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Composition and denominator transparency of Saudi Arabia's reported healthcare workforce in 2024: a reproducible analysis of national aggregate tables

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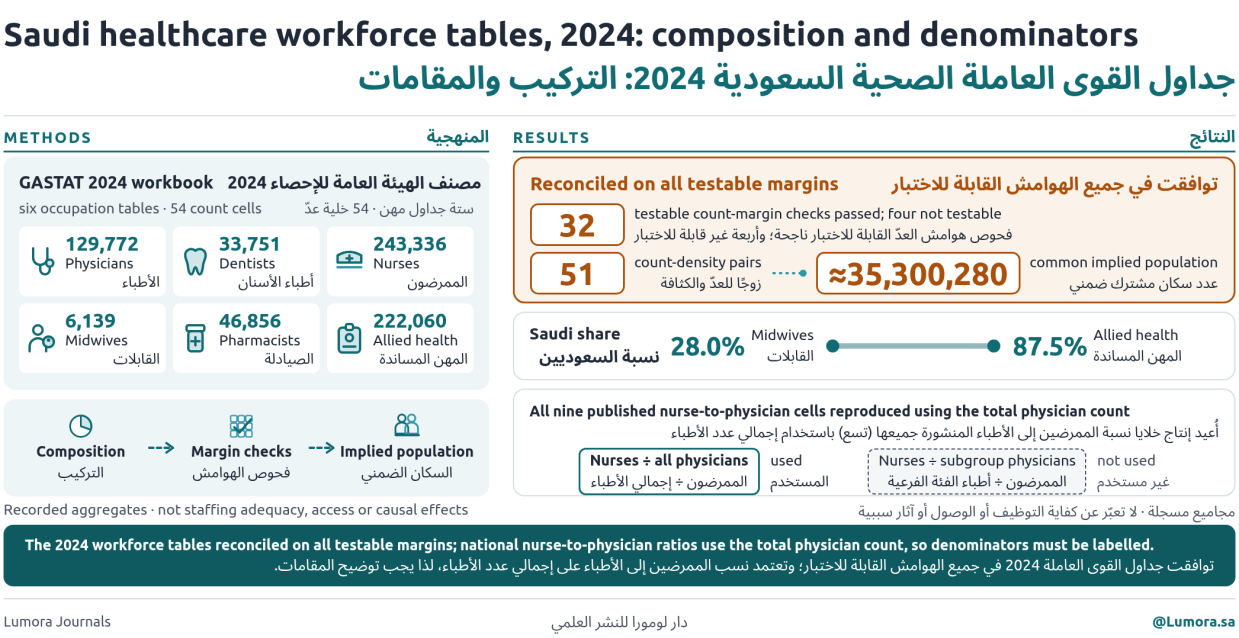
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Abstract

Graphical abstract



Background: Public workforce tables can support health-system planning, but interpreting occupational composition requires explicit denominators and careful treatment of unavailable categories. We examined the composition and internal numerical coherence of Saudi Arabia's published 2024 healthcare workforce tables.

Methods: We analyzed the frozen English workbook from the General Authority for Statistics. Six occupation tables supplied 54 count cells classified by recorded sex and Saudi/non-Saudi nationality. We preserved nonnumeric cells, calculated composition measures, checked testable margins, recovered implied population denominators from corresponding densities, and compared two interpretations of the published nurse-to-physician ratios. The analysis was exploratory and used aggregate records without sampling-based inference.

Results: The workbook reported 129,772 physicians, 33,751 dentists, 243,336 nurses, 6,139 midwives, 46,856 pharmacists and 222,060 allied health professionals. Fifty-one count cells were numeric; the male midwifery row was a merged not-applicable category. All 32 testable count-margin checks passed; four were not testable. Saudi shares ranged from 28.0% among midwives to 87.5% among allied health professionals. In the five occupations with complete sex-by-nationality cells, female shares differed between Saudi and non-Saudi records, especially in nursing and pharmacy. All 51 count-density pairs implied a common population of approximately 35,300,280. All nine published nurse-to-physician cells were reproduced using the total physician count; only the grand total also matched a corresponding-subgroup denominator.

