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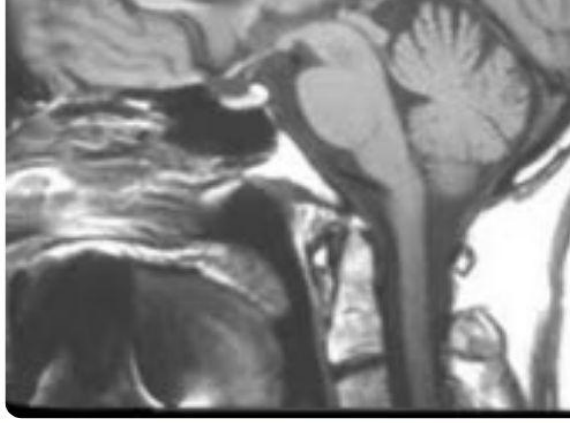

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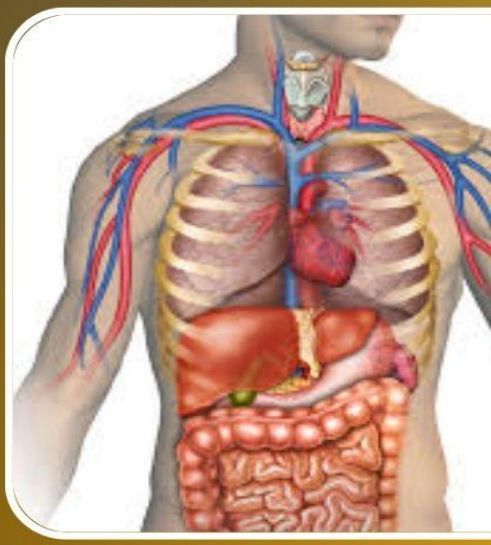

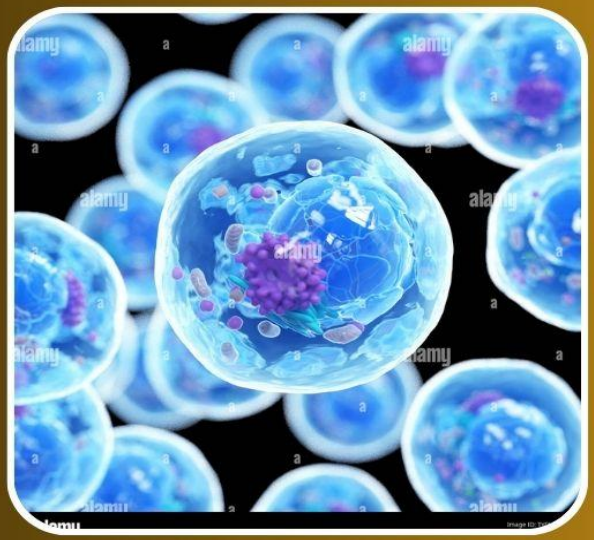

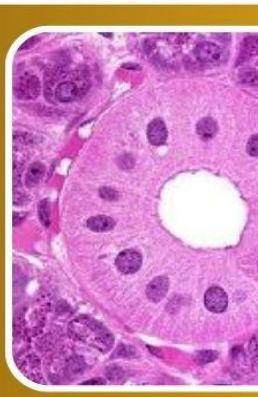

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*Editorial*

# BREAST CANCER SCREENING OR EARLY DETECTION IN LOW- AND MIDDLE-INCOME COUNTRIES: CHOOSING THE WISE FIRST STEP

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**ABSTRACT:**

Breast cancer control in low- and middle-income countries (LMICs) is frequently framed as a choice between screening and early detection. This framing is misleading: screening is not an alternative to early detection but one component of it. Drawing on the World Health Organization's Global Breast Cancer Initiative, this editorial distinguishes early diagnosis of symptomatic women from population screening of asymptomatic women, and argues that in resource-limited systems early diagnosis should be built first. The dominant clinical problem in LMICs is late presentation rather than missed subclinical disease; lower incidence, high infrastructure demands, and a contested benefit-to-harm balance further weaken the case for early mammographic screening. Detection, moreover, is of value only where a functioning diagnostic and treatment pathway exists. A pragmatic, sequenced strategy is proposed—strengthening early diagnosis and referral first, adding clinical-breast-examination-based screening thereafter, and reserving organised mammographic screening for systems able to sustain it—underpinned by investment in a national cancer registry

**Keywords: Breast cancer; Early detection; Screening; Low- and middle-income countries; Clinical breast examination; Cancer registry**

## INTRODUCTION

Screening in cancer control plays an important role in particular when it comes to breast cancer screening. However in low-middle income countries it provokes confusion at the policy table that should we invest in breast cancer screening or in early detection? It is clear that screening is not the alternative to early detection, it is one component of it. Clarifying that relationship is the first step toward a wise decision, and it changes the answer considerably.

A distinction that decides the strategy

The World Health Organization's Global Breast Cancer Initiative (GBCI) defines early detection as the overall process by which cancer is identified at earlier stages, when treatment is more effective (1). It proceeds along two routes. Early diagnosis targets symptomatic women — those who already have a palpable lump or other warning sign(s) and seeks to shorten the interval between that sign and start of definitive treatment. Screening, by contrast, actively tests asymptomatic women with no signs at all, usually by mammography, to find cancers before they become palpable. Both routes pursue the same endpoint that the GBCI has made its first pillar: at least 60% of invasive cancers diagnosed at stage I or II (1-2).

For a resource-limited health system, then, the operational question is not whether to pursue early detection, but which route to build first. On this, the evidence is reasonably consistent: early diagnosis of symptomatic women should come first, and organised mammographic screening should be deferred until the diagnostic and treatment pathway can bear the load it would generate.

Why early diagnosis comes first in our setting

The clinical reality of breast cancer in low- and middle-income countries (LMICs) is not one of early cancers slipping past imaging. It is one of catastrophically late presentation. Whereas more than 90% of women in high-income settings present with localised disease, over half of women in LMICs present at stage III or IV (3). When most patients arrive with advanced, sometimes fungating tumours, the highest-yield intervention is to move those already-symptomatic women through diagnosis and treatment faster; not to search for subclinical lesions in a largely healthy population.

The epidemiology reinforces this. Age-standardised incidence is generally lower in LMICs than in industrialised countries, so a screening programme aimed at asymptomatic women yields fewer true cases per thousand examined; the number needed to screen rises and the economics deteriorate. Mammographic screening is also

demanding in radiologists, equipment, quality assurance and call–recall infrastructure, and its benefit-to-harm balance has been most contested precisely in women under 50, the age band that contributes the majority of breast cancer cases in our region. Screening additionally imports its own harms: false positives, overdiagnosis, and the cost and anxiety of investigating benign findings.

Lower-cost alternatives exist and can downstage disease. Clinical breast examination (CBE) by a trained health worker, paired with public awareness and breast self-awareness, has been modelled as cost-effective for downstaging in comparable settings. Indeed, the influential analysis by Harford argued more than a decade ago that resources in LMICs are often better spent raising awareness and helping women with palpable lumps reach timely treatment than on population screening (4). These interventions sit among the WHO's costed non-communicable disease "best buys," with early-stage diagnosis linked to timely work-up and treatment delivering healthy life-years at a very cost-effective rate.

Detection without a pathway is not a kindness

One condition must accompany any early-detection effort, and it is where programmes most often fail. Finding a lump earlier helps only if the woman can then obtain a biopsy, a pathology report with receptor testing, and complete treatment. Detection without a functioning diagnostic and treatment setup is not only wasteful but it is ethically untenable, generating anxiety and cost without altering outcomes(5).

This is why the GBCI's remaining pillars are inseparable from the first: timely diagnosis within 60 days of presentation, and completion of full treatment in at least 80% of patients (1). The linkage is borne out in mortality data. No country has achieved a sustained annual decline in breast cancer mortality of 2% or more without also reaching a level of early detection at which 60% of patients present with stage I or II disease, and early stage converts to survival only when treatment follows: in the African ABC-DO cohort, mortality was lowest among women who achieved both early-stage diagnosis and complete treatment (6).

The wise decision, stated plainly

The prudent choice for Pakistan and comparable systems is a sequence, not a single either/or selection. Firstly, invest in early diagnosis of symptomatic women: public awareness so a woman recognises a lump and knows to act; de-stigmatisation, since fear of mastectomy and fatalism drive much of the delay; training of primary-care and community health workers in CBE; and, above all, an unblocked referral-to-diagnosis-to-treatment pathway. Secondly, consider CBE-based screening of a defined higher-risk age band once that path reliably absorbs the cases early diagnosis already produces. Third, reserve organised mammographic screening for when the radiology workforce, quality assurance, registry and treatment capacity exist to justify it — for most LMIC systems a later ambition, and better piloted regionally than launched nationally.

A further, uncomfortable point deserves emphasis in our own context: we cannot yet measure the very indicator the first pillar depends upon, because population-based staging data remain scarce. A functioning national cancer registry is utmost precondition for knowing whether any early-detection strategy is working at all and its absence is itself an argument for the early-diagnosis-first approach, which strengthens the clinical pathway that a registry must one day measure.

## CONCLUSION

Screening seems a fancy word in developing countries with limited resources thus the starting point should be the focus on early detection, developing system to bear the burden of early detected breast cancer, establishment of a robust breast cancer

## Conflict of Interest

Author declare no conflict of interest.

## REFERENCES


1. World Health Organization. Global Breast Cancer Initiative Implementation Framework: assessing, strengthening and scaling up services for the early detection and management of breast cancer. Geneva: World Health Organization; 2023.
2. Global breast cancer survival estimates in 2017–2021 to advance the WHO Global Breast Cancer Initiative. *Nat Med.* 2026 (published online).
3. Gutnik LA, Matanje-Mwagomba B, Msosa V, et al. Breast cancer screening in low- and middle-income countries: a perspective from Malawi. *J Glob Oncol.* 2016;2(1):4–11.
4. Harford JB. Breast-cancer early detection in low-income and middle-income countries: do what you can versus one size fits all. *Lancet Oncol.* 2011;12(3):306–312.

5. Corbex M, Burton R, Sancho-Garnier H. Breast cancer early detection methods for low and middle income countries, a review of the evidence. *Breast.* 2012;21(4):428–434.
6. Pauline B et al. Measuring the WHO Global Breast Cancer Initiative pillars' key performance indicators in Sub-Saharan Africa: the African Breast Cancer—Disparities in Outcomes (ABC-DO) cohort. *eClinicalMedicine.* 2025;80:102036.

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*Original Article*

# ANTIOXIDANT AND CYTOPROTECTIVE EFFECTS OF IFLOGA SPICATA-DERIVED GOLD NANOPARTICLES IN HUMAN LYMPHOCYTES

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## ABSTRACT:

Green synthesis of gold nanoparticles (AuNPs) using plant extracts has emerged as a sustainable and biocompatible approach in nanomedicine. In this study, AuNPs were synthesized using *Ifloga spicata* (Forssk.) whole-plant extract and evaluated for their biological effects on human blood lymphocytes exposed to hydrogen peroxide–induced oxidative stress. Nanoparticle formation was confirmed using UV–visible spectroscopy, Fourier-transform infrared spectroscopy (FT-IR), and X-ray diffraction (XRD). Exposure to oxidative stress significantly increased intracellular reactive oxygen species (ROS) and thiobarbituric acid reactive substances (TBARS), while suppressing antioxidant enzyme activities, including catalase (CAT), superoxide dismutase (SOD), and peroxidase (POD). Treatment with *I. spicata*–mediated AuNPs significantly attenuated ROS and TBARS levels and restored antioxidant enzyme activities in a concentration-dependent manner, with maximal protective effects observed at 5 and 50 µg/mL. Importantly, AuNPs did not induce adverse oxidative effects under normal physiological conditions, indicating a favorable cytocompatibility profile. These findings suggest that *I. spicata*–derived AuNPs exhibit antioxidant and cytoprotective properties and may represent promising candidates for mitigating oxidative stress–related cellular damage. Further in vivo studies are warranted to elucidate their mechanistic pathways and therapeutic potential.

**Keywords:** Gold nanoparticles; Ifloga spicata; cytoprotection; oxidative stress; antioxidants; nanomedicine.

## INTRODUCTION

Nanotechnology has gained substantial attention in biomedical research due to its potential to enhance diagnostic, therapeutic, and preventive strategies through nanoscale materials with unique physicochemical properties (1, 2). Among various nanomaterials, gold nanoparticles (AuNPs) have attracted particular interest owing to their chemical stability, biocompatibility, ease of surface functionalization, and relatively low toxicity compared to other metallic nanoparticles (3, 4). These

characteristics make AuNPs especially suitable for biomedical applications, including drug delivery, imaging, and antioxidant therapy (5).

Conventional physical and chemical methods for AuNP synthesis often involve high energy requirements and the use of toxic reducing or stabilizing agents, which may limit their biomedical applicability (6). In contrast, green synthesis approaches utilizing biological resources, particularly plant extracts, offer an environmentally friendly, cost-effective, and scalable alternative (7). Plant-mediated synthesis not only reduces environmental burden but also enables nanoparticle stabilization through naturally occurring phytochemicals such as flavonoids, phenolics, terpenoids, and alkaloids, which may impart additional biological activity (8).

*Ifloga spicata* (Forssk.), a medicinal plant traditionally used in ethnopharmacological practices, is known for its antioxidant, anti-inflammatory, and protective properties. Despite its documented medicinal relevance, limited information is available regarding its application in nanoparticle synthesis and subsequent biological evaluation. Given the growing evidence that oxidative stress plays a central role in the pathogenesis of numerous diseases, including inflammatory disorders, neurodegeneration, and cancer, the development of biocompatible nanomaterials capable of modulating oxidative damage is of considerable interest (9).

