices, such as residue burning, low-cost irrigation techniques, or mechanized plowing, that contribute to short-term output. This dynamic reflects the broader tension between environmental sustainability and economic survival in agrarian economies, where farmers operate under narrow profit margins and have limited capacity to adapt to policy shocks [35,36,37]. Furthermore, the insignificant effect of the SAT in the South Asian model may reflect a saturation point beyond which additional warming no longer benefits productivity or even begins to degrade it. Several studies suggest that high base temperatures and increased heatwave frequency in South Asia already threaten staple crop yields, exacerbating food insecurity [38,39,40].

Capital formation and fertilizer use, however, remain the most robust positive drivers of productivity in South Asia. The results affirm the longstanding belief that agricultural growth in lower-income countries continues to depend heavily on input intensification, infrastructure development, and mechanization. GFCF likely captures investments in irrigation systems, machinery, and transport logistics—all of which increase land and labor productivity. Similarly, fertilizer application increases soil fertility and crop yields, although excessive or unbalanced use may carry long-term ecological risks such as nutrient runoff and soil acidification [41]. Recent studies have confirmed that precision fertilization and integrated nutrient management can balance productivity gains with environmental protection [42,43,44].

Perhaps most surprising is the significant and positive relationship between CRB and productivity in South Asia. While the practice is environmentally detrimental—emitting large amounts of particulate matter, CO₂, and other pollutants—it appears to serve as a low-cost method for field clearing and nutrient recycling, particularly among resource-constrained farmers [45]. Similarly, previous studies have reported that CRB may lead to short-term productivity gains by quickly preparing land for the next sowing cycle [46]. However, this increase comes at the cost of serious air quality degradation, contributing to respiratory health crises in rural and peri-urban areas [45,47]. Thus, the productivity benefits of CRB must be carefully weighed against its long-term environmental and public health consequences.

In contrast, the Southern European results reveal a more climate-sensitive and infrastructure-oriented story. Here, the SAT is positively associated with agricultural productivity, likely because moderate warming extends the growing season and improves crop suitability in previously cooler regions [48]. These findings are consistent with studies on Mediterranean and temperate climates, which show that a 1–2°C rise can increase yields under adequate water availability and modern farming systems [49,50]. Unlike South Asia, the effects of air quality and governance are statistically insignificant in this region, possibly because of already well-established environmental standards and institutional stability [51]. Southern Europe has long benefited from environmental regulation under EU frameworks and higher levels of farmer compliance, which may dilute the observable productivity impacts in cross-country analysis [51].

Fertilizer use and capital investment also play positive roles in Southern Europe, although the magnitude of these effects is smaller than that in South Asia [52,53]. This could reflect the law of diminishing returns, whereby European farmers already operate near optimal input levels, and additional investments yield marginal gains [54]. Moreover,

governance quality, although insignificant, has a positive coefficient—suggesting that its stabilizing effects on markets, extension services, and land rights may be more long-term in nature and less observable in short-run productivity estimates. The much lower R^2 value in the Southern Europe model also indicates that productivity is influenced by additional variables not captured in this analysis, such as labor migration, EU subsidies, or biodiversity preservation policies.

In both regions, the findings reflect a growing need to align agricultural productivity goals with climate resilience, environmental health, and social equity. The regional differences imply that one-size-fits-all solutions are unlikely to be effective. South Asian countries, in particular, face a challenging policy environment where productivity imperatives often conflict with environmental and health objectives. In this context, adaptive strategies such as precision farming, climate-smart agriculture, and institutional strengthening must take center stages to ensure sustainable development.

This study's strength lies in its comprehensive comparative design and methodological rigor, revealing how environmental, economic, and institutional factors affect agricultural productivity. However, the limited explanatory power in Southern Europe and reliance on aggregate data constrain insight into local and farmer-level dynamics. Future research should integrate microlevel or subregional data and explore the links among agricultural policy, public health outcomes, and social equity. Emphasis should also be placed on how environmental regulations and technological transitions impact vulnerable populations, especially in regions where agriculture supports livelihoods as well as community health. The incorporation of interdisciplinary perspectives from health, governance, and rural sociology could offer more holistic policy insights and strengthen adaptive capacity in diverse agricultural systems.