Conclusions: The reported aggregates reconciled on the tested arithmetic margins; this does not establish registry completeness or independently authenticate every extracted workbook cell. Explicit denominator labeling is essential because contributions to a national ratio differ from ratios within workforce subgroups. These aggregates describe recorded workforce composition; they do not establish staffing adequacy, service access, unique-person totals or causal policy effects.

Keywords: health workforce; Saudi Arabia; administrative data; reproducibility; nursing; workforce composition

Introduction

Healthcare workforce planning depends on knowing what a reported number represents. A count of recorded professionals, a workforce density per population, a share within an occupation and a ratio between occupations answer different questions. An internally consistent number may still be misinterpreted if its numerator, denominator or inclusion rule is unclear. National Health Workforce Accounts provide a framework for making workforce concepts and their measurement more explicit. The international SDG indicator for health-worker density likewise requires explicit occupation and population definitions. [1, 2]

Saudi Arabia offers a relevant setting for this distinction. Its published workforce statistics describe several professions and distinguish recorded sex and Saudi/non-Saudi nationality. These dimensions are useful for understanding the composition of the recorded workforce, but they do not by themselves describe working hours, patient contact, geographical deployment or the accessibility of care. The source's units and coverage must therefore be established before counts can inform policy. [3]

Saudi workforce research already includes labor-market projections, needs-based planning, and studies of nursing and physician distribution. The 2025 Saudi nursing analysis examined regional densities across 20 health regions over 2019–2023; a separate 2025 physician paper analyzed 2022 yearbook data across 20 regions. A 2026 global analysis modeled sex-specific estimates for 20 cadres across 204 locations over 1990–2023. These studies use broader time, geography, or modeling inputs than a direct reading of one national release. They set a narrow contribution for this paper: test how selected cells and denominators in the 2024 source fit together, without claiming the first account of Saudi workforce composition or regional distribution. [4, 5, 6, 7, 8, 9, 10]

The present study focuses on that narrower contribution. The General Authority for Statistics, or GASTAT, released an English workbook accompanying its Healthcare Establishments and Workforce Statistics for 2024. The workforce component provides national occupation counts by sex and nationality, corresponding population-based densities, and a nurse-to-physician ratio table. The accompanying methodology describes registry-based information and a reference date at the end of 2024. Although the broader publication covers administrative regions, the sex-by-nationality workforce tables examined here contain national aggregates. Their existence cannot support a regional workforce allocation analysis. [3, 11, 12]

Two interpretation problems motivated the analysis. First, broad statements about the nationality or sex composition of the health workforce may conceal substantial differences between occupations. Reporting both overall and within-nationality proportions helps expose these differences without attributing them to a causal mechanism. Second, a table described as nurses per physicians by sex and nationality could plausibly be read as either subgroup nurses divided by all physicians or subgroup nurses divided by the corresponding physician subgroup. These calculations have different meanings even when both are mathematically valid. Reproducing the published values makes the distinction observable rather than assumed.

Our objectives were to describe the recorded composition of six healthcare occupations, assess arithmetic coherence within their published margins, examine the denominator implied by the accompanying density tables, and identify which denominator reproduces the nurse-to-physician table. We did not assess the completeness of the underlying registries, estimate workforce shortages, test policy effects or compare patient outcomes. The analysis supplies a reproducible reading of a fixed public release, with cell-level

provenance and explicit limits. Its practical purpose is to help readers use available statistics more accurately and identify which additional information would be necessary for stronger conclusions.