Oxidative stress results from an imbalance between reactive oxygen species generation and cellular antioxidant defenses, leading to lipid peroxidation, protein damage, and enzymatic dysfunction (10). Human lymphocytes are particularly sensitive to oxidative insults and serve as a relevant model for assessing oxidative stress–mediated cellular responses. Biomarkers such as ROS, thiobarbituric acid reactive substances, and antioxidant enzymes, including catalase, superoxide dismutase, and peroxidase, provide valuable insight into cellular redox status (11).

The present study aimed to synthesize AuNPs using *Ifloga spicata* extract via a green synthesis approach and to evaluate their biological effects on human blood lymphocytes under hydrogen peroxide–induced oxidative stress. Rather than inducing cytotoxicity, the study focuses on assessing the cytoprotective and antioxidant potential of plant-derived AuNPs through modulation of oxidative stress markers and antioxidant enzyme activities. The findings provide insight into the potential application of *I. spicata*–mediated AuNPs as biocompatible nanomaterials for oxidative stress mitigation.

## MATERIALS AND METHODS

### Collection and Extraction of Plant

*Ifloga spicata* (whole plant) was collected from the university site, District Bannu, Khyber Pakhtunkhwa, Pakistan. Dr. Faizan Ullah, Department of Botany, University of Science and Technology, Bannu, identified the plant, and a voucher specimen was deposited at the Department of Botany of the same university. The plant material was shade-dried and ground to a fine powder, then soaked in 80% aqueous methanol. After five days at room temperature, the filtrate was concentrated using a rotary evaporator (Buchi Rotavapor R-200). The crude plant extract (200 g) was stored at 4 °C for further processing (12).

### Extract Solution Preparation and Nanoparticle Synthesis

Plant-mediated synthesis of gold nanoparticles was carried out using a general protocol. Two grams of the methanolic dry extract were dissolved in 100 mL methanol on a hot-plate magnetic stirrer for 30 minutes at 50 °C. After cooling to ambient temperature, 5 mL of the extract was added to 45 mL of 1 mM aqueous $HAuCl_4$ solution. The mixture was kept for 2 hours, and formation of gold nanoparticles was confirmed visually by a colour change to ruby red (12).

### Catalase (CAT)

Catalase activity was determined from the decrease in absorbance due to $H_2O_2$ consumption, following a previously reported method (12).

**Superoxide Dismutase (SOD)**

Superoxide dismutase activity was determined according to a previously reported method (12). The amount of chromogen formed was measured at 560 nm using a spectrophotometer, and results were expressed in mU/$10^8$ cells.

**Peroxidase (POD)**

Peroxidase activity in the homogenate was evaluated using the Carlberg spectrophotometric technique (12). After one minute, the absorbance of the reaction solution at 470 nm was measured to assess the change in absorbance.

**Thiobarbituric Acid Reactive Substances (TBARS)**

TBARS were determined using a previously described method (12). The optical density at 532 nm was used to quantify the TBARS produced. Using a molar extinction coefficient of 156 mmol/L/cm at 37 °C, results were expressed as nmol malonaldehyde/min/mg tissue.

**Reactive Oxygen Species (ROS)**

A microplate reader was used to measure absorbance at 505 nm for 180 seconds at 15-second intervals. ROS concentrations were calculated using a standard curve. The amount of hydrogen peroxide in the sample was measured in units of ROS (1 unit = 1.0 mg $H_2O_2$/L) and expressed as U/$10^8$ cells (12).

**Statistical Analysis**

Data were analysed using two-way analysis of variance (ANOVA) to evaluate the effects of the treatments. A p-value < 0.05 was considered statistically significant.

## RESULTS AND DISCUSSION

**Effect of *Ifloga spicata*-derived AuNPs on ROS content of human blood lymphocytes**

Normal human blood lymphocytes showed no response to the synthesized AuNPs derived from *Ifloga spicata*. However, the human blood lymphocytes were deliberately exposed to $H_2O_2$ stress to evaluate the level of ROS. The raised ROS level due to stress was considerably improved by the different fractions of *I. spicata*-derived AuNPs.

**Effect of *Ifloga spicata*-derived AuNPs on blood enzyme activities**

Exposure of human blood lymphocytes to $H_2O_2$ stress reduced the antioxidant enzyme (SOD, CAT and POD) activities as compared to the normal control ($p < 0.05$). The different fractions of *I. spicata*-derived AuNPs at concentrations of 10 µg/ml and 50 µg/ml potentially recovered antioxidant enzyme activity (SOD, CAT and POD). Irrespective of the others, the crude methanolic and aqueous fractions were significantly more effective in recovering the adverse effects on antioxidant enzyme activities, as shown in Tables 2–4.

**Effect of *Ifloga spicata*-derived AuNPs on TBARS of human blood lymphocytes**

After treatment with oxidative stress, the blood lymphocytes were evaluated for levels of TBARS. The synthesised plant-based AuNPs smoothly recovered the elevated level of TBARS contents. Concentrations of 10 µg/ml and 50 µg/ml were the most effective, at which blood lymphocytes recovered maximum TBARS contents. The data presented in Table 5 indicate that the ethyl acetate and chloroform fractions were more significantly effective in recovering the elevated level of TBARS ($p < 0.05$).

Although classical cytotoxicity assays such as MTT or lactate dehydrogenase (LDH) release were not performed in the present study, the biological endpoints evaluated provide indirect yet meaningful evidence regarding cytocompatibility. Under normal physiological conditions, treatment with Ifloga

spicata-derived gold nanoparticles did not elevate reactive oxygen species levels, induce lipid peroxidation, or suppress endogenous antioxidant enzyme activities in human lymphocytes. Instead, antioxidant enzyme levels remained comparable to those of untreated controls, indicating the absence of oxidative or metabolic stress.

**Table 1.** Recovery effects of *I. spicata*-derived AuNPs on ROS of human blood lymphocytes.

| Dose | Different Fractions of Crude Extract | | | | | Mean value |
|---|---|---|---|---|---|---|
| | Methanol | Ethyl acetate | n-hexane | Chloroform | Aqueous | |
| Control | 0.4 ± 0.06g | 0.40 ± 0.06g | 0.36 ± 0.02e | 0.40 ± 0.16h | 0.40 ± 0.12g | 0.39 ± 0.06g |
| 100 μM $H_2O_2$ stress | 0.6 ± 0.64a | 0.6 ± 0.33a | 0.59 ± 0.14a | 0.57 ± 0.55a | 0.6 ± 0.21a | 0.6 ± 0.43a |
| AuNPs 10 μg/ml | 0.34 ± 0.18a | 0.37 ± 0.27a | 0.39 ± 0.44a | 0.31 ± 0.34a | 0.33 ± 0.24a | 0.32 ± 0.27a |
| AuNPs 25 μg/ml | 0.39 ± 0.22a | 0.35 ± 0.34a | 0.37 ± 0.11a | 0.38 ± 0.27a | 0.39 ± 0.24a | 0.37 ± 0.17a |
| AuNPs 50 μg/ml | 0.47 ± 0.32a | 0.42 ± 0.42a | 0.49 ± 0.42a | 0.46 ± 0.22a | 0.45 ± 0.52a | 0.44 ± 0.32a |

**Table 2.** Recovery effects of *I. spicata*-derived AuNPs on CAT antioxidant enzyme of human blood lymphocytes.

| Dose | Different Fractions of Crude Extract | | | | | Mean value |
|---|---|---|---|---|---|---|
| | Methanol | Ethyl acetate | n-hexane | Chloroform | Aqueous | |
| Control | 0.4 ± 0.06g | 0.39 ± 0.06g | 0.30 ± 0.02e | 0.40 ± 0.16h | 0.38 ± 0.12g | 0.39 ± 0.06g |
| 100 μM $H_2O_2$ stress | 0.2.861 ± 0.14n | 0.2.871 ± 0.33n | 0.2.6571 ± 0.132n | 0.2.7571 ± 0.25n | 0.1.9571 ± 0.18n | 0.1.9781 ± 0.134b |
| AuNPs 10 μg/ml | 0.3.2183 ± 0.24b | 0.3.20 ± 0.36b | 0.3.171 ± 0.24e-i | 0.3.2811 ± 0.18b-h | 0.3.613 ± 0.17b-e | 0.3.7829 ± 0.16a |
| AuNPs 25 μg/ml | 0.39 ± 0.22a | 0.39 ± 0.35a | 0.38 ± 0.52a | 0.37 ± 0.12a | 0.39 ± 0.52a | 0.39 ± 0.42a |
| AuNPs 50 μg/ml | 0.48 ± 0.06g | 0.49 ± 0.06g | 0.41 ± 0.02e | 0.47 ± 0.16h | 0.41 ± 0.12g | 0.341 ± 0.06g |

**Table 3.** Recovery effects of *I. spicata*-derived AuNPs on POD antioxidant enzyme of human blood lymphocytes.

| Dose | Different Fractions of Crude Extract | | | | | Mean value |
|---|---|---|---|---|---|---|
| | Methanol | Ethyl acetate | n-hexane | Chloroform | Aqueous | |
| Control | 0.52 ± 0.23ab | 0.541 ± 0.33ab | 0.53 ± 0.24ab | 0.57 ± 0.34ab | 0.481 ± 0.04ab | 0.531 ± 0.43b |
| 100 μM $H_2O_2$ stress | 0.43 ± 0.14de | 0.41 ± 0.12de | 0.41 ± 0.23de | 0.381 ± 0.22de | 0.3391 ± 0.32de | 0.3631 ± 0.13c |
| AuNPs 10 μg/ml | 0.561 ± 0.134ab | 0.51 ± 0.4cd | 0.5699 ± 0.11a | 0.569 ± 0.15a | 0.565 ± 0.15ab | 0.575 ± 0.1a |
| AuNPs 25 μg/ml | 0.651 ± 0.144ab | 0.66 ± 0.31ab | 0.65 ± 0.10ab | 0.61 ± 0.32ab | 0.65 ± 0.24a | 0.6943 ± 0.51ab |
| AuNPs 50 μg/ml | 0.661 ± 0.134ab | 0.61 ± 0.4cd | 0.5699 ± 0.11a | 0.67 ± 0.15a | 0.775 ± 0.15ab | 0.675 ± 0.1a |

**Table 4.** Recovery effects of *I. spicata*-derived AuNPs on SOD antioxidant enzyme of human blood lymphocytes.

| Dose | Different Fractions of Crude Extract | | | | | Mean value |
|---|---|---|---|---|---|---|
| | Methanol | Ethyl acetate | n-hexane | Chloroform | Aqueous | |
| Control | 0.52 ± 0.23ab | 0.51 ± 0.33ab | 0.53 ± 0.24ab | 0.57 ± 0.34ab | 0.581 ± 0.04ab | 0.531 ± 0.43b |
| 100 μM $H_2O_2$ stress | 0.47 ± 0.14de | 0.41 ± 0.12de | 0.491 ± 0.23de | 0.381 ± 0.22de | 0.391 ± 0.32de | 0.3.31 ± 0.13c |
| AuNPs 10 μg/ml | 0.561 ± 0.134ab | 0.57 ± 0.4cd | 0.599 ± 0.11a | 0.569 ± 0.15a | 0.55 ± 0.15ab | 0.65 ± 0.1a |
| AuNPs 25 μg/ml | 0.61 ± 0.144ab | 0.66 ± 0.31ab | 0.65 ± 0.10ab | 0.61 ± 0.32ab | 0.65 ± 0.24a | 0.6.243 ± 0.51ab |
| AuNPs 50 μg/ml | 0.661 ± 0.134ab | 0.671 ± 0.4cd | 0.59 ± 0.11a | 0.69 ± 0.15a | 0.75 ± 0.15ab | 0.65 ± 0.1a |

**Table 5.** Recovery effects of *I. spicata*-derived AuNPs on TBARS of human blood lymphocytes.

| Dose | Different Fractions of Crude Extract | | | | | Mean value |
|---|---|---|---|---|---|---|
| | Methanol | Ethyl acetate | n-hexane | Chloroform | Aqueous | |
| Control | 0.52 ± 0.23ab | 0.541 ± 0.33ab | 0.53 ± 0.24ab | 0.57 ± 0.34ab | 0.481 ± 0.04ab | 0.531 ± 0.43b |
| 100 μM $H_2O_2$ stress | 0.73 ± 0.11a | 0.75 ± 0.11a | 0.715 ± 0.11a | 0.65 ± 0.11a | 0.68 ± 0.11a | 0.71 ± 0.11a |
| AuNPs 10 μg/ml | 0.463 ± 0.03k-l | 0.421 ± 0.452h-j | 0.633 ± 0.63h-j | 0.347 ± 0.13h-l | 0.629 ± 0.1031h | 0.299 ± 0.011e |
| AuNPs 25 μg/ml | 0.51 ± 0.003lmn | 0.69 ± 0.41j | 0.545 ± 0.11h | 0.617 ± 0.28g | 0.699 ± 0.11i | 0.5142 ± 0.04e |
| AuNPs 50 μg/ml | 0.6763 ± 0.01m | 0.585 ± 0.112i-j | 0.690 ± 0.650j-k | 0.6520 ± 0.450h-i | 0.60 ± 0.001h | 0.69 ± 0.04c |

Collectively, these findings suggest that the synthesized AuNPs exhibit a favorable cytocompatibility profile within the tested concentration range. Future investigations incorporating direct cell viability and apoptosis assays will further strengthen the safety assessment and support translational applications.