5. Conclusion and policy implications

This study provides compelling comparative insights into the complex dynamics shaping agricultural productivity in South Asia and Southern Europe. While capital investment and fertilizer use consistently drive productivity across both regions, environmental regulation, governance quality, and climate conditions exert region-specific effects. These findings highlight the importance of designing tailored agricultural policies that reflect the unique socioenvironmental challenges of each context. In South Asia, stringent air quality regulations, although vital for environmental health, appear to limit short-term agricultural output. Simultaneously, the widespread use of CRB, while increasing productivity, imposes serious public health and environmental costs through elevated air pollution and associated respiratory risks. This dual challenge calls for integrated policy responses that support cleaner technologies and offer transitional support for affected farmers.

The significant positive effects of capital formation and fertilizer use in South Asia reflect ongoing modernization, but the high variability in fertilizer application points to inefficient and potentially harmful practices. These inefficiencies may degrade soil health and contaminate water systems, threatening long-term productivity. Policymakers must therefore promote efficient input use through strengthened extension services, credit access, and regionally tailored guidance. In contrast, Southern Europe appears to benefit from a moderate warming trend, likely due to favorable baseline temperatures and the presence of robust infrastructure and institutional support. While fertilizer use and capital investment remain key productivity drivers in this region, they are applied more uniformly and effectively. Interestingly, governance and AQP are not statistically significant in Southern Europe, perhaps because of already well-established regulatory frameworks.

Despite this relative stability, European agricultural systems are not immune to future risks. Fertilizer intensification poses environmental threats, particularly in nitrate-sensitive zones, and ongoing climate change demands proactive adaptation measures. Investment in precision agriculture, climate-smart technologies, and continued institutional reinforcement will be critical. Ultimately, across both regions, the study highlights that agricultural development must extend beyond economic considerations to incorporate social equity and public health imperatives. Environmental degradation, air pollution, and climate variability disproportionately affect vulnerable populations, making sustainable agriculture essential for ensuring food security, human well-being, and ecological resilience in the years ahead.

Supplementary materials: The following supporting information can be accessed through the embedded links: [Supplementary Table S1](#), Model specification and cross-sectional dependence test results; [Supplementary Table S2](#), Panel unit root test results using CIPS and CADF methods; and [Supplementary Table S3](#), Correlation matrix of variables used in the study for South Asian and Southern European countries.

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Original Article

Assessing nurses' pain management competence using KASRP and organizational support in a public tertiary care hospital in Lahore

Zunaira Parveen ^{a,*}, Maryam Altaf ^a, Nimra Ruddat ^a, Rahila Mushtaq ^a, Naeema Bibi ^b

^a Sheikha Fatima Institute of Nursing and Allied Health Sciences, Pakistan

^b DHQ Hospital Timergara, Pakistan

* Correspondence: zunairamalik280@gmail.com



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Abstract

Effective pain management is a cornerstone of quality nursing care, yet knowledge gaps and systemic barriers often hinder optimal practice, particularly in low-resource settings. This study aimed to assess nurses' knowledge and attitudes regarding pain management, evaluate their self-reported pain practices, and explore the role of perceived organizational support in shaping pain management competence among nurses in a tertiary care hospital in Lahore, Pakistan. An exploratory survey was conducted with 120 registered nurses using the Knowledge and Attitudes Survey Regarding Pain (KASRP), a perceived organizational support scale, and a self-reported practice checklist. Descriptive statistics revealed that only 22.5% of the nurses reported good knowledge, whereas 45% reported moderate knowledge, and 32.5% reported poor knowledge. Perceived organizational support was moderate on average, and although self-reported practice scores were relatively high, they did not significantly correlate with knowledge levels. The Mann-Whitney U test revealed no significant differences in knowledge or practice scores by sex. Spearman correlation analysis revealed a significant positive association between organizational support and knowledge scores. Multiple linear regression identified organizational support as the only significant predictor of knowledge scores ($p = 0.003$). These findings highlight the critical role of organizational factors in fostering clinical competence and suggest the need for system-level interventions—such as regular training, managerial support, and access to protocols—to improve pain management outcomes in nursing practice.