Methods

Design, source and setting

We conducted an exploratory secondary analysis of public national aggregate tables. The unit of extraction was a published workbook cell; the unit described by the occupational counts was the recorded workforce within the source's categories. This was neither a participant survey nor an individual-record cohort. The analysis was performed using an author-retained local copy of the public workbook and associated publication and methodology report; source-file receipts and extraction code are required to reproduce the source-cell analysis independently. We retained the original files and documented their hashes. The earlier analysis examined regional facilities; the present study uses national workforce tables and different outcomes. The common source and methodological overlap constrain claims of novelty based solely on reproducing published headcounts.

The frozen workbook has SHA-256 a8145fbece45cf9f5d62660e0fd2894a641364c11c2cb2d5f6675fdb1d4625a2. The methodology report describes administrative records from the Ministry of Health, Saudi Commission for Health Specialties and other government entities, together with GASTAT population estimates. The selected count tables credit the Ministry of Health for 2024. According to the methodology, administrative data refer to the last day of the Gregorian year 2024. The source methodology describes a Saudi occupational classification based on ISCO-08; our analysis does not independently remap the broad published occupation groups to detailed codes. [13] We use the workbook's occupation labels and the source's sex and nationality terminology without treating nationality as ethnicity or sex as a comprehensive measure of gender. [3, 11]

We recorded an analysis plan after feasibility inspection of the workbook and selected values, before executing the new analysis script. The plan was not preregistered, and its timing does not establish confirmatory independence from the data. Reporting was informed by relevant STROBE items and the transparency principles of RECORD, with nonapplicable participant-level items identified in a separate reporting map. This use of reporting guidance does not imply that aggregate cells form a patient cohort. [14, 15]

Context search and related work

To update the literature context on 27 September 2026, PubMed was searched with ("Saudi Arabia"[Title/Abstract] OR "Kingdom of Saudi Arabia"[Title/Abstract]) AND ("health workforce"[Title/Abstract] OR workforce[Title/Abstract] OR "health personnel"[MeSH Terms]), with an abstract filter. The initial run returned 2,244 records; a same-date rerun returned 2,288, so counts are run-time snapshots. Only the first 30 from the initial run, sorted by publication date, were retrieved; neither full result set was screened. SciSpace was queried with the natural-language question, "What peer-reviewed studies analyze the composition, nationality, sex, distribution, density, or denominator definitions of the health workforce in Saudi Arabia, especially official statistics published for 2024?" It returned 10 relevance-ranked records. The publisher record for the 2025 physician study and PubMed/PMC record for the 2026 global analysis were checked for the specific comparisons cited here. This was a bounded context update, not a systematic review, complete screening, Arabic-language search, or novelty certification.

Table selection and extraction

We selected count tables 12 through 17, respectively describing physicians, dentists, nurses, midwives, pharmacists and allied health professionals. For each table, cells B8:D10 provide Saudi, non-Saudi and total counts for the male, female and total rows. This yields nine selected cells per occupation and 54 cells overall. We extracted coordinates, table identifiers, row and column labels, original values, storage state, merged ranges and the displayed meaning of merged labels. The original extraction did not capture merged ranges; a documented exploratory amendment added that information after the methods pre-review. Totals and subgroup cells were retained as separate observations for reconciliation, but were not treated as independent people or independent statistical samples.

Corresponding density tables were 18, 19, 21, 23, 24 and 25. Table 27 supplied nurses per physicians. Tables 20 and 22, which combine physicians with dentists and nurses with midwives, respectively, were used for supplementary checks of arithmetic additivity in the published combined densities. These calculations do not validate occupational definitions, registry coverage or person-level disjointness. We did not analyze the workbook's regional facility counts, specialty-bed tables, pharmacy establishments or year-to-year growth table. Excluding the growth table prevented an exploratory cross-section from becoming a trend analysis without a separate assessment of comparability. The previously drafted facility article used different tables and questions; their common source is disclosed in the related-work record.