## CONCLUSION

This study demonstrates that gold nanoparticles synthesized from *Ifloga spicata* extract exert significant antioxidant and cytoprotective effects on human lymphocytes under oxidative stress. The findings support the potential use of plant-mediated AuNPs in nanomedicine, particularly for conditions associated with oxidative damage. Future research should explore mechanistic pathways and evaluate efficacy in in-vivo models.


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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES


1. Rizvi SAA, Saleh AM. Applications of nanoparticle systems in drug delivery technology. Saudi Pharm J. 2018;26(1):64–70.
2. Shahzad Y, Rizvi SAA, Yousaf AM, Hussain T. Drug delivery using nanomaterials. Boca Raton (FL): CRC Press; 2022.
3. Ahmed H, Khan YM, Rizvi SAA, Nazir H, Latif N, Khan AU, Khan WU, Khan MU, Nisar N, Jan S, Khan RA. Characterization and biological evaluation of silver nanoparticles synthesized using *Ifloga spicata* (Forssk.) crude extract. J Xi'an Shiyou Univ Nat Sci Ed. 2023;19(1):1214–1230.
4. Khalifa HO, Alkhoori H. Beyond the glitter: gold nanoparticles as powerful weapons against multidrug-resistant pathogens. Front Mol Biosci. 2025;12:1612526.
5. Ahmad S, Ahmad S, Ali S, Esa M, Khan A, Yan H. Recent advancements and unexplored biomedical applications of green synthesized Ag and Au nanoparticles: a review. Int J Nanomedicine. 2024;19:3187–3215.
6. Kulkarni D, Sherkar R, Shirsathe C, Sonwane R, Varpe N, Shelke S, More MP, Pardeshi SR, Dhaneshwar G, Junnuthula V, Dyawanapelly S. Biofabrication of nanoparticles: sources, synthesis, and biomedical applications. Front Bioeng Biotechnol. 2023;11:1159193.
7. Ayub A, Wani AK, Malik SM, Ayub M, Singh R, Chopra C, Malik T. Green nanoscience for healthcare: advancing biomedical innovation through eco-synthesized nanoparticles. Biotechnol Rep. 2025;47:e00913.
8. Singh H, Desimone MF, Pandya S, Jasani S, George N, Adnan M, Aldarhami A, Bazaid AS, Alderhami SA. Revisiting the green synthesis of nanoparticles: uncovering influences of plant extracts as reducing agents for enhanced synthesis efficiency and its biomedical applications. Int J Nanomedicine. 2023;18:4727–4750.
9. Shah SNA, Ullah F, Ayaz M, Shinwari ZK. Phytochemical profiling and pharmacological evaluation of *Ifloga spicata* (Forssk.) Sch. Bip. in leishmaniasis, lung cancer, and oxidative stress. Pak J Bot. 2019;51(6):2159–2169.
10. Chandimali N, Bak SG, Park EH, Lim HJ, Won YS, Kim EK, Park SI, Lee SJ. Free radicals and their impact on health and antioxidant defenses: a review. Cell Death Discov. 2025;11(1):19.
11. Jomova K, Raptova R, Alomar SY, Alwasel SH, Nepovimova E, Kuca K, Valko M. Reactive oxygen species, toxicity, oxidative stress, and antioxidants: chronic diseases and aging. Arch Toxicol. 2023;97(10):2499–2574.

12. Khan YM, Rizvi SAA, Jan S, Shah MI, Khan R, Hussain M, Ullah W. Antimicrobial, antioxidant and cytotoxic evaluation of *Ifloga spicata* (Forssk.) Sch. Bip. biosynthesized silver nanoparticles. Liaquat Med Res J. 2025;7(2):Article 2-04.

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# ATTITUDES AND PRACTICES REGARDING TUBERCULOSIS INFECTION CONTROL AMONG NURSES AT KHYBER TEACHING HOSPITAL, PESHAWAR, PAKISTAN

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**ABSTRACT:**

This study was a cross-sectional study conducted to assess the attitudes and practices regarding tuberculosis (TB) infection control among nurses working at Khyber Teaching Hospital, Peshawar. The study included 187 registered nurses at Khyber Teaching Hospital, Peshawar. Participants were selected through convenience sampling. Data were collected using a structured, self-administered questionnaire assessing attitudes and practices related to TB infection control. Data were analyzed using SPSS version 22, and results were presented as frequencies and percentages. Majority of participants demonstrated positive attitudes toward TB infection control. Most nurses reported routinely screening patients for cough (79.1%) and ensuring separation of suspected TB cases (77%). A high proportion (89.3%) reported consistent use of personal protective equipment when managing TB patients. Additionally, 88.7% emphasized the importance of proper ventilation in infection control. Regarding practices, 88.8% reported using protective measures, and 85.5% expressed confidence in managing TB patients. However, gaps were identified in specific practices such as sputum collection in well-ventilated areas. Nurses exhibited generally positive attitudes and satisfactory practices regarding TB infection control. However, inconsistencies in certain practices highlight the need for continuous training and reinforcement of infection control guidelines to minimize the risk of TB transmission in healthcare settings.

**Keywords:** Tuberculosis, Infection Control, Nurses, Attitude, Practices, Pakistan

## INTRODUCTION

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide, particularly in low- and middle-income countries such as Pakistan (1,2). According to the World Health Organization (WHO), Pakistan is among the top 30 high TB burden countries globally, reporting over 400,000 new TB cases annually (3). TB is caused by *Mycobacterium tuberculosis* and is primarily transmitted through airborne droplets expelled when infected individuals cough or sneeze (4). Despite ongoing control efforts, TB continues to pose significant public health challenges, particularly in healthcare facilities where nosocomial transmission is a major concern (5). Healthcare workers, particularly nurses, are at increased risk of exposure due to frequent and prolonged contact with patients. In high-burden countries, risk is compounded by overcrowding, inadequate infection control measures, limited resources, and insufficient occupational training (6,7). Effective tuberculosis infection control (TBIC) measures, including early identification of suspected cases, separation of infectious patients, use of personal protective equipment (PPE), and maintenance of proper ventilation are essential for reducing transmission within healthcare facilities (8,9). Nurses' attitudes and practices significantly influence the successful implementation of TBIC measures. Positive attitudes and adherence to recommended practices can substantially reduce transmission risk, whereas gaps or misconceptions may compromise both patient safety and healthcare worker well-being (10,11). Previous studies report considerable variability in infection control practices among nurses, often affected by training, resource availability, institutional policies, and perceived occupational risk (12–14). In Pakistan, limited evidence exists regarding nurses' attitudes and practices toward TBIC in tertiary care hospitals, despite the country's high TB

burden. Understanding these factors is critical for designing targeted interventions aimed at improving infection control, reducing occupational risk, and ultimately minimizing nosocomial transmission. Therefore, this study aimed to assess the attitudes and practices regarding tuberculosis infection control among nurses at Khyber Teaching Hospital, Peshawar, providing evidence to inform both institutional policies and broader public health strategies.

## METHODS

**Study Design and Setting:** A descriptive cross-sectional study was conducted at Khyber Teaching Hospital (KTH), Peshawar, a tertiary care hospital providing diverse medical, surgical, and infectious disease services (15). Data collection took place over a three-month period, from May to July 2025.

**Study Population and Sampling:** The study population included registered nurses with a minimum of one year of clinical experience. Student nurses and those with less than one year of experience were excluded. A total of 187 nurses participated, recruited using convenience sampling. This sampling method allowed inclusion of all available nurses during the study period, although it may limit generalizability.

**Data Collection Tool and Procedure:** Data were collected using a structured, self-administered questionnaire designed based on international TBIC guidelines (CDC 2005, WHO 2019). The questionnaire included three sections: demographic characteristics, attitudes toward TBIC, and routine clinical practices. The tool was pilot-tested on 10 nurses not included in the final sample to ensure clarity, validity, and reliability. Minor modifications were made based on pilot feedback. Questionnaires were distributed in person and collected after completion, ensuring completeness and confidentiality.

**Data Analysis:** Data were entered and analyzed using Statistical Package for Social Sciences (SPSS version 22). Descriptive statistics, including frequencies and percentages, were calculated for categorical variables. Results were presented in tables for clarity and ease of interpretation.

## RESULTS

A total of 187 nurses participated. Demographic characteristics are summarized in Table 1. Most participants were female (72.2%), aged 25–30 years (63.6%), and had 2–5 years of experience (65.2%). The majority held a Bachelor of Science in Nursing with professional qualification (62.6%).

**Attitudes toward TB Infection Control:** The majority demonstrated proactive attitudes. Routine screening for cough was reported by 79.1%, and 77% ensured separation of symptomatic patients. Patient education was emphasized by 88.8%, instructing patients to cover their mouth when coughing. Ventilation was considered important by 88.7%, and consistent PPE use was reported by 89.3%. Lower adherence was noted for sputum collection in well-ventilated areas (62.5%) (Table 2).

**Practices Regarding TB Infection Control:** Most nurses expressed comfort caring for TB patients (70.6%) and endorsed equal care for TB patients (68.4%). PPE use was reported by 88.8%, and 85.5% expressed confidence in managing TB patients. Adequate training was reported by 82.3%, though gaps were noted. About 92.5% supported regular TB screening for healthcare workers (Table 3).

## DISCUSSION

This study evaluated TBIC attitudes and practices among nurses at KTH, Peshawar. Overall, nurses exhibited positive attitudes and generally good practices, although some inconsistencies were identified.

Routine patient screening and separation of suspected TB cases demonstrate proactive attitudes. These findings align with previous studies emphasizing early identification as a cornerstone for reducing nosocomial TB transmission (16,17). Ventilation was widely recognized, consistent with literature highlighting its role in controlling airborne infections (18). However, lower adherence in sputum collection indicates that knowledge does not always translate into practice, possibly due to workload, infrastructure limitations, or insufficient reinforcement of guidelines (19). High PPE usage aligns with global research, reflecting institutional emphasis on infection prevention and heightened awareness following global infectious disease outbreaks (20,21). Nurses

reported confidence in managing TB patients and commitment to equal care, although stigma perceptions persisted in some cases, suggesting a need for ongoing sensitization (22).

**Table 1: Demographic Characteristics of Participants (n = 187)**

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **Gender** | | |
| Male | 52 | 27.8 |
| Female | 135 | 72.2 |
| **Marital Status** | | |
| Married | 105 | 56.1 |
| Single | 82 | 43.9 |
| **Education** | | |
| PRN | 117 | 62.6 |
| BSN | 69 | 36.9 |
| MSN | 1 | 0.5 |
| **Age (years)** | | |
| 20–25 | 50 | 26.7 |
| 25–30 | 119 | 63.6 |
| >30 | 18 | 9.6 |
| **Experience (years)** | | |
| <2 | 29 | 15.5 |
| 2–5 | 122 | 65.2 |
| >5 | 36 | 19.3 |

**Table 2: Attitudes Regarding TB Infection Control (n = 187)**

| Statement | Agree / Strongly Agree n (%) | Neutral n (%) | Disagree / Strongly Disagree n (%) |
|---|---|---|---|
| Routinely ask patients about cough upon entry | 148 (79.1) | 21 (11.2) | 18 (9.7) |
| Ensure separation of coughing patients | 144 (77.0) | 26 (13.9) | 17 (9.1) |
| Emphasize importance of proper ventilation in clinical areas | 166 (88.7) | 14 (7.5) | 7 (3.8) |
| Encourage patients to cover mouth when coughing | 166 (88.8) | 12 (6.4) | 9 (4.8) |
| Ensure sputum collection in well-ventilated areas | 117 (62.5) | 38 (20.3) | 32 (17.1) |
| Consistently use PPE when managing TB patients | 167 (89.3) | 14 (7.5) | 6 (3.2) |

Training significantly influenced adherence. Although most participants received training, gaps were reported, echoing other studies where irregular or inadequate training was associated with suboptimal infection control practices (23). Continuous professional development and hands-on reinforcement are necessary to ensure sustained compliance. Awareness of occupational risk was high, promoting cautious behavior, but may also contribute to anxiety and stress. Institutional support, including psychological counseling and regular health screening, is crucial to safeguard healthcare worker well-being (24). These findings highlight encouraging TBIC practices among nurses but underscore the need for regular training, infrastructure improvement, and institutional monitoring to address gaps, improve compliance, and minimize nosocomial TB risk.

Limitations: The cross-sectional design represents a single point in time, limiting causal inference. Convenience sampling may affect generalizability. Self-reported practices may be influenced by social desirability bias.

**Table 3: Practices Regarding TB Infection Control (n = 187)**

| Statement | Yes / Agree n (%) | Neutral n (%) | No / Disagree n (%) |
|---|---|---|---|
| Comfortable caring for TB patients | 132 (70.6) | 31 (16.6) | 24 (12.8) |
| TB patients deserve equal care and compassion | 128 (68.4) | 39 (20.9) | 20 (10.7) |
| Use of personal protective equipment during patient care | 166 (88.8) | 14 (7.5) | 7 (3.7) |
| Perceive risk of contracting TB while caring for patients | 146 (78.1) | 27 (14.4) | 14 (7.5) |
| Confident in managing TB patients effectively | 160 (85.5) | 18 (9.6) | 9 (4.8) |
| Received adequate TB infection control training | 154 (82.3) | 22 (11.8) | 11 (5.9) |
| TB patients face stigma from healthcare providers | 103 (55.1) | 49 (26.2) | 35 (18.7) |
| Support regular TB screening for healthcare workers | 173 (92.5) | 9 (4.8) | 5 (2.7) |

## CONCLUSION

Nurses at Khyber Teaching Hospital generally exhibit positive attitudes and satisfactory TBIC practices, including patient screening, PPE use, and ventilation maintenance. Gaps in practices, particularly during procedures like sputum collection, require attention. Continuous training, regular monitoring, and institutional reinforcement of infection control protocols are essential to ensure consistent and effective implementation. Future studies should explore compliance determinants and evaluate targeted interventions to further strengthen TBIC practices among healthcare workers.