Keywords

Pain management; Nurses; Attitude of health personnel; Clinical competence; Hospitals, public; Developing Countries; Organizational support

1. Introduction

Pain is one of the most frequent and distressing symptoms experienced by hospitalized patients, with studies reporting that up to 70–90% of patients suffer from moderate to severe pain during hospitalization [1,2]. Nurses, as the primary caregivers in clinical settings, are responsible for pain assessment, timely intervention, and continuous monitoring. However, despite their central role, research suggests that only 32% to 60% of nurses demonstrate adequate knowledge in pain management, and an even smaller proportion exhibit consistently positive attitudes toward pain relief strategies [3,4,5].

International studies have revealed that 40% of nurses fear opioid-related adverse effects such as respiratory depression or addiction, leading to reluctance in the administration of adequate doses, especially in elderly or postoperative patients [6,7]. Further-

more, over 40% of nurses reportedly underestimate patient-reported pain when objective signs (e.g., vital and facial expressions) are lacking [8,9]. In critical care and emergency settings, knowledge scores often drop even further due to workload pressure and clinical complexities, with some studies reporting only 50–76% competency in these environments [10].

In the Pakistani context, a recent cross-sectional study in Multan reported that while 67.3% of nurses had good knowledge about pain management, only 50.6% demonstrated favorable attitudes [11]. Similarly, inadequate training and a lack of formal education in pain assessment and management were among the most common barriers perceived by nurses caring for critically ill patients. [12]. Moreover, only 46.2% of nurses in a Lahore-based study reported using standardized pain assessment tools regularly in their practice [13]. These findings suggest a critical disconnect between the theoretical understanding and clinical application of pain management strategies, leading to persistent undertreatment of pain in public hospitals.

Educational interventions, especially those involving simulation or case-based training, have been shown to improve knowledge scores and significantly increase the likelihood of applying nonpharmacologic techniques or reassessing pain postintervention [14,15,16]. However, such structured programs remain limited in Pakistan's public health system, where high patient volumes, inconsistent protocols, and a lack of continuing education prevail.

While prior research has relied primarily on descriptive or knowledge, attitudes, and practices (KAP)-based approaches, this study integrates the Knowledge and Attitudes Survey Regarding Pain (KASRP) with an additional dimension of perceived organizational support to reflect the broader institutional context influencing nurses' competence. This framework enables a more comprehensive assessment of nurses' pain management competence and allows exploration of how system-level support may facilitate or hinder effective clinical practice. Therefore, this study aims to assess nurses' knowledge and attitudes toward pain management, examine their self-reported pain management behaviors, and evaluate how perceived organizational support contributes to their overall competence in a tertiary care hospital in Lahore, Pakistan.

2. Methods

2.1. Study design and duration

This was an exploratory study conducted over a period of two months, from December 2023 to February 2024.

2.2. Ethics approval

Ethical approval for this study was obtained from the Institutional Review & Research Advisory Board (IRRAB) and the Technical & Ethical Review Committee (TERC) of the National Health Research Complex and Sheikh Khalifa Bin Zayed Al-Nahyan Medical & Dental College, Lahore, Pakistan (No. TERC/SC/Internal/2023/513).

2.3. Sample size and sampling technique

A total of 120 registered nurses were recruited through convenience sampling from Mayo Hospital Lahore. The sample size was guided by Green's formula for regression analysis ($N \geq 50 + 8m$), where m represents the number of predictors in the regression model [17]. This formula is used to estimate an adequate sample size to ensure sufficient statistical power in multiple regression analyses. In this study, with up to seven predictors, the formula yields $N \geq 50 + (8 \times 7) = 106$ participants. Given that the analysis included

key predictors such as the KASRP score, perceived organizational support, self-reported practices, and relevant demographic variables, a sample of 120 participants was deemed adequate to meet the recommended threshold for robust multivariable analysis.

2.4. Study setting and population

This study was conducted at a public tertiary care hospital—Mayo Hospital Lahore—which is known for its high patient volume and wide range of clinical departments, including intensive care units (ICUs), emergency departments, medical and surgical wards, and outpatient units. The study population comprised registered nurses working in these departments who met the predefined inclusion and exclusion criteria.