The extraction script checked the expected sex and nationality headers and the recorded source-file checksum before reading fixed cells. It retained numerical precision in machine-readable results and used published workbook cells rather than values copied from prose or chart labels. Reproducibility of a calculation does not, by itself, validate registry coverage or the original data-generating process. [16, 17]

Composition measures and unavailable categories

For each occupation, the Saudi share was its Saudi total divided by its published occupation total. For the five occupations with complete numeric sex-by-nationality cells, the female share was calculated overall and separately within Saudi and non-Saudi records. The difference between the two within-nationality female percentages was expressed in percentage points, with Saudi minus non-Saudi as the declared direction. We present these as descriptive contrasts. They are not estimates of the causal effect of nationality, migration, education or recruitment practices, and they do not identify the individual circumstances of any worker.

In the midwifery count and density tables, cells B8:D8 are merged and display “Not applicable” across the male row. The text is stored in B8; C8 and D8 are empty merged-cell placeholders, not independent missing observations. We retain both the raw storage and this structural meaning. No entry is converted into an observed zero. Female and total rows contain numeric values. We report those counts and nationality composition but withhold midwifery from the cross-occupation female-share comparison because its male category is structurally nonapplicable rather than an ordinary observed count. This is not a claim about professional eligibility outside the published table.

Arithmetic and denominator checks

Within each count table, we checked three row margins by comparing Saudi plus non-Saudi counts with the corresponding published total, and three column margins by comparing male plus female counts with the corresponding total. A check was eligible only when all three required cells were numeric. Ineligible checks were labeled not testable, never passed through imputation. The resulting 36 planned checks

include redundancy because margins share cells. Their pass count is not a sample size for estimating general statistical quality. The distinction between internal consistency and broader verification is consistent with the scope of WHO's data-quality framework; we did not implement its complete assessment toolkit. [18]

For every numeric count paired with a positive published density, we recovered the implied population as count divided by density, multiplied by 10,000. A common recovered value would show only that the extracted cells are arithmetically compatible with a shared denominator. It would not independently validate that population estimate, because both operands originate in the same publication. The separate GASTAT population release reports a rounded 35.3 million for mid-2024; that summary provides context but cannot establish exact agreement or identical reference timing with year-end workforce counts. [19] We used an absolute tolerance of one-millionth of a person for the spread of recovered denominators and retained unrounded values in the output. The tolerance handles floating-point arithmetic and should not be interpreted as meaningful population precision.

For the nine cells in the nurse-to-physician table, we calculated two alternatives: the corresponding nurse cell divided by the grand total of physicians, and the same nurse cell divided by the corresponding physician cell. We compared each calculation with the published value using an absolute tolerance of 1e-9. The grand-total cell necessarily uses the same denominator under both alternatives. For combined density tables, we tested addition only when both constituent cells and the combined cell were numeric. Structural missingness was preserved even if treating an unavailable cell as zero could reproduce a displayed total.

Analysis, uncertainty and governance

The analyses use the complete selected published aggregates. We did not calculate sampling confidence intervals, p values, regression models or tests of between-group significance. Such calculations would risk implying a random-sampling design that the source does not have and would not capture administrative coverage errors. Percentages are shown to one decimal and ratios to three decimals where useful, with counts as published. No occupation totals were summed into a unique-person workforce total because mutually exclusive registration and person-level deduplication were not independently established for this analysis.

Python and openpyxl were used for extraction and deterministic calculations. Figures were generated from the published aggregate cells by script. No identifiable individual records were accessed. The applicable institutional determination and authors' approval remain to be documented before submission.

Results

Published occupation counts and composition

The six selected occupation tables reported 129,772 physicians, 33,751 dentists, 243,336 nurses, 6,139 midwives, 46,856 pharmacists and 222,060 allied health professionals. These are separate published occupation totals. We do not present their sum as a number of distinct workers. Among the 54 selected count cells, 51 were numeric. The remaining three belonged to the merged male midwifery range: one stored nonapplicability label and two empty merged placeholders representing the same structural category. The internal extraction record preserves all 54 original cell states and their coordinates.