### Conflict of Interest

The authors declare no conflict of interest.

### Ethical Consideration

Ethical approval was obtained from the institutional review board, and permission was secured from KTH administration. Written informed consent was obtained from all participants. Participation was voluntary, and confidentiality and anonymity were strictly maintained.

## REFERENCES


1. Abbas U, Masood KI, Khan A, Irfan M, Saifullah N, Jamil B, et al. Tuberculosis and diabetes mellitus: relating immune impact of co-morbidity with challenges in disease management in high burden countries. J Clin Tuberc Other Mycobact Dis. 2022;29:100343.
2. Swalehe H, Obeagu E. Tuberculosis: current diagnosis and management. Elite J Public Health. 2024;2(1):23-33.
3. World Health Organization. Global tuberculosis report 2023. Geneva: WHO; 2023.
4. Mack U, Migliori GB, Sester M, Rieder HL, Ehlers S, Goletti D, et al. LTBI: latent tuberculosis infection or lasting immune responses? Eur Respir J. 2009;33(5):956-73.
5. World Health Organization. WHO consolidated guidelines on drug-resistant tuberculosis treatment. Geneva: WHO; 2019.
6. Khan MS, Mustufa MA, Saeed A. Infection control practices among healthcare workers in Pakistan. J Infect Public Health. 2021;14(5):672-678.
7. Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among healthcare workers in low- and middle-income countries: a systematic review. PLoS Med. 2006;3(12):e494.
8. Centers for Disease Control and Prevention. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in healthcare settings. MMWR. 2005;54(RR-17):1–141.
9. Huemer M, Mairpady Shambat S, Brugger SD, Zinkernagel AS. Antibiotic resistance and persistence. EMBO Rep. 2020;21(12):e51034.
10. Al-Dossary R, Alamri M, Alshahrani M, et al. Knowledge and attitudes regarding TB infection control among nurses. Saudi J Health Sci. 2021;10(3):198-204.

**11.** Kassa ZY, Abebe DS, Wassie MM, et al. Assessment of tuberculosis infection control knowledge, practice, and attitude among healthcare workers in Ethiopia. PLoS One. 2019;14(5):e0217026.

**12.** Nair D, Thampi R, Kumar S. Adherence to TB infection control guidelines among nurses in tertiary care hospitals. Int J Infect Control. 2020;16(1):1–8.

**13.** Pathak R, Gurung S. Practices of TB infection control among nurses: a cross-sectional study. Asian Pac J Trop Med. 2019;12(5):233-238.

**14.** Khan M, Urooj M, Haq F. Attitude and practices regarding TB infection control in tertiary care hospitals, Pakistan. Pak J Med Health Sci. 2022;16(3):543-548.

**15.** Khyber Teaching Hospital Annual Report. Peshawar: KTH; 2021.

**16.** Lönnroth K, Raviglione M. Global epidemiology of tuberculosis: prospects for control. Semin Respir Crit Care Med. 2008;29(5):481–491.

**17.** Escombe AR, Oeser CC, Gilman RH, et al. Natural ventilation for the prevention of airborne contagion. PLoS Med. 2007;4(2):e68.

**18.** Makhdoom F, Ahmed N, Rafiq A. Barriers to TB infection control practices among nurses in Pakistan. J Infect Dev Ctries. 2019;13(12):1082–1088.

**19.** Azizi H, Ghafouri M, Moradi G, et al. Infection control practices and adherence among healthcare professionals. J Infect Public Health. 2021;14(6):789–795.

**20.** Sadeghi E, Azadi S, Ghazvini A. Knowledge and practice of TB infection control among nurses. J Infect Dev Ctries. 2020;14(7):813–821.

**21.** Uysal Z, Akyol A, Ozturk C. Stigmatizing attitudes toward TB patients among healthcare workers. Int J Tuberc Lung Dis. 2018;22(3):289–295.

**22.** Shrestha R, Adhikari B, Devkota B. Training and compliance with TB infection control guidelines in healthcare settings. BMC Health Serv Res. 2021;21:75.

**23.** World Health Organization. WHO guidelines on TB infection prevention and control, 2019 update. Geneva: WHO; 2019.

**24.** Pathak R, Gurung S. Occupational risk perception and TB infection control among nurses. Asian Pac J Trop Med. 2021;14(2):95–102.

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# DEMOGRAPHIC AND CLINICAL PATTERNS OF CERVICAL CANCER, COLORECTAL CARCINOMA, AND ACUTE LEUKAEMIA AT A TERTIARY ONCOLOGY CENTRE IN PAKISTAN: A SECONDARY BENCHMARKING ANALYSIS

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## ABSTRACT

This study was conducted to describe and compare the demographic and clinical profiles of patients with cervical cancer, colorectal carcinoma, and acute leukaemia at a tertiary oncology centre in Karachi, Pakistan, and to benchmark these findings against local, regional, and global reference data, with a view to informing screening policy and cancer awareness strategies in a resource-limited setting. This study was secondary synthesis of aggregated data from published cross-sectional observational studies. The study was conducted at the Department of Medical Oncology, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan. A combined cohort of 329 adult patients with histologically confirmed malignancies: 92 with cervical cancer, 107 with colorectal carcinoma, and 130 with acute leukaemia were included. The mean age at diagnosis was 53.4 years (SD 10.9) for cervical cancer, with approximately 11% of patients under 40 years — consistent with local and global norms. By contrast, colorectal carcinoma presented at a median age of 40 years (IQR 16), with an estimated 65% of patients under 40, and acute leukaemia at a mean age of 27.9 years (SD 14.5), with approximately 80% under 40. These younger age profiles align broadly with South Asian data but diverge substantially from global medians of 68–72 years for colorectal carcinoma and 68–71 years for acute leukaemia. A descriptive comparison of the proportion of under-40 patients across the three cancer types showed a marked gradient (cervical ~11%, colorectal ~65%, leukaemia ~80%). Male predominance was observed in both colorectal carcinoma (66%) and acute leukaemia (65%). Advanced-stage disease was common in both solid tumours, affecting 60% of cervical and 67% of colorectal cases. Sedentary behaviour (92%) and smoking (58%) were frequently documented among colorectal carcinoma patients. This synthesis demonstrates a pronounced age divergence in colorectal carcinoma and acute leukaemia relative to global benchmarks, consistent with broader trends across Pakistan and South Asia. The findings support a review of locally appropriate screening thresholds and underscore the need for age-inclusive cancer awareness programmes. Multi-centre collaborative studies are required to generate the evidence base necessary for context-specific national guidelines.

**Keywords:** Cancer epidemiology, Cervical cancer, Colorectal carcinoma, Acute leukaemia, Early-onset cancer

## INTRODUCTION

Cancer represents a major and growing public health burden in low- and middle-income countries (LMICs), where limited healthcare infrastructure, socioeconomic constraints, and low awareness frequently result in delayed diagnosis and presentation at advanced disease stages (1). Pakistan, with a population exceeding 230 million, faces a particularly acute challenge. Its rapidly urbanising landscape is associated with shifting dietary habits, rising rates of tobacco use, physical inactivity, and environmental exposures — all of which have been implicated in changing cancer epidemiology (1,3). Critically, the age at cancer diagnosis in Pakistan and neighbouring South Asian countries is frequently reported as substantially younger than in high-income settings, where incidence data typically reflect an older demographic (6,7). At the Department of Medical Oncology, Jinnah Postgraduate Medical Centre (JPMC), Karachi, a major tertiary referral centre serving Sindh province and beyond observational data have been collected on three common malignancies: cervical cancer, colorectal

carcinoma, and acute leukaemia. Reviewed individually, each of these studies offered valuable site-specific insights. Cervical cancer cases followed patterns broadly consistent with established epidemiological expectations, with associations to high parity and presumed HPV exposure (4,5). In contrast, colorectal carcinoma and acute leukaemia cases frequently involved younger adults, many presenting with advanced disease (6,7,11,12). When considered together, these datasets offer a cross-malignancy perspective on cancer presentation at a single urban Pakistani centre. Whether this constitutes a consistent pattern of earlier disease onset across non-gynaecological cancers and how such a pattern compares with national, regional, and global benchmarks, has not previously been examined in a synthesised manner. The present study addresses this gap by integrating data from four contemporaneous observational studies conducted at the same institution and contextualizing the findings against data from Pakistani registries, South Asian cohorts, and international sources including GLOBOCAN 2020 and the Surveillance, Epidemiology, and End Results (SEER) programme (1,3,8,9).

The novelty of this analysis lies not in the observation of early-onset cancer in isolation, but in demonstrating a consistent, cross-malignancy age divergence from global norms, a pattern with direct implications for screening thresholds, clinical suspicion, and public health planning in this setting.

## METHODS

### Study Design and Data Sources

This study constitutes a secondary synthesis of aggregated, anonymised data from four peer-reviewed cross-sectional observational studies conducted at the Department of Medical Oncology, JPMC, between late 2023 and early 2025 (10–13). All primary studies employed convenience sampling, included adult patients with histologically confirmed malignancies, and were conducted within the same clinical department. Recruitment periods were reviewed for potential overlap; where overlapping periods were identified, the combined patient totals were checked against study-reported figures to minimise the likelihood of duplicate case inclusion. Individual-level data were not available for re-analysis.

### Variables Extracted

Variables extracted from each primary study included age at diagnosis (reported as means with standard deviations, or medians with interquartile ranges, as available), sex distribution, disease stage at presentation (AJCC staging system for solid tumours; FAB classification where reported for leukaemia), histopathological subtypes, and documented lifestyle-associated factors. Where specific age-group proportions (e.g., percentage of patients under 40 years) were not directly reported, approximate estimates were derived from published group means, standard deviations, and medians using standard distributional assumptions. For normally distributed data (mean and SD available), proportions below a given threshold were estimated using the cumulative normal distribution. For skewed distributions represented by median and IQR, estimates were made with explicit acknowledgement of uncertainty. All such values are clearly labelled as approximations throughout this paper.

**Data origin statement:** All numerical values presented in this synthesis originate from the published primary studies (10–13) or cited benchmark sources (1,3–9,14–18). No extrapolation or modelling beyond the above-described approximations was performed.

### Statistical Approach

Given the unavailability of individual-level data, all analyses are descriptive. Comparative assessments across cancer types and against external benchmarks were conducted on the basis of effect magnitude and directionality, rather than formal statistical inference. The use of t-tests or chi-squared tests on aggregated summary statistics which would require unverifiable distributional assumptions was deliberately avoided.

Where proportions or group summaries are compared, findings are expressed as descriptive contrasts with explicit acknowledgement of their approximate nature.

### Benchmarking

Benchmarks were drawn from Pakistani cancer registry data (14–16), published South Asian cohort studies (17,18), and international datasets including GLOBOCAN 2020 (1) and the National Cancer Institute SEER programme (3,9). Comparisons were made at the level of age at presentation, sex distribution, and stage at diagnosis, where data permitted.

### Ethical Considerations

Each primary study received institutional ethics committee approval prior to data collection, and all data used in this synthesis were de-identified prior to publication. As this analysis is based solely on previously published aggregated data, no additional ethical approval was required.

## RESULTS

The combined dataset of 329 patients, including 92 with cervical cancer, 107 with colorectal carcinoma, and 130 with acute leukaemia provides a contemporaneous cross-malignancy perspective on cancer demographics at a major urban Pakistani referral centre. Key findings are presented below and summarised in Tables 1–3.

### Age at Diagnosis and Early-Onset Patterns

Table 1 presents age at diagnosis alongside local, regional, and global comparators across all three cancer types.

**Table 1: Age at Diagnosis and Benchmark Comparisons Across Cancer Types**

| Cancer Type | n | Mean/Median Age (years) | Proportion <40 years (%) | Local Pakistan Age Range | Regional South Asia Age Range | Global Median (years) |
|---|---|---|---|---|---|---|
| Cervical Cancer | 92 | Mean 53.4 (SD 10.9) | ~11 | 48–53 (10) | 50–55 (4) | 50–53 (1) |
| Colorectal Carcinoma | 107 | Median 40 (IQR 16) | ~65 | 37–55 (11,6) | 43–62 (17) | 68–72 (3) |
| Acute Leukaemia | 130 | Mean 27.9 (SD 14.5) | ~80 | 30–38 (12) | 35–45 (18) | 68–71 (9) |

Cervical cancer presented at a mean age of 53.4 years (SD 10.9), with approximately 11% of patients aged under 40 years. This profile was closely consistent with reported local and international data (1,4,10). Colorectal carcinoma, in contrast, presented at a median age of 40 years (IQR 16), with an estimated 65% of patients under 40. This is markedly younger than the global median of 68–72 years reported in SEER data (3) but broadly concordant with age ranges reported from other Pakistani centres (37–55 years) (6,11) and regional South Asian cohorts (43–62 years) (17).

Acute leukaemia presented at the youngest age profile, with a mean of 27.9 years (SD 14.5) and approximately 80% of patients under 40. This is substantially younger than the global age range of 68–71 years for acute myeloid leukaemia (9) and also younger than the upper ranges reported from Pakistan (30–38 years) (7,12) and South Asia (35–45 years) (18), though broadly within the lower end of these distributions. The estimated proportion of patients under 40 years varied markedly across the three cancer types (Table 2). These differences are presented descriptively, given that the proportions for cervical and leukaemia groups are approximations derived from distributional parameters rather than directly reported counts.