2.5. Selection criteria

The participants eligible for inclusion were registered nurses working in a tertiary care hospital who were currently involved in clinical care within departments such as the ICU, emergency ward, inpatient ward, or outpatient unit and had completed at least six months of clinical experience following their internship. Nurses were excluded only if they were unavailable during the data collection period due to leave or reassignment. Participants who declined to take part, did not provide written informed consent, or submitted incomplete questionnaires were excluded from the study.

2.6. Measures and procedures

Data were collected via a structured, self-administered questionnaire developed from established instruments and tailored to the clinical context of nurses working in a public tertiary care hospital. The questionnaire was systematically divided into four thematic sections:

Section A covered demographic information, including age, sex, nursing qualifications (Diploma, Post-RN BSc, Generic BSc, or MSN and higher), years of clinical experience, current department or unit (e.g., ICU, emergency, ward, OPD), and whether the participant had received formal training in pain management.

Section B consisted of the complete 41-item KASRP, a validated tool developed by Ferrell and McCaffery [18]. This section assessed nurses' knowledge and attitudes toward pain management through 22 true/false items, 14 multiple-choice questions, and two clinical case scenarios with multiple subquestions, including pain scale ratings and dosage decisions. The KASRP has been widely used in various clinical settings and has demonstrated acceptable reliability and construct validity in international contexts [19].

Section C included five items assessing perceived organizational support for pain management. These items evaluate the availability of protocols, supervisor support, access to tools, training opportunities, and adequate time for pain assessment and reassessment. Each item was rated on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." The concept of perceived organizational support is rooted in organizational psychology and has been previously validated as a predictor of professional performance and motivation [20].

Section D captured self-reported pain management behavior via five items that asked how frequently nurses engaged in practices such as using standardized pain scales, reassessing pain after interventions, documenting pain scores, using nonpharmacologic methods, and escalating unresolved pain to physicians. These items were rated on a 5-point scale from "never" to "always" [21].

2.7. Study measures

Scoring was carried out independently for each section of the questionnaire. For the KASRP (Section B), each correct response was awarded one point, resulting in a total score ranging from 0–41. Higher scores indicate greater knowledge and more positive attitudes toward pain management. No reverse scoring was necessary. For analytical purposes, KASRP scores were treated as a continuous variable and categorized into poor (< 50% correct), moderate (50–79% correct), and good (80–100% correct) knowledge and attitude levels [22].

Perceived organizational support (Section C) was measured using five-item scores. Each item was rated on a 5-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”), and the overall score was calculated as the median, with values between 1 and 5. Scores closer to 1 indicate low support, whereas scores closer to 5 indicate high support. All the items were positively framed, so reverse coding was not needed. Similarly, the self-reported practice score (Section D) was computed as the average of the five behavior items, where higher scores indicated more consistent application of pain management practices. These three scores—KASRP, organizational support, and self-reported practice—were analyzed both individually and collectively to explore how knowledge, workplace support, and behaviors relate to overall competence. This approach allowed for a broader understanding of the factors influencing effective pain management among nurses.

2.8. Data analysis

Data analysis was carried out using IBM SPSS Statistics (version 25.0). Descriptive analyses—comprising frequency distributions, means, standard deviations, medians, and interquartile ranges—were used to summarize demographic characteristics, KASRP results, levels of perceived organizational support, and reported pain management behaviors. To examine the associations between knowledge, support, and practice variables, Spearman’s correlation coefficients were calculated. Differences in KASRP and practice scores between binary groups were assessed using Mann–Whitney U test, where appropriate. Additionally, multiple linear regression was employed to determine significant predictors of knowledge outcomes, incorporating demographic factors and organizational support as explanatory variables. A two-tailed significance threshold of $p < 0.05$ was applied for all the statistical procedures.

3. Results

Table 1 shows that the majority were female (90.0%), with a mean age of 39.5 ± 7.1 years. Most nurses held a diploma qualification (58.3%), followed by post-RN BSc (20.8%), generic BSc (13.3%), and MSN or higher degrees (7.5%). In terms of clinical experience, 39.2% of the nurses had 5–10 years of experience, 37.5% had less than 5 years, and smaller proportions had 11–20 years (18.3%) or more than 20 years (5.0%). Nurses worked across various departments: wards (43.3%), ICUs (20.8%), emergencies (20.0%), OPDs (10.8%), and other units (5.0%). Moreover, 35.8% reported having received prior training in pain management.