Saudi shares differed across the six categories: 42.5% among physicians, 58.1% among dentists, 43.6% among nurses, 28.0% among midwives, 47.6% among pharmacists and 87.5% among allied health

professionals. The corresponding Saudi counts were 55,159, 19,598, 106,145, 1,721, 22,283 and 194,376. These occupation-specific shares cannot identify training location, recruitment route or service availability.

For occupations with complete numeric sex-by-nationality cells, the overall female share was 38.4% among physicians, 44.8% among dentists, 73.6% among nurses, 27.9% among pharmacists and 46.2% among allied health professionals. Within Saudi versus non-Saudi records, respectively, female shares were 40.3% versus 37.0% for physicians, 46.4% versus 42.6% for dentists, 55.7% versus 87.5% for nurses, 48.2% versus 9.5% for pharmacists, and 45.4% versus 52.0% for allied health professionals. The largest absolute descriptive differences occurred in pharmacy, at 38.7 percentage points, and nursing, at minus 31.8 percentage points. No significance tests were performed.

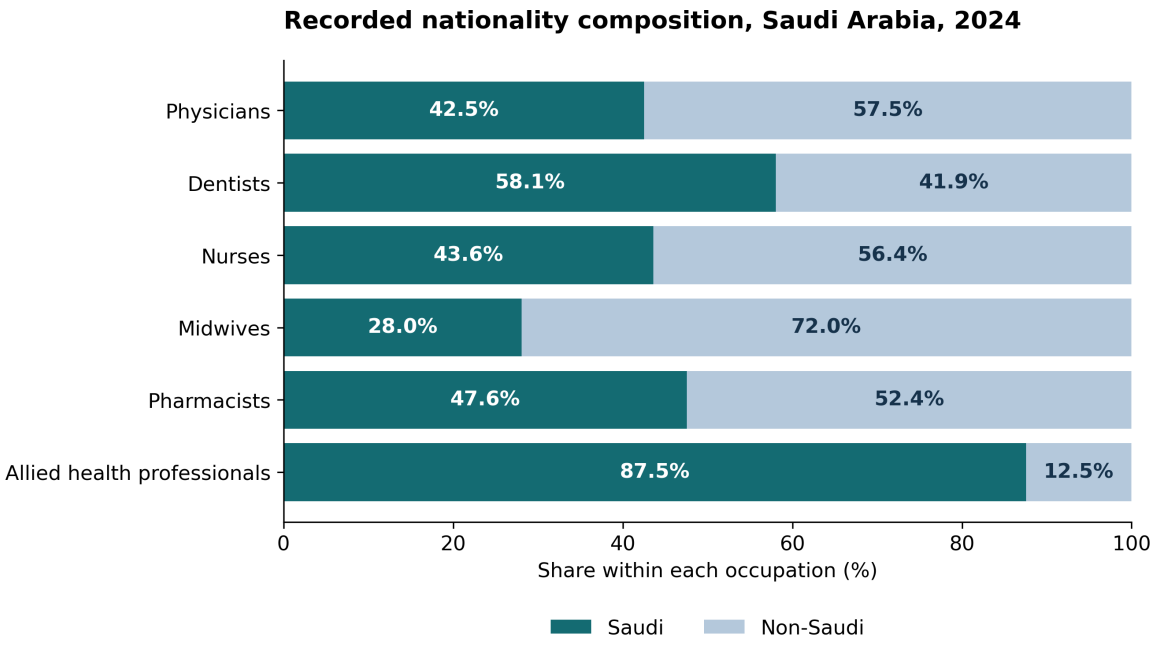
Midwifery's published female and total rows both contained 1,721 Saudi and 4,418 non-Saudi records, totaling 6,139. We report those counts without calculating a female-share comparison or replacing the male row's structural nonapplicability with an observed zero. The source structure therefore remains visible rather than disappearing into an apparently complete percentage table. Table 1 presents the occupational composition, and Figure 1 shows the nationality shares while keeping the categories separate.