**Table 2: Estimated Proportion of Patients Diagnosed Under 40 Years of Age by Cancer Type**

| Cancer Type | Approximate Proportion <40 Years (%) | Notes |
|---|---|---|
| Cervical Cancer | ~11 | Derived from primary study distribution (10) |
| Colorectal Carcinoma | ~65 | Derived from primary study distribution (11) |
| Acute Leukaemia | ~80 | Derived from primary study distribution (12) |

**Sex Distribution, Disease Stage, and Risk Factors**

A male predominance was observed in both colorectal carcinoma (66% male) and acute leukaemia (65% male). Sex-disaggregated data were consistent with findings from comparable Pakistani studies (6,7). Advanced-stage disease at presentation was common among the solid tumours. Approximately 60% of cervical cancer cases presented at Stages II–III (10), and 67% of colorectal carcinoma cases were classified as Stage III at diagnosis (11). Staging data for acute leukaemia were not consistently reported across the primary studies, precluding a comparable estimate for that group. These advanced-stage rates align with Pakistani registry data demonstrating high rates of late presentation (14) and contrast with lower proportions reported in high-resource settings (1). Among colorectal carcinoma patients, a high prevalence of potentially modifiable lifestyle-associated factors was documented: 92% reported sedentary behaviour and 58% reported current or past smoking (11). In cervical cancer cases, high parity was the most frequently recorded clinical association, noted in 62% of patients (10). No consistent risk factor associations were reported across the acute leukaemia studies included. Table 3 summarises sex, staging, and risk factor data across the three cancer types.

**Table 3: Sex Distribution, Disease Stage, and Key Risk Factor Highlights by Cancer Type**

| Feature | Cervical Cancer | Colorectal Carcinoma | Acute Leukaemia |
|---|---|---|---|
| Male (%) | 0 | 66 | 65 |
| Advanced Stage (%) | 60 (Stages II–III) | 67 (Stage III) | Not consistently reported |
| Notable Associations | High parity (62%) | Sedentary behaviour (92%); smoking (58%) | None consistently identified |

## DISCUSSION

The principal finding of this synthesis is a pronounced shift toward younger age at presentation for colorectal carcinoma and acute leukaemia at JPMC, Karachi a divergence from global norms that appears to reflect a broader regional pattern rather than an artefact of this institution alone. With median and mean ages at presentation of 40 and 27.9 years respectively, these patients present decades earlier than the global medians of 68–72 years for colorectal carcinoma and 68–71 years for acute leukaemia (1,3,9). The estimated proportions of under-40 cases, approximately 65% and 80% respectively, far exceed the under-10–15% figures reported in global high-income datasets for colorectal carcinoma (15), and are consistent with patterns described across Pakistan and South Asia more broadly (6,7,17,18).

Cervical cancer, by contrast, followed established demographic expectations, presenting at a mean age of 53.4 years and closely mirroring both local and international comparators (1,4,10). The strong association with high parity (62%) is consistent with documented HPV-related risk profiles in the region (4,5), and highlights the importance of sustaining and expanding HPV vaccination and cervical screening initiatives. Even so, the proportion of cervical cancer cases presenting at advanced stage remained high — 60% at Stage II or III — which is consistent with Pakistani registry data and reflects the persistent challenge of late diagnosis in this setting (14).

Several factors may contribute to the early-onset phenotype observed in colorectal carcinoma and acute leukaemia. Environmental and lifestyle exposures are plausible contributors: the high rates of sedentary behaviour (92%) and tobacco use (58%) documented in our colorectal cohort are consistent with risk factors identified in regional literature (6,16). Urban Karachi presents a constellation of exposures including air pollution, dietary transitions towards processed foods, and occupational sedentarism that have been proposed as potential contributors in analogous LMIC settings. Genetic predisposition is another plausible factor; population-specific germline variants or hereditary cancer syndromes may be more prevalent than currently recognised, though systematic genomic data from Pakistani populations remain limited. This represents a significant gap in the evidence base.

The advanced stage at presentation observed across both solid tumour groups has multifactorial origins. Younger patients may not recognise the significance of early symptoms, or may attribute them to more common benign conditions. Clinicians unfamiliar with the epidemiological context of their population may have a lower index of suspicion for malignancy in working-age adults. Structural barriers, including financial access, geographic distance from tertiary facilities, and healthcare-seeking behavior, further compound diagnostic delays. These factors collectively perpetuate the late presentation that characterises cancer in many LMIC contexts (1,14).

**Clinical and Policy Implications**

The findings of this synthesis have practical implications for both clinical practice and public health policy. Current international guidelines recommending commencement of colorectal cancer screening at age 45–50 (3) are likely to miss a substantial proportion of cases in this population. A locally appropriate approach might include opportunistic assessment of symptomatic or high-risk individuals from age 35–40, using accessible modalities such as faecal immunochemical testing or flexible sigmoidoscopy. Any such recommendation, however, must be grounded in prospective epidemiological evidence from multi-centre Pakistani data rather than extrapolated from international guidelines developed in different demographic contexts.

At the clinical level, these findings argue for a lower threshold of suspicion for gastrointestinal malignancy and haematological cancer in patients presenting in the third and fourth decades of life. Persistent rectal bleeding, unexplained anaemia, unintentional weight loss, or constitutional symptoms in young adults warrant structured workup rather than empirical management. General practitioners and emergency physicians, who are frequently the initial point of contact in Pakistan's healthcare system would benefit from targeted continuing education programmes that emphasise age-agnostic red flag recognition. From a public health perspective, awareness campaigns that frame cancer as a condition affecting working-age adults rather than exclusively the elderly may reduce symptom minimisation and encourage earlier presentation. Strengthening national cancer registry infrastructure would provide longitudinal data necessary to track these demographic trends, identify geographic variation, and support evidence-based guideline development.

**Economic and Societal Considerations**

Early-onset cancers disproportionately affect individuals of working age, with consequences extending beyond clinical outcomes. The economic impact of lost productivity, prolonged treatment courses, and informal caregiver burden falls heavily on households with limited financial resilience (2). Addressing upstream determinants, including smoking cessation, physical activity promotion, and occupational health alongside improvements in diagnostic pathways may reduce both the incidence and the socioeconomic consequences of these malignancies over time. The data originate from a single tertiary referral centre, which may introduce referral bias; patients with complex or advanced disease, or those from lower socioeconomic backgrounds without access to closer facilities, may be overrepresented relative to the general population of cancer

patients in Karachi. Individual- level data were not available, precluding adjustment for confounders or formal statistical testing; all group comparisons are descriptive and should be interpreted accordingly. Certain age-group proportions were estimated from distributional parameters rather than directly reported, introducing additional uncertainty. The consistency of variable reporting across the four primary studies also varied, particularly for acute leukaemia, limiting cross-cancer comparisons in some domains. Finally, misclassification or data recording errors in the original studies cannot be independently verified.

The principal strengths of this work include the contemporaneous nature of the datasets, their origin from a consistent clinical setting, the structured approach to multi-level benchmarking, and the transparency with which data origins and approximations have been reported. The synthesis adds value by identifying patterns across malignancies that would not be apparent from any single primary study.

## CONCLUSION

This secondary synthesis demonstrates that colorectal carcinoma and acute leukaemia at a major Pakistani tertiary centre present predominantly in younger adults, a pattern consistent with regional data but markedly divergent from global medians. Cervical cancer follows established demographic norms, though advanced-stage presentation remains a shared challenge across all three tumour types. These findings support a clinical reorientation towards age-agnostic cancer suspicion in the Pakistani context, alongside policy-level consideration of locally applicable, lower screening age thresholds. Prospective, multi-centre collaborative studies are needed to provide the epidemiological foundation for evidence-based, population-specific cancer control strategies.

### Conflict of Interest

The author declares no conflict of interest.

### Ethical Consideration

This study is based solely on previously published, aggregated, and de-identified data; each primary study received institutional ethics committee approval prior to data collection, and no additional ethical approval was required for this synthesis.

## REFERENCES


1. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021;71(3):209–249. doi:10.3322/caac.21660
2. Arnold M, Morgan E, Rumgay H, et al. Current and future burden of breast cancer: Global statistics for 2020 and 2040. Breast. 2022;66:15–23. doi:10.1016/j.breast.2022.08.010
3. Howlader N, Noone AM, Krapcho M, et al. SEER Cancer Stat Facts: Colorectal Cancer. National Cancer Institute [Internet]. Available from: https://seer.cancer.gov/statfacts/html/colorect.html
4. Bhurgri Y, Nazir K, Shaheen Y, Usman A, Faridi N, Bhurgri H, et al. Patho-epidemiology of Cancer Cervix in Karachi South. Asian Pac J Cancer Prev. 2007;8(3):357–362.
5. Effect of Age on Survival in Patients with Cervical Cancer. Pak J Health Sci. 2023;4(02). doi:10.54393/pjhs.v4i02.622
6. Osama M, Moosa H, Rangwala HS, Rangwala BS, Farrukh A, Fayaz S, et al. Analysis of demographic associations and survival outcomes in patients with colorectal cancer at a tertiary care hospital in Pakistan: a retrospective cross-sectional study. Cancer Control. 2025;32:10732748251351423. doi:10.1177/10732748251351423
7. Ashfaq M, Haider G, Aslam B, Taj A, Ahmed K, Rani B. Association of Major Leukaemias with Different Age Groups. Pak Armed Forces Med J. 2023;73(Suppl-1):S73–78. doi:10.51253/pafmj.v73iSUPPL-1.5389
8. Ferlay J, Ervik M, Lam F, et al. Global Cancer Observatory: Cancer Today. Lyon: International Agency for Research on Cancer; 2024. Available from: https://gco.iarc.who.int/today

9. Howlader N, Noone AM, Krapcho M, et al. SEER Cancer Stat Facts: Acute Myeloid Leukaemia. National Cancer Institute [Internet]. Available from: https://seer.cancer.gov/statfacts/html/amyl.html
10. Hashmat S, Bhutto S, Haider G, Qazi SA, Shah A, Qureshi A. The age, parity and stage of cervical cancer among cervical cancer patients attending oncology department — an observational cross-sectional study. Liaquat Med Res J. 2024;6(3). doi:10.38106/LMRJ.2024.6.3-08
11. Bhutto S, Hashmat S, Haider G, Rehman A, Zahoor S, Qazi SA, Qureshi A. The changing trends amongst patients with colorectal carcinoma presenting at medical oncology department, JPMC. Liaquat Med Res J. 2024;6(4). doi:10.38106/LMRJ.2024.6.4-03
12. Bhutto S, Haider G, Hashmat S, Alam N, Zahoor S, Qazi SA, Qureshi A. Current trends in acute leukaemia: a cross-sectional survey of adult acute leukaemia cases. Liaquat Med Res J. 2025;7(1). doi:10.38106/LMRJ.2025.7.1-02
13. Hashmat S, Bhutto S, Haider G, Kumar K, Qazi SA, Alam N, Qureshi A. The age standardized remission rate of acute myeloid leukaemia in adults. Liaquat Med Res J. 2024;6(4). doi:10.38106/LMRJ.2024.6.4-04
14. Late-stage diagnosis and its impact on survival in Pakistani women with cervical cancer: Findings from an institutional cancer registry. Pak J Med Sci. 2024. doi:10.12669/pjms.41244540
15. Early onset colorectal cancer in Pakistan: Frequency and association with stage and grade. J Clin Oncol. 2025;43(16 Suppl):e15709. doi:10.1200/JCO.2025.43.16_suppl.e15709
16. Zubair M, Akhtar MAB, Tayyab Z, Kazim SM, Syed A, Khattak S, et al. Incidence, Clinicopathological Features, and Outcomes of Signet Ring Colorectal Carcinoma: A Retrospective Study. Cureus. 2024;16(12):e74916. doi:10.7759/cureus.74916
17. Khan M, Altaf C, Malik HS, Naeem MA. Cytogenetic profile of Acute Myeloid Leukaemia and Acute Lymphoblastic Leukaemia in Northern Pakistan. Pak J Med Sci. 2023;39(5):1440–1445. doi:10.12669/pjms.39.5.6405
18. Demographic and Clinical Characteristics of Adult Acute Myeloid Leukaemia — Tertiary Care Experience. Asian Pac J Cancer Prev. 2016;17(1):357–360.

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# ASSOCIATION BETWEEN IDIOPATHIC TOE WALKING AND GROSS MOTOR SKILL DEVELOPMENT IN EARLY CHILDHOOD

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## ABSTRACT:

The objective of this cross-sectional study was to establish the association between idiopathic toe walking and gross motor skill acquisition among children aged 4 to 10 years. Data were collected between July 2025 and January 2026 from the Physical Therapy and Rehabilitation Department at the University of Lahore Teaching Hospital (ULTH) and the Physical Therapy Department at Sehat Medical Complex (SMC), Hanjarwal, Lahore, Pakistan, after obtaining informed written consent. Children with idiopathic toe walking (ITW) were recruited through non-probability convenience sampling (n = 29). ITW characteristics were assessed using the Toe Walking Tool (TWT), while gross motor performance was measured using the locomotor subtest of the Test of Gross Motor Development, Third Edition (TGMD-3). Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 26, applying descriptive statistics and the Spearman rank correlation. A statistically significant moderate negative correlation was found between toe-walking frequency and gross motor development scores ($r = -0.529$, $p = 0.003$). Children with higher severity of toe walking demonstrated lower gross motor performance, and significant differences in motor scores were observed across severity groups. Idiopathic toe walking is significantly associated with reduced gross motor skill development; increased frequency and severity of toe walking are linked with poorer motor performance, highlighting the importance of early identification and physiotherapy intervention.