Table 1. Demographic characteristics of the participants (N = 120).

Variables		Frequency (%)
Age (in years), Mean $\pm$ SD		39.53 $\pm$ 7.09
Gender	Male	12 (10.00)
	Female	108 (90.00)

Variables		Frequency (%)
Nursing qualification	Diploma	70 (58.33)
	Post RN BSc	25 (83.33)
	Generic BSc	16 (13.33)
	MSN or higher	9 (7.50)
Years of experience	< 5 years	45 (37.50)
	5-10 years	47 (39.17)
	11-20 years	22 (18.33)
	> 20 years	6 (5.00)
Department/unit	ICU	25 (20.83)
	Emergency	24 (20.00)
	Ward	52 (43.33)
	OPD	13 (10.83)
	Other	6 (5.00)
Have you received training in pain management?	Yes	43 (35.83)
	No	77 (64.17)

The average KASRP score among nurses was 27.00 (IQR = 18.00). According to the standard cutoff scores, 32.5% of the nurses reported poor knowledge, 45.0% reported moderate knowledge, and only 22.5% reported good knowledge. Perceived organizational support had a median score of 3.20 (IQR = 1.60), with a Cronbach's alpha of 0.752, indicating acceptable internal consistency. The median self-reported pain management practice score was 3.60 (IQR = 1.15), with a Cronbach's alpha of 0.705, also reflecting acceptable reliability.

Table 2. Descriptive statistics of KASRP scores, perceived organizational support, and self-reported pain management practices (N = 120).

Variables	Frequency (%)	Median (IQR)	Cronbach Value
KASRP score	-	27.00 (18.00)	-
Perceived organizational support	-	3.20 (1.60)	0.752
Self-reported pain management practice	-	3.60 (1.15)	0.705
Level of pain management knowledge and attitudes	Poor	39 (32.50)	-
	Moderate	54 (45.00)	-
	Good	27 (22.50)	-

Table 3 shows that there was a statistically significant positive correlation between KASRP scores and perceived organizational support for pain management ($p = 0.007$), suggesting that greater organizational support is associated with greater knowledge and attitudes toward pain management. However, no significant correlation was found between KASRP scores and self-reported pain management practices ($p = 0.633$).

Table 3. Spearman correlation of KASRP scores with organizational support and pain management practice scores (N = 120).

Independent Variables	Spearman Correlation (ρ)	p Value
Perceived organizational support for pain management	0.246	0.007 **
Self-reported pain management practice	0.044	0.633

* Spearman correlation (2-tailed). ** $p < 0.01$ was considered statistically significant.

Table 4 shows the results of the Mann-Whitney U test comparing male and female nurses' KASRP and self-reported practice scores. While female nurses had slightly higher

median KASRP scores (median = 27.00, IQR = 17.00) than male nurses did (median = 25.00, IQR = 17.75), the difference was not statistically significant ($p = 0.324$). Similarly, no significant sex difference was observed in pain management practice scores ($p = 0.174$), although female nurses again presented higher median values (median = 3.60, IQR = 1.20) than males did (median = 3.00, SD = 0.95).

Table 4. Comparison of the KASRP and practice scores according to sex (N = 120).

Variables	Gender	N	Median (IQR)	U Statistic	p Value
KASRP score	Male	12	25.00 (17.75)	535.50	0.324
	Female	108	27.00 (17.00)		
Self-reported pain management practice	Male	12	3.00 (0.95)	493.50	0.174
	Female	108	3.60 (1.20)		

* Mann–Whitney U test was used to compare scores between male and female nurses. ** A p value < 0.05 was considered statistically significant.

Table 5 shows the results of a multiple linear regression analysis examining predictors of nurses' KASRP knowledge scores. The overall model was statistically significant, $F(5, 114) = 3.150$, $p = 0.011$, and accounted for 12.1% of the variance in knowledge scores ($R^2 = 0.121$). Among the predictors, perceived organizational support for pain management was the only statistically significant factor ($B = 2.891$, $p = 0.003$), indicating that greater perceived support is associated with greater knowledge and attitudes toward pain management. However, age, sex, nursing qualification, and years of experience were not significant predictors in this model.

Table 5. Multiple linear regression predicting KASRP knowledge scores on the basis of demographic factors and organizational support (N = 120).