Table 1. Composition of the six reported healthcare occupations in 2024

Occupation	Published total	Saudi (%)	Female (%)	Female among Saudi (%)	Female among non-Saudi (%)
Physicians	129,772	42.5	38.4	40.3	37.0
Dentists	33,751	58.1	44.8	46.4	42.6
Nurses	243,336	43.6	73.6	55.7	87.5
Midwives	6,139	28.0	Withheld	Withheld	Withheld
Pharmacists	46,856	47.6	27.9	48.2	9.5
Allied health professionals	222,060	87.5	46.2	45.4	52.0

Table 1 footnote. Source: General Authority for Statistics (GASTAT), Healthcare Establishments and Workforce Statistics 2024, workbook tables 12–17. Percentages use each occupation's reported total. The male midwifery row is structurally not applicable; female-share percentages are therefore withheld. Totals across occupations must not be interpreted as a count of distinct individuals.

Figure 1. Saudi and non-Saudi composition by occupation



Source: GASTAT 2024 workforce tables 12–17. Occupations use separate denominators; bars do not show workforce sizes.

Figure 1 footnote. Source: GASTAT 2024 workbook, tables 12–17; plotted percentages were calculated from published counts. Each bar has an occupation-specific denominator and does not indicate the relative size of the professions.

The publication prose reports 106,140 Saudi nurses, whereas its Figure 5 and workbook cell 14!B10 report 106,145. The workbook component counts, 47,027 and 59,118, sum to 106,145. We retain that value because the analysis is explicitly bound to the frozen workbook, and report the conflicting prose value separately. The difference is five records and does not change the displayed 43.6% Saudi nursing share. No publisher-confirmed correction is claimed. [11, 12]

Internal arithmetic and population denominators

The analysis outputs reported that all 32 eligible row or column margin checks passed exactly. Four planned checks were not testable because of the male midwifery row. No eligible margin failed. This result concerns only the selected count tables; it should not be generalized to the full workbook or to the underlying records. In combined-density checks retained in the internal evidence record, 15 relationships passed within the stated tolerance and three were not testable because a component was nonnumeric. We did not recode those entries to make the combination checks complete.

All 51 eligible count-density pairs yielded 35,300,280 as the implied total population after rounding to persons. Before rounding, the calculated values differed only at numerical precision. This agreement identifies the denominator used by the published rates; it does not independently validate the population estimate.

Nurse-to-physician denominator interpretation

Every one of the nine published nurse-to-physician cells matched its nurse numerator divided by all 129,772 physicians. Only the grand total also matched the corresponding-subgroup calculation. The published overall ratio was 1.875 nurses per physician. The male and female row totals were 0.494 and 1.381, respectively, which add to the national ratio. By contrast, dividing male nurses by male physicians yields 0.803, and dividing female nurses by female physicians yields 3.596. These latter values answer different questions and are not corrections to the published cells.

The distinction also applied to nationality. The published Saudi and non-Saudi total-row contributions were 0.818 and 1.057 nurses per all physicians. Using the corresponding nationality's physician denominator gives 1.924 and 1.839 instead. Table 2 and Figure 2 show both sets of quantities with their denominators. These national combinations do not describe clinical teams or imply that the published counts are wrong.

Table 2. Reported nurse-to-physician ratios and subgroup-denominator alternatives

Sex	Group	Nurses	Physicians	Published ratio	Within-group ratio
Male	Saudi	47,027	32,932	0.362	1.428
Male	Non-Saudi	17,132	47,012	0.132	0.364
Male	Total	64,159	79,944	0.494	0.803
Female	Saudi	59,118	22,227	0.456	2.660
Female	Non-Saudi	120,059	27,601	0.925	4.350
Female	Total	179,177	49,828	1.381	3.596
Total	Saudi	106,145	55,159	0.818	1.924
Total	Non-Saudi	137,191	74,613	1.057	1.839
Total	Total	243,336	129,772	1.875	1.875

Table 2 footnote. Source: GASTAT 2024 workbook, table 27 and occupational tables 12 and 14. The published/reproduced ratio divides the listed nurse count by all 129,772 physicians. The alternative divides by the physician count in the corresponding sex-by-nationality subgroup. Values describe different denominators, not competing estimates of one measure.