**Keywords:** Early childhood, Gait, Motor skills, Movement, Physical performance

## INTRODUCTION

Toe walking is a gait pattern in which children walk on their forefeet without heel contact (1). A certain amount of toe walking in very young children is generally interpreted as part of normal motor exploration during development; however, when the pattern persists beyond the age at which it is expected to resolve, it becomes a cause for clinical concern (2). Persistent toe walking may become fixed and can lead to pain, movement impairment, restriction in school and play activities, and reduced emotional wellbeing (3). Idiopathic toe walking (ITW) is regarded as a diagnosis of exclusion and may continue into later childhood, potentially affecting lower-limb biomechanics and the functional development of motor activity. The reported prevalence of idiopathic toe walking ranges from 2% to 5% among otherwise healthy children below ten years of age (4) a developmental window during which basic motor skills and habitual physical activity are established. Because motor competence, social participation, and psychosocial wellbeing are closely tied to physical activity, the early appearance of ITW raises the need to understand its wider impact, particularly on the acquisition of gross motor skills and on everyday functional activities (5). ITW is observed in both sexes, indicating that it reflects neuromuscular control rather than a sex-linked characteristic (6). It is commonly associated with ankle equinus (7) and is thought to be an important

contributor to foot pain, poor motor skills, and low participation in sport and leisure activity, with only limited guidelines available to support consistent treatment recommendations (8). This study was conducted to determine the association between idiopathic toe walking and gross motor skill development in children. It was hypothesised that increased frequency and severity of toe walking are associated with poorer gross motor performance.

## METHODS

This cross-sectional study was conducted at the Physical Therapy and Rehabilitation Department of the University of Lahore Teaching Hospital (ULTH) and the Physical Therapy Department of Sehat Medical Complex (SMC), Hanjarwal, Lahore, Pakistan, following informed written consent and approval from the Research Ethics Committee (REC), University Institute of Physical Therapy, University of Lahore (REC No. REC-UIPT-29-08926/DPT-Aug-2025, dated 29 August 2025). Using convenience sampling, 29 participants were recruited with the aid of Epi Tool (9).

**Inclusion criteria:** Children aged 4 to 10 years at the time of enrolment, of either sex, who demonstrated a stable pattern of ITW gait with a Gross Motor Quotient below 90 were included.

**Exclusion criteria:** Children with a diagnosed neurological, neuromuscular, cognitive, or genetic disorder were excluded, as were those with any acute lower-limb injury or fracture, or emotional or psychological stress within the preceding six months. Written informed consent was obtained from the parents or guardians of all participating children prior to data collection, and the study was conducted in accordance with ethical standards for research involving human participants.

Data were collected using questionnaires and standardised assessment instruments, namely the Toe Walking Tool (TWT) and the Test of Gross Motor Development, Third Edition (TGMD-3), which were used to record demographic details, gait characteristics, and gross motor skills. Only the locomotor subtest of the TGMD-3 was administered, as the study was concerned with gait-based gross motor performance. All children were assessed in a relaxed, distraction-free setting, with their caregivers present to help them cooperate during the assessment.

### Statistical Analysis

Data were analysed using SPSS version 26. Demographic variables and gross motor development categories were summarised using descriptive statistics. The Shapiro–Wilk test indicated that the data were not normally distributed; the Spearman rank correlation coefficient was therefore used to determine the strength and direction of the relationship between the variables. Gross motor development scores across the toe-walking severity groups were compared using the Kruskal–Wallis H test. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

### Demographic Characteristics of Participants

A total of 29 children with toe walking were included in the final analysis. As shown in Table 1, most children had an idiopathic presentation, with no reported medical condition (79.3%) and no family history of toe walking (86.2%). Toe-walking frequency varied, with nearly half of the children walking on their toes only occasionally (48.3%). A functional impact was reported for 48.3% of children, while 89.7% had received no prior intervention. Most children (82.8%) had achieved their gross motor milestones, and the sample was almost evenly distributed by sex.

### Association Between Toe-Walking Frequency and Gross Motor Development

As shown in Table 2, the analysis revealed a statistically significant moderate negative correlation between toe-walking frequency and gross motor development scores (Spearman's rho = -0.529, p = 0.003). This indicates that a higher reported frequency of toe walking was associated with poorer standardised gross motor performance in this sample. To examine differences in gross motor development across the mild, moderate, and severe toe-walking groups, a Kruskal–Wallis H test was applied because of the non-normal distribution of the data. As shown in Table 3, the mean rank was highest in the mild group, followed by the moderate group, and was lowest in the severe group, indicating a graded relationship in which greater toe-walking severity is associated with poorer gross motor performance.

**Table 1. Demographic characteristics of participants (n = 29).**

| Variable | Frequency (n) | Percent (%) |
|---|---|---|
| **Child Gender** | | |
| Male | 15 | 51.7 |
| Female | 14 | 48.3 |
| Total | 29 | 100.0 |
| **Birth History** | | |
| Full term | 25 | 86.2 |
| Pre term | 4 | 13.8 |
| Total | 29 | 100.0 |
| **Toe-Walking Frequency** | | |
| Always | 8 | 27.6 |
| Sometimes | 14 | 48.3 |
| Rarely | 7 | 24.1 |
| Total | 29 | 100.0 |
| **Reported Medical Condition** | | |
| No | 23 | 79.3 |
| Yes | 6 | 20.7 |
| Total | 29 | 100.0 |
| **Previous Interventions for Toe Walking** | | |
| No | 26 | 89.7 |
| Yes | 3 | 10.3 |
| Total | 29 | 100.0 |
| **Gross Motor Milestone Achievement** | | |
| No | 5 | 17.2 |
| Yes | 24 | 82.8 |
| Total | 29 | 100.0 |
| **Family History of Toe Walking** | | |
| No | 25 | 86.2 |
| Yes | 4 | 13.8 |
| Total | 29 | 100.0 |
| **Functional Impact of Toe Walking** | | |
| No | 15 | 51.7 |
| Yes | 14 | 48.3 |
| Total | 29 | 100.0 |

**Table 2. Spearman correlation between idiopathic toe-walking frequency and gross motor development.**

| Variables | Spearman's rho (r) | Sig. (2-tailed) | N |
|---|---|---|---|
| Toe-walking frequency vs. gross motor development scores | -0.529** | 0.003 | 29 |

***Correlation is significant at the 0.01 level (2-tailed).*

## DISCUSSION

The present study set out to determine the relationship between idiopathic toe walking and gross motor skill development in children. Although persistent toe walking has traditionally been regarded as a benign developmental variation, accumulating evidence suggests that it may be linked to measurable differences in functional and motor performance.

**Table 3. Comparison of gross motor development scores across toe-walking severity groups (Kruskal–Wallis test).**

| Toe-walking severity | N | Mean rank |
|---|---|---|
| Mild | 7 | 20.57 |
| Moderate | 14 | 16.39 |
| Severe | 8 | 7.69 |
| **Total** | **29** | |

The findings of this study are, in part, consistent with the existing literature. Several studies have reported that idiopathic toe walking is associated with deficits in balance, coordination, posture, and motor planning. The negative correlation observed here between toe-walking frequency and gross motor development supports earlier work indicating that continuous toe walking can disrupt efficient movement patterns and functional motor activity.

The present study examined the relationship between ITW severity and gross motor skill development, whereas Morrow et al. focused on quality of life in children with ITW. Their findings pointed to reduced physical functioning, particularly in persistent cases. In a similar vein, the present results show that greater ITW severity is associated with poorer gross motor performance. Although most children in this sample achieved their early milestones, their motor scores varied widely, suggesting subtle impairments. In contrast to the largely subjective focus of that earlier work, the present study provides objective evidence of declining motor performance with increasing ITW severity (10).

Compared with the cross-sectional survey by Harris et al. on ITW management in the United Kingdom, the present study focuses on the functional relationship between ITW and gross motor development in early childhood. Harris et al. described differences in treatment approaches between physiotherapists and surgeons based on perceived severity. By contrast, the present study offers objective evidence of a strong negative relationship between toe-walking frequency and motor performance, showing a decline in motor skill with increasing ITW severity. Whereas their work emphasised clinical decision-making, these findings support early, targeted physiotherapy by demonstrating measurable motor impairment in severe and persistent ITW (11).

Unlike the review by Freiman et al., which examined the diagnosis, progression, and treatment of ITW, the present study concentrates on the link between ITW severity and gross motor skill in young children. While Freiman et al. noted that many children show normal early development and may improve spontaneously — consistent with the present finding that most children reached their early milestones — this study identifies a strong negative relationship between toe-walking frequency and motor performance. It demonstrates that gross motor skill declines as ITW severity increases, suggesting that chronic ITW may contribute to functional impairment and underlining the need for timely assessment and targeted physiotherapy (12).

Compared with Gray et al., who sought to standardise outcome measures for assessing ITW severity, the present study examines the functional relationship between ITW severity and gross motor development in early childhood. Gray et al. highlighted inconsistencies in assessment and the importance of parental input; the present study adds empirical evidence of a significant negative correlation between toe-walking frequency and motor performance (Spearman's rho = -0.529, p = 0.003), showing that gross motor skill declines as ITW severity increases. Rather than focusing on measurement standardisation, these findings emphasise the clinical value of early detection and targeted physiotherapy in addressing potential motor impairment (13).

Bauer et al. suggested that most children with ITW achieve their early motor milestones and follow a benign course. The present study echoes this in part — 82.8% of children in the sample reached their milestones on time — but also reveals notable functional variability, with a moderate negative correlation between toe-walking frequency and gross motor development. Unlike the diagnostic and treatment focus of Bauer et al., the present study demonstrates a gradual decline in motor performance with increasing ITW severity, suggesting an underlying functional impairment rather than a simple gait variation (14).

Other work has explored sensory processing differences in children with idiopathic toe walking, reporting that altered sensory modulation — particularly tactile and proprioceptive processing — may contribute to persistent toe-walking behaviour. The present study, by contrast, focused on functional outcomes and demonstrated a significant negative association between toe-walking severity and gross motor skill development. Taken together, these lines of evidence indicate that idiopathic toe walking is multifactorial, involving both sensory processing differences and measurable deficits in gross motor performance, and reinforce the need for comprehensive assessment and early intervention (15).

Studies of the prevalence and natural history of idiopathic toe walking have reported that many children outgrow the condition spontaneously without significant long-term consequences. The present findings, however, show a significant negative association between toe-walking frequency and gross motor skill development, particularly in children with persistent and severe patterns. While Engström and Tedroff emphasised the generally benign, self-limiting nature of idiopathic toe walking, the present results suggest that persistent cases may be associated with functional motor impairment, highlighting the importance of early assessment and targeted intervention (16).

Work assessing dynamic stability in children with idiopathic toe walking has reported that altered gait mechanics and reduced stability may contribute to inefficient walking patterns. The present study extends these biomechanical observations by demonstrating a significant negative association between toe-walking severity and gross motor skill development. Whereas that earlier work concentrated on gait-stability deficits, the present results point to a broader functional impact on locomotor performance, suggesting that impaired dynamic stability may underlie the reduced gross motor outcomes seen in children with persistent idiopathic toe walking (17).

Finally, research using wearable sensors and machine learning to classify gait patterns in children with ITW has identified measurable variations in movement. The present study, in contrast, focuses on functional outcomes, showing a significant negative relationship between ITW severity and gross motor skill. While that earlier research emphasised technological assessment, the present study highlights clinical relevance by linking greater severity with poorer motor performance. Together, these approaches underline the value of combining gait analysis with functional evaluation for a comprehensive understanding of ITW (18). There are a few limitations of the study need to be considered when interpreting these findings. First, the small sample size and the restriction to two Lahore-based rehabilitation centres limit the generalisability of the results. Second, the use of only the locomotor subtest of the TGMD-3 provides a narrow picture of gross motor skill, as ball skills were not assessed. Finally, the short study duration precluded long-term follow-up, limiting insight into how motor development changes over time.

## CONCLUSION

This study concludes that idiopathic toe walking is significantly associated with reduced gross motor skill development. Increased frequency and severity of toe walking are linked with poorer motor performance. Early identification and targeted physiotherapy intervention are recommended to improve functional outcomes. Future research should recruit a larger and more geographically diverse sample to strengthen statistical power and external validity, as the present work was confined to an urban population. The administration of the full Test of Gross Motor Development, Third Edition (TGMD-3), rather than the locomotor subtest alone, is strongly advised so that both locomotor and object-control abilities can be evaluated and the influence of ITW on gross motor proficiency more fully described. Longitudinal studies following children with ITW over time are also needed to clarify developmental trajectories and establish causal relationships.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

## ETHICAL APPROVAL

The study was approved by the local Research Ethics Committee.

