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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.

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