Figure 2. Published ratio contributions compared with within-subgroup ratios

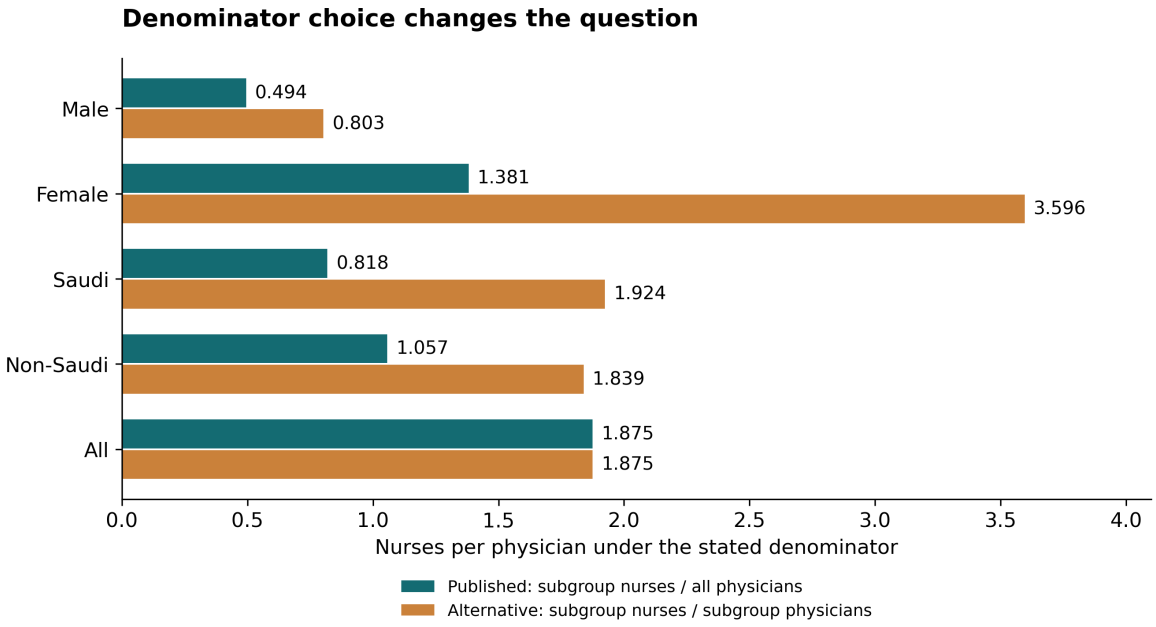


Figure 2 footnote. Source: GASTAT 2024 workbook, tables 12, 14 and 27; ratios were reproduced from published counts. All-physician and corresponding-subgroup denominators answer different descriptive questions. Neither quantity describes a clinical team.

Discussion

Principal findings and contribution

This analysis found substantial variation in recorded nationality and sex composition across six Saudi healthcare occupations, together with internally coherent arithmetic among the selected testable counts. Its most actionable methodological finding concerns denominator interpretation. The density cells use a common total-population denominator, while the subgroup nurse-to-physician cells can be reproduced as contributions to the national nurse-to-physician ratio. Neither observation is inherently an error. Both require explicit labels because readers could otherwise assume that a subgroup label applies to the denominator as well as to the numerator.