## REFERENCES

1. Costanza C, Gallai B, Sorrentino M, Gnazzo M, Pisanò G, Parisi L, et al. The prevalence and clinical significance of toe walking in autism spectrum disorder: a cross-sectional study in an Italian pediatric sample. Medicina. 2025;61(8):1346. https://doi.org/10.3390/medicina61081346
2. Gwerder M, Widmer M, Schären O, Singh NB, Sangeux M, Viehweger E. Assessing dynamic stability in children with idiopathic toe walking during overground walking. Clin Biomech. 2025;123:106468. https://doi.org/10.1016/j.clinbiomech.2025.106468
3. de Angeli LRA, Serafim BLC, Masquijo JJ. The autistic toe walking: a narrative review for interventions and comparison with idiopathic toe walking. Children. 2025;12(9):1198. https://doi.org/10.3390/children12091198
4. Caserta A, Reedman S, Morgan P, Williams CM. Physical activity and quality of life in children with idiopathic toe walking: a cross-sectional study. BMC Pediatr. 2022;22(1):544. https://doi.org/10.1186/s12887-022-03583-w
5. Veerkamp K, van der Krogt MM, Waterval NF, Geijtenbeek T, Walsh HJ, Harlaar J, et al. Predictive simulations identify potential neuromuscular contributors to idiopathic toe walking. Clin Biomech. 2024;111:106152. https://doi.org/10.1016/j.clinbiomech.2023.106152
6. De Oliveira V, Arrebola L, De Oliveira P, Yi L. Investigation of muscle strength, motor coordination and balance in children with idiopathic toe walking: a case-control study. Dev Neurorehabil. 2021;24(8):540–546. https://doi.org/10.1080/17518423.2021.1899326
7. Robinson JM, Mielke CH. Ankle equinus. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024.
8. Williams CM, Gray K, Davies N, Barkocy M, Fahey M, Simmonds J, et al. Exploring health professionals' understanding of evidence-based treatment for idiopathic toe walking. Child Care Health Dev. 2020;46(3):310–319.
9. Engström P, Tedroff K. Idiopathic toe-walking: prevalence and natural history from birth to ten years of age. J Bone Joint Surg Am. 2018;100(8):640–647.
10. Morrow E, Harris J, Gelfer Y, Cashman J, Kothari A; FU Collaborators. Health-related quality of life in idiopathic toe walkers: a multicenter prospective cross-sectional study. J Pediatr Orthop. 2024;44(4):e357–e360.
11. Harris J, Gelfer Y, Cashman J, Eyre-Brook A, Kothari A. Current management of idiopathic toe-walking gait in children and young people in the UK: a cross-sectional survey to reflect physiotherapists' and surgeons' perspectives. J Surg. 2022. https://doi.org/10.29011/2575-9760.001688
12. Freiman HD, Mensah C, Codrington J, Frick SL. Idiopathic toe-walking in children and adolescents: diagnosis, natural history, and treatment options. JBJS Rev. 2022;10(2):e21.
13. Gray K, Pacey V, Caserta A, Polt D, Williams C. Development of the Idiopathic Toe Walking Outcome (iTWO) proforma: a modified Delphi study and online parent survey for measurement consensus. Gait Posture. 2023;99:111–118.

14. Bauer JP, Sienko S, Davids JR. Idiopathic toe walking: an update on natural history, diagnosis, and treatment. J Am Acad Orthop Surg. 2022;30(22):e1419–e1430.
15. Chu V, Girolami GL, Grant-Beuttler M. Assessing sensory processing differences in children with idiopathic toe walking: a pilot study. Physiother Theory Pract. 2023;39(11):2314–2326.
16. Engström P, Tedroff K. Idiopathic toe-walking: prevalence and natural history from birth to ten years of age. J Bone Joint Surg Am. 2018;100(8):640–647.
17. Gwerder M, Widmer M, Schären O, Singh NB, Sangeux M, Viehweger E. Assessing dynamic stability in children with idiopathic toe walking during overground walking. Clin Biomech. 2025;123:106468.
18. Soangra R, Wen Y, Yang H, Grant-Beuttler M. Classifying toe walking gait patterns among children diagnosed with idiopathic toe walking using wearable sensors and machine learning algorithms. IEEE Access. 2022;10:77054–77067.

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# KNOWLEDGE, ATTITUDE, AND PRACTICE OF PHARMACISTS IN PAKISTAN REGARDING PHARMACEUTICAL PRODUCT RECALL

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## ABSTRACT

Pharmaceutical product recalls are essential for safeguarding public health by removing defective, unsafe, or substandard medicines from circulation. Pharmacists play a key role in identifying, communicating, and managing recalled products; however, evidence regarding their preparedness in Pakistan remains limited. A cross-sectional KAP survey was conducted among pharmacists working in clinical, industrial, hospital, community, retail, and academic settings across Pakistan. A structured and internally validated questionnaire assessed participants' knowledge, attitudes, and practices related to pharmaceutical product recalls. Reliability was evaluated using Cronbach's alpha. Descriptive statistics, Mann–Whitney U, Kruskal–Wallis, and correlation analyses were performed. A total of 106 pharmacists participated, including 49.1% males and 50.9% females. Most respondents demonstrated good awareness regarding recall definitions, recall classifications, and the importance of timely communication during recalls. More than 95% supported immediate recalls for safety concerns, while 97.2% emphasized timely communication with healthcare professionals and the public. Despite positive knowledge and attitudes, practical exposure was limited, with only one participant reporting direct experience handling a recall. Approximately 38.7% reported never receiving recall-related information from authorities or manufacturers. Significant differences were observed in knowledge scores across gender ($p = 0.004$) and practice scores across professional domains ($p = 0.034$). Positive correlations were identified between knowledge, attitude, and practice scores. Pakistani pharmacists demonstrated good knowledge and positive attitudes toward pharmaceutical product recalls; however, practical engagement and communication systems remain inadequate. Strengthening recall reporting systems, communication channels, and practical training may improve recall preparedness and patient safety outcomes.

**Key Words:** Product recall, Pharmacovigilance, Patient Safety, Pharmacists

## INTRODUCTION

A pharmaceutical product recall is an important regulatory action in the product life cycle. It involves the removal or withdrawal of a product from the market to protect the public from defective or potentially harmful medicines. A recall is required when a product poses a health risk because of manufacturing defects or when it is identified as substandard, falsified, or spurious. Product recall is a key outcome of pharmacovigilance and an essential part of drug regulation (1). Inadequate quality control during manufacturing can result in the production and distribution of low-quality medicines. Poor-quality medicines may also enter the market through deliberate falsification (2). The relative contribution of these two sources is unclear. However, substandard but legitimate pharmaceutical

products may be more common and may pose a greater risk to patient health. Current regulations often focus more on intentionally falsified products, but both issues require effective control (3). This study aimed to assess the knowledge, attitudes, and practices of pharmacists in Pakistan regarding pharmaceutical product recalls. Pharmaceutical product recalls may be voluntary or statutory (4). Voluntary recalls usually occur when a product shows defects in quality, safety, or efficacy, whereas statutory recalls are initiated under the direction of drug regulatory authorities (4).

Pharmacists have an important role in recall management because they identify recalled products, remove them from use, communicate recall information, counsel affected patients, and report relevant findings to regulatory authorities (5). Drug recalls are issued when products present problems related to quality, safety, or effectiveness, including substandard or counterfeit medicines, serious adverse reactions, fatalities, or products with suspended or cancelled licenses (6, 7). This study assessed the knowledge, attitude, and practice of the pharmacist community in Pakistan regarding pharmaceutical product recalls.

## METHODOLOGY

### Study Setting and Participants

This was a cross-sectional survey-based study and data were collected through a structured online questionnaire using Google Forms. Participants were recruited by convenience sampling. Pharmacists from clinical, community, retail, hospital, industrial, and academic settings were included. Informed consent was obtained before participation. The questionnaire included sections on demographics, knowledge, attitudes, practices, recall-related actions, and satisfaction with the recall system. Demographic variables included age, gender, and education level. The knowledge section contained 8 items, the attitude section contained 5 items, and the practice section contained 4 items. The questionnaire also covered recall definitions, recall classification, communication channels, patient safety, actions taken during recall events, willingness to provide updates, and preferred reporting methods. This broad professional representation allowed assessment of recall-related knowledge, attitudes, and practices across multiple pharmacy settings.

Ethical approval was obtained from the Ethical Review Committee of Hamdard University under reference number FOP-ERC-04-12. The purpose of the study was explained to all participants before data collection. Written informed consent was obtained before questionnaire completion. The questionnaire was reviewed by experts for face and construct validity, and their suggestions were incorporated into the final version. A pilot study was then conducted with 30 respondents. Internal reliability was assessed using Cronbach's alpha.

### KAP Scoring

The Knowledge, Attitude, and Practice scoring system was used to assess participants' responses regarding pharmaceutical product recalls. Each item was scored on a five-point Likert scale ranging from 1 to 5, as described in Supplementary S1. Scores for items within each domain were added to obtain the total score. The maximum score was 40 for knowledge based on 8 items, 20 for attitude based on 4 items, and 10 for practice based on 2 items.

## RESULTS

### Demographics

Among 106 respondents, 52 (49.1%) were male and 54 (50.9%) were female. Most participants had a bachelor's degree (73, 68.9%), followed by a master's degree (31, 29.2%), while 2 (1.9%) had a PhD. By professional domain, 8 (7.5%) were clinical pharmacists, 44 (41.5%) were industrial pharmacists, 16 (15.1%) were community or retail pharmacists, 18 (17.0%) were hospital pharmacists, and 20 (18.9%) belonged to other categories. The median age was 27.0 years, with a 95% confidence interval of 27.0 to 28.0 years. The median professional experience was 3 years, with a 95% confidence interval of 3 to 4 years. These data are presented in Table 1.

The internal consistency of the study domains was assessed using Cronbach's alpha. The knowledge domain, which included eight items, showed moderate reliability with an alpha value of 0.639. The attitude domain, based on four items, also showed moderate internal consistency with an alpha of 0.643. The practice domain, which contained two items, showed comparatively higher reliability with an alpha of 0.737.

## Knowledge, Attitude, and Practice of the Pharmacist Community in Pakistan Regarding Product Recalls

Pakistani pharmacists showed good knowledge of pharmaceutical product recalls. Most respondents understood the definition of a product recall and the distinction between Class I, Class II, and Class III recalls. Most also supported immediate recall for serious safety concerns and recall for minor quality defects to protect patient safety. Participants recognized the public health importance of recalls, supported removal of related products from shelves, and considered timely communication with healthcare professionals and the public essential. Many also reported confidence in the steps required during a recall.

**Table 1: Demographic characteristics of respondents**

| Category | Indicators | N (%) |
|---|---|---|
| Gender | Male | 52 (49.1%) |
| | Female | 54 (50.9%) |
| Qualification | Bachelor | 73 (68.9%) |
| | Masters | 31 (29.2%) |
| | PhD | 2 (1.9%) |
| Domain | Clinical Pharmacist | 8 (7.5%) |
| | Industrial Pharmacist | 44 (41.5%) |
| | Community/Retail Pharmacist | 16 (15.1%) |
| | Hospital Pharmacist | 18 (17.0%) |
| | Other | 20 (18.9%) |

These findings are presented in Table 2. Attitudes toward pharmaceutical product recalls were positive. Most respondents believed that pharmaceutical companies should be responsible for issuing recalls. Most also supported the involvement of regulatory authorities and healthcare providers in mock recall exercises and favored improvement of recall communication channels. Many agreed that companies should take immediate action when safety concerns are identified and reported confidence in recognizing and responding to recall events. These findings are presented in Table 2. In contrast, recall-related practice was limited. Follow-up after recall events was poor, and regular submission of updates was uncommon. Receipt of recall information was also low. Reporting practices were suboptimal, as most respondents preferred reporting recall actions to the press, while fewer reported to the pharmaceutical company, the Drug Regulatory Authority, or their immediate manager. Overall, the findings indicate a gap between recall knowledge and practical implementation.

After receiving a product recall notice, respondents reported different intended actions. Most pharmacists (64.2%) stated that they would contact the manager. In addition, 29.2% reported that they would remove the product from pharmacy shelves. A smaller proportion (6.6%) stated that they would inform patients about the recall.

The comparison of KAP scores by gender showed that male participants had a higher mean knowledge score (32.48 ± 4.25) compared to females (30.72 ± 4.60). Practice scores were relatively similar between the two groups, with males scoring 16.44 ± 3.10 and females 16.00 ± 3.25. In contrast, female participants demonstrated a slightly higher mean attitude score (7.46 ± 1.15) than males (7.31 ± 1.20), indicating minimal variation between genders across the assessed domains.

### Assessment of Knowledge, Attitude, and Practice Scores among Genders

Gender was significantly associated with knowledge scores (U = 951.000, p = 0.004). In contrast, attitude scores (U = 1225.500, p = 0.245) and practice scores (U = 1479.500, p = 0.625) did not differ significantly by gender. Across qualification groups, knowledge scores (p = 0.070) and practice scores (p = 0.086) showed no significant difference, whereas attitude scores differed significantly (H = 6.11, p = 0.047). Pairwise analysis showed no significant difference in knowledge scores between bachelor's and master's groups (test statistic = −6.704, p = 0.294). However, attitude scores differed significantly between bachelor's and PhD groups (test statistic = −49.647, p = 0.020), and practice scores differed significantly between master's and PhD groups (test statistic = −42.944, p = 0.048). Across professional domains, knowledge scores (H = 1.706, p = 0.790) and attitude scores (H = 2.207, p = 0.698) showed no significant difference, while practice scores differed significantly (H = 10.443, p = 0.034). Gender was analyzed using the Mann–Whitney U test, whereas qualification and professional domain were analyzed using the Kruskal–Wallis test. These findings are presented in Figure 1.