Variables	Unstandardized Coefficients (B)		Standardized Coefficients	p Value
	B	Std. Error		
Age	0.138	0.180	0.109	0.443
Gender	4.081	2.679	0.136	0.130
Nursing qualification	-1.553	0.839	-0.167	0.067
Years of experience	-1.866	1.453	-0.180	0.202
Perceived organizational support for pain management	2.891	0.957	0.267	0.003 **

* Multiple linear regression was conducted to identify predictors of KASRP knowledge scores. ** $F = 3.150$; $R^2 = 0.121$, Sig = 0.011. *** $p < 0.05$ was considered statistically significant.

4. Discussion

The current study examined nurses' knowledge and attitudes toward pain management, their self-reported practices, and the role of perceived organizational support. The findings revealed moderate overall KASRP scores, with nearly one-third of nurses falling into the "poor" category. A positive association was found between organizational support and knowledge scores, whereas practice scores did not significantly correlate with knowledge. Gender differences were not statistically significant, and organizational support emerged as a significant predictor of KASRP scores in the regression model.

These results align with those of national and international studies reporting similar deficits in nurses' knowledge regarding pain. A recent study conducted across multiple hospitals in China reported that nurses scored an average of 40.3 ± 7.95 on the KASRP, with significant variation on the basis of training and department assignment [23]. In Pakistan, most nurses lack confidence in assessing and managing pain because of inadequate training and the absence of standardized pain protocols [24]. Comparable outcomes were observed among nurses in Cyprus, Saudi Arabia, and Egypt, where

knowledge gaps were attributed to outdated curricula and a lack of structured continuing education [25,26,27].

Interestingly, in the current study, years of experience and academic qualifications were not statistically significant predictors of knowledge, which contrasts with findings from Jordan and Ireland, where higher academic credentials were associated with improved pain attitudes and practices [28]. This discrepancy may reflect context-specific limitations in Pakistan's clinical environment, where experiential learning is often unstructured and mentorship is lacking. The disconnect between formal education and actual practice has also been highlighted in Palestinian study, where clinical workload, time constraints, and hierarchical medical systems reduce opportunities for reflective practice and pain reassessment [29,30].

Perceived organizational support stood out as the only significant positive predictor of KASRP knowledge scores. This finding reinforces previous research from the U.S. and Europe suggesting that institutional investment—through training, supervision, and the availability of pain tools—directly enhances pain management competence [31,32,33]. In contrast, environments with weak leadership and ambiguous protocols often experience knowledge stagnation despite staff experience. A recent cross-sectional study in Ethiopia also showed that supportive environments, including regular feedback and interprofessional collaboration, led to better adherence to pain protocols [34].

Despite relatively high self-reported adherence to practices such as reassessment and documentation, there was no meaningful correlation between these behaviors and knowledge scores. This finding supports the notion that practice may be influenced by routine compliance or external factors (e.g., policies or peer behavior) rather than a deep understanding. Such discrepancies have been observed in Lebanon and Oman, where nurses reported following pain protocols but lacked clarity about pharmacologic options or assessment tools [35,36]. This suggests a need to reinforce the conceptual underpinnings of pain care alongside procedural compliance.

This study has several notable strengths, including the application of a validated tool (KASRP), the integration of perceived organizational support as an innovative variable, and the use of regression analysis to identify significant predictors. Nonetheless, it is important to acknowledge certain limitations. Since the research was conducted within a single tertiary care facility, the results may not be widely generalizable. Additionally, reliance on self-reported practices could have led to social desirability bias, and the exploratory design limits the ability to draw causal conclusions. Future research should explore longitudinal or multicenter approaches, incorporate observational methods to validate reported practices, and assess the impact of structured educational interventions—such as simulations or case-based learning—on sustained knowledge improvement.

5. Conclusions

This study reveals persistent gaps in nurses' knowledge and attitudes toward pain management in a tertiary care setting in Pakistan. While nurses report adhering to practice standards, knowledge remains suboptimal. Notably, organizational support emerged as a key driver of improved knowledge, suggesting that systemic and institutional investments may yield significant improvements in patient pain outcomes. Interventions targeting workplace support, structured education, and leadership engagement should be prioritized.

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