The contribution is a reproducible reading of this release, not the discovery of nationality or sex differences in the Saudi workforce. Recent Saudi nursing and physician studies examine regional distributions over different periods, and a global analysis provides modeled estimates across countries and cadres. Our narrower contribution is to document cell-level extraction, preserve structural nonapplicability, and identify the denominator that reproduces each published nurse-to-physician value. The bounded context search cannot exclude every similar analysis; no first-study claim is made. [5, 6, 7, 8, 9, 10]

Composition is a planning input, not an explanation

The nursing and pharmacy contrasts illustrate why occupational categories should be kept separate. A high overall female share in nursing coexists with different female shares among Saudi and non-Saudi records. Pharmacy shows a contrast in the opposite direction. These patterns could motivate questions about training pipelines, hiring practices, mobility, employment sectors or historical participation. The aggregate tables cannot discriminate among those explanations. Nationality should not be used as a proxy for competence, commitment or cultural compatibility, and sex composition should not be interpreted as a direct measure of employment equity. WHO's global gender-and-equity analysis considers leadership and working conditions that these aggregate sex counts do not measure. [20]

Almaghaslah's pharmacy workforce study used Ministry of Health yearbooks for 2017–2021 and examined sex, nationality, sector and regional composition. It identified community pharmacy as a major employment setting and lacked information on industrial pharmacists. These sector distinctions are relevant to interpreting the present pharmacy contrast, but our national 2024 table does not provide the corresponding employment-sector cross-tabulation. We therefore cannot attribute the observed nationality-by-sex difference to a sector or calculate a harmonized trend from the earlier study. Its results establish relevant prior work, while the present increment is explicit source-cell and denominator reconstruction. [21]

A responsible next study would begin with a clearly defined decision. For workforce availability, the relevant unit may be a practicing professional's full-time-equivalent contribution rather than a registration or headcount. For training policy, graduate flows, attrition and transitions into employment may matter more than a single stock measure. For service access, location, hours, skill mix and the distribution of population needs are essential. Needs-based workforce models explicitly require assumptions linking those elements. A national composition table is a starting point for such models, not a substitute for them. The 2025 global nursing report addresses education, jobs, leadership and service delivery, illustrating the wider information needed for policy interpretation. [22] [2, 5, 6]

The selected tables also do not provide employment histories. A difference between Saudi and non-Saudi shares cannot establish a localization trend, nor can it demonstrate success or failure of a policy. Even an apparently straightforward comparison with the workbook's 2023 figures would require confirmation that definitions, coverage, reference dates and counting rules remained compatible. We therefore avoided the available growth table in this analysis. Future repeated cross-sections should document comparability before interpreting changes in published totals.

Making denominator semantics visible

The nine-cell table shows why denominator labels matter. Contributions to a national ratio are additive when each subgroup numerator shares the same all-physician denominator. Ratios using each subgroup's own physician count describe a different quantity and do not generally add to the national ratio. Workforce densities require the same clarity about whether the denominator is total or subgroup population. A formula printed beside each table and machine-readable metadata for population, reference date, occupational coverage, and nonapplicable entries would make future reuse easier. These are recommendations derived from the table structure, not evidence that GASTAT failed its own quality checks.

What internal coherence does and does not establish

Arithmetic agreement lowers uncertainty about transcription and marginal calculations only. It does not establish registry completeness, active practice, mutually exclusive worker records, a stable allied-health definition, or an externally correct population denominator. A separate population series and documented agreement in scope and reference date would be needed for external denominator validation. The combined-density checks establish arithmetic compatibility only; they do not show that individual records are disjoint. [1, 2]

Spreadsheet layout is part of the evidence. Reading cell values alone initially made two entries in the male midwifery row look independently missing; inspecting the merged B8:D8 range showed that the entire row is labeled structurally not applicable. This correction changes the interpretation of the extraction without changing the numeric calculations. GASTAT's methodology reports internal consistency checks; our public-table reproduction does not imply that the agency undertook no quality assurance. [3] An unperformed numeric check on a structural category is neither a pass nor a failure. Both the eligible-check denominator and the spreadsheet semantics therefore need to remain visible.

Reproducibility and source-version control

The source checksum, cell map, merged-cell record, and analysis code permit reconstruction of the results from a fixed release. The authors' analysis archive distinguishes counts, margins, and structural categories. If the statistical authority