**Table 2: Pharmacists' responses regarding knowledge, attitude, and practices about drug recalls**

| Questions / Indicators | SD N (%) | D N (%) | N N (%) | A N (%) | SA N (%) |
|---|---|---|---|---|---|
| **Knowledge** | | | | | |
| I am aware of the definition of a pharmaceutical product recall. | 1 (0.94) | 1 (0.94) | 2 (1.89) | 48 (45.28) | 54 (50.94) |
| I know the difference between Class I and Class II recalls. | 1 (0.94) | 5 (4.72) | 13 (12.26) | 53 (50.00) | 34 (32.08) |
| A pharmaceutical product recall should be initiated even for minor quality issues to ensure patient safety. | 2 (1.89) | 2 (1.89) | 1 (0.94) | 63 (59.43) | 38 (35.85) |
| Pharmaceutical product recall is a serious issue that affects patient safety and public health. | – | 1 (0.94) | 6 (5.66) | 64 (60.38) | 35 (33.02) |
| If a product recall is announced for a specific batch, all products of that name should be removed from shelves. | 2 (1.89) | 9 (8.49) | 4 (3.77) | 57 (53.77) | 34 (32.08) |
| Pharmaceutical companies should recall a product immediately if it is found to have a serious safety issue. | – | – | 1 (0.94) | 57 (53.77) | 48 (45.28) |
| Timely communication with healthcare professionals and the public during a product recall is essential. | – | 1 (0.94) | 2 (1.89) | 66 (62.26) | 37 (34.91) |
| I know the steps to take when a pharmaceutical product recall is issued. | 1 (0.94) | 13 (12.26) | 7 (6.60) | 64 (60.38) | 21 (19.81) |
| **Attitude** | | | | | |
| I think that pharmaceutical companies should be held accountable for issuing recalls. | – | – | 9 (8.49) | 78 (73.58) | 19 (17.92) |
| Should mock recall exercises involve relevant stakeholders like regulatory agencies and healthcare providers? | 1 (0.94) | 2 (1.89) | 13 (12.26) | 70 (66.04) | 20 (18.87) |
| I believe that communication channels for pharmaceutical product recalls could be improved. | 1 (0.94) | – | 3 (2.83) | 71 (66.98) | 31 (29.25) |
| Companies should take immediate action, including recalling products, when they discover a safety concern. | 1 (0.94) | – | 3 (2.83) | 71 (66.98) | 31 (29.25) |
| I feel confident in my ability to identify and respond to a pharmaceutical product recall. | 1 (0.94) | 11 (10.38) | 8 (7.55) | 65 (61.32) | 21 (19.81) |
| **Practice** | | | | | |
| **Questions / Indicators** | **Always N (%)** | **Often N (%)** | **Sometimes N (%)** | **Rarely N (%)** | **Never N (%)** |
| How likely are you to submit updates on actions following a product recall announcement? | 9 (8.49) | 22 (20.75) | 10 (9.43) | 15 (14.15) | 50 (47.17) |
| How often do you receive information about pharmaceutical product recalls from authorities or manufacturers? | 12 (11.32) | 13 (12.26) | 13 (12.26) | 27 (25.47) | 41 (38.68) |
| SD: Strongly Disagree, D: Disagree, N: Neutral, A: Agree, SA: Strongly Agree. | | | | | |

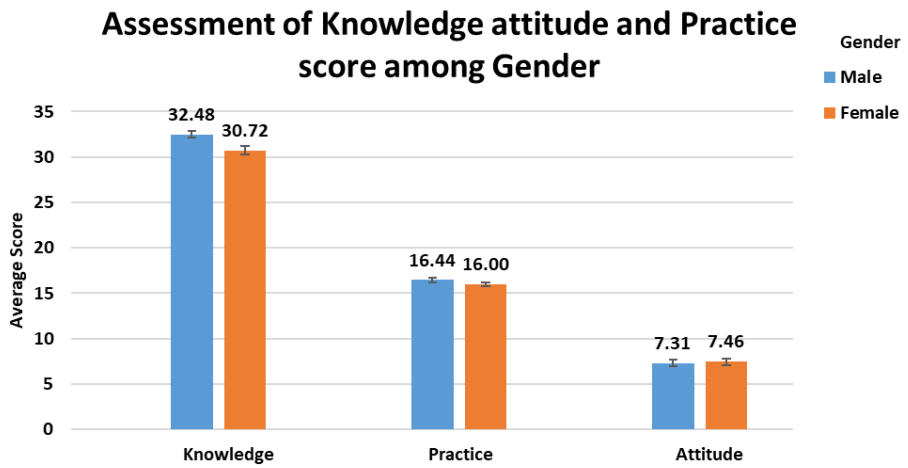


**Figure 1: Assessment of knowledge, attitude, and practice scores among genders. Error bars show Mean ± S.E.**

### Assessment of Knowledge, Attitude, and Practice across Professional Domains

Knowledge and attitude scores did not differ significantly across professional domains. Knowledge scores showed no significant variation ($p = 0.790$). Attitude scores also showed no significant variation ($p = 0.698$). In contrast, practice scores differed significantly across domains ($p = 0.034$). Pairwise analysis showed differences between the other group and industrial pharmacists ($p = 0.005$), and between community or retail pharmacists and industrial pharmacists ($p = 0.041$). After Bonferroni correction, only the difference between the other group and industrial pharmacists remained significant (adjusted $p = 0.049$). Correlation analysis showed a moderate positive association between knowledge and attitude scores (rho = 0.541, $p < 0.01$). However, practice scores showed weak negative correlations with knowledge scores (rho = −0.230, $p < 0.05$) and attitude scores (rho = −0.277, $p < 0.01$). These findings indicate that professional domain was associated with practice scores but not with knowledge or attitude scores, and that higher knowledge was associated with more positive attitudes, while practice showed an inverse relationship with both knowledge and attitude.

## DISCUSSION

This study assessed the knowledge, attitudes, and practices of pharmacists in Pakistan regarding pharmaceutical product recalls. The findings showed good knowledge and positive attitudes toward product recalls. However, practical involvement in recall activities was limited. This result indicates a gap between awareness and actual practice within the pharmaceutical safety system in Pakistan.

Pharmacists showed good knowledge of product recall systems, including recall classification categories. This finding suggests adequate theoretical understanding of recall procedures. Similar results were reported by Shanableh et al. (8), who found high awareness among pharmacists. That study linked awareness to academic training and regulatory communication. In Pakistan, this level of knowledge may also reflect the role of the Drug Regulatory Authority of Pakistan in recall communication (9). However, practical experience with recalls was limited among the participants. This finding indicates a gap between knowledge and implementation. In developed countries, pharmacists appear to have greater practical involvement in recall management. For example, community pharmacists in the United States handle a large number of recalls each year (10, 11). In contrast, the lower number of recalls reported by DRAP may reflect underreporting or limited activation of the recall system. This may reduce pharmacists' practical exposure to recall procedures. DRAP reported 45 recalls in 2022, most of which were Class II or Class III (9).

In this study, pharmacists showed a strong patient safety orientation. Most supported immediate product recalls when safety concerns were identified. Many also supported recalls for minor quality defects. These views are consistent with international pharmacovigilance principles described by the

World Health Organization (12). Most respondents assigned primary recall responsibility to manufacturers, which suggests awareness of accountability within the pharmaceutical supply chain. However, this view may reduce the perceived role of pharmacists in recall implementation. Clear protocols are therefore needed to define shared responsibilities among all stakeholders.

A key finding was the strong support for better recall communication systems and mock recall exercises. This is consistent with earlier studies that identified poor communication as a major barrier to effective recall implementation in low- and middle-income countries (1, 13, 14). However, the reported practices showed gaps in follow-up and reporting after recall events. Many pharmacists were unlikely to submit updates or report directly to regulatory authorities. Most preferred to report to their managers. This pattern may reflect hierarchical and system-related practices in South Asian healthcare settings. Similar findings were reported in Bangladesh, where 70% of drug-related problems were referred to supervisors rather than reported directly to regulatory bodies or the media (15). In contrast, direct reporting systems used by agencies such as the European Medicines Agency may improve accountability and traceability (1).

Correlation analysis supported the KAP framework, but practice gaps remained. These gaps may reflect weak regulatory enforcement, limited infrastructure, and inadequate practical training (20, 21). Pharmacists in Pakistan showed good awareness and positive attitudes toward product recalls, but practical implementation was limited. This may be due to structural and operational barriers. Pakistan's recall system may also be less centralized and less active than those of neighboring countries (22, 23).

Strengthening the national pharmacovigilance system through digital reporting tools and real-time communication platforms may improve recall effectiveness. There are a few limitations of the study including the sample size was small, and the data were self-reported, which may have introduced bias and reduced generalizability. The cross-sectional design also limited causal interpretation. Future studies should include larger multicenter samples and qualitative methods to better identify barriers to effective recall practice.

## CONCLUSION

Pakistani pharmacists showed good knowledge and positive attitudes toward pharmaceutical product recalls, but practical involvement remained limited. Improving pharmacovigilance, communication, and recall training may enhance preparedness and patient safety.

## CONFLICT OF INTEREST

Authors declare no conflict of interest.

## ETHICAL CONSIDERATION

The study was approved by the Ethical Review Committee of Hamdard University (reference number FOP-ERC-04-12). Written informed consent was obtained from all participants prior to data collection.

## REFERENCES


1. Miglani A, Saini C, Musyuni P, Aggarwal GJJoGM. A review and analysis of product recall for a pharmaceutical drug product. 2022;18(2):72-81.
2. Fryze I, Naughton BDJBo. Substandard and falsified medicine recalls in the legitimate supply chain: a systematic review of evidence. 2025;15(10):e103672.
3. Eagle L, Rose LC, Kitchen PJ, Hawkins JJJoCP. Regulatory oversight or lack of foresight? Implications for product recall policies and procedures. 2005;28(4):433-60.
4. Vvss R, Prakash Veluchuri J, Adhikari S, Indukuri HJTPCJ. An overview on pharmaceutical drug recalls. 2020;7:16-22.

5. Ganso M, Said A, Schulz MJDS. Do Pharmacists' Spontaneous Reports of Quality Defects Contribute to Product Recalls? 2021;44(12):1456-.
6. Costantino RCJJotAPA. The US medicine chest: Understanding the US pharmaceutical supply chain and the role of the pharmacist. 2021;61(1):e87-e92.
7. Hall K, Stewart T, Chang J, Freeman MKJAJoH-SP. Characteristics of FDA drug recalls: a 30-month analysis. 2016;73(4):235-40.
8. Shanableh S, Zainal H, Alomar M, Palaian SJJoPP, Practice. A national survey of knowledge, attitude, practice, and barriers towards pharmacovigilance and adverse drug reaction reporting among hospital pharmacy practitioners in the United Arab Emirates. 2023;16(1):92.
9. Mehmood S. Regulating the pharmaceutical industry: an analysis of the drug regulatory authority of Pakistan (DRAP). 2022.
10. Hincapie AL, Alyami F, Alrasheed M, Hegener M, Beaton C, O'Brien L, et al. Continuous quality improvement regulations for community pharmacy practice in the United States. 2021;61(4):470-5. e2.
11. Mattingly AN, Mattingly II TJ, Phan ALN, Negash KJJotAPA. Categorization and comparisons of drug recalls for manufacturers and compounders. 2022;62(4):1344-50.
12. Garashi HY, Steinke DT, Schafheutle EIJTi, science r. A systematic review of pharmacovigilance systems in developing countries using the WHO pharmacovigilance indicators. 2022;56(5):717-43.
13. Eissa MEJGJoQ, Healthcare Si. Drug recall monitoring and trend analysis: a multidimensional study. 2019;2(2):34-9.
14. Lin ID, Hertig JBJTJoMA. Risk control drives risk assessment and risk review: A cause and effect model of pharmaceutical drug recall on patient safety. 2023;7:27550834231170075.
15. Todar TL, Agrawal M, Hishikar R, Jha A, Maheshwari B, Joshi UJIJoB, et al. Knowledge, attitude and practice toward adverse drug reaction reporting among practicing clinicians at a tertiary care hospital. 2017;6(4):845.
16. Cervantes-Arellano MJ, Castelan-Martinez OD, Marin-Campos Y, Chavez-Pacheco JL, Morales-Rios O, Ubaldo-Reyes LMJDJoPS. Educational interventions in pharmacovigilance to improve the knowledge, attitude and the report of adverse drug reactions in healthcare professionals: Systematic Review and Meta-analysis. 2024;32(1):421-34.
17. Khan Z, Karatas Y, Martins MAP, Jamshed S, Rahman HJCmr, opinion. Knowledge, attitude, practice and barriers towards pharmacovigilance and adverse drug reactions reporting among healthcare professionals in Turkey: a systematic review. 2022;38(1):145-54.
18. Ahire YS, Patil JH, Chordiya HN, Deore RA, Bairagi VAJJPR. Advanced applications of artificial intelligence in pharmacovigilance: Current trends and future perspectives. 2024;23(1):23-33.
19. Kompa B, Hakim JB, Palepu A, Kompa KG, Smith M, Bain PA, et al. Artificial intelligence based on machine learning in pharmacovigilance: a scoping review. 2022;45(5):477-91.
20. Nagaich U, Sadhna D. Drug recall: An incubus for pharmaceutical companies and most serious drug recall of history. International journal of pharmaceutical investigation. 2015;5(1):13-9.
21. Kerr A, O'Connor H, Gallagher P, Pawlikowska T, Strawbridge JJSR. A scoping review of health professional curricula: implications for developing integration in pharmacy. 2005;8:1932.
22. Song H, Pei X, Liu Z, Shen C, Sun J, Liu Y, et al. Pharmacovigilance in China: Evolution and future challenges. British journal of clinical pharmacology. 2023;89(2):510-22.
23. Jabeen S, Sridhar S, Balamuralidhara VJRJoP, Technology. Drug recall procedure in ASEAN countries. 2019;12(12):6041-8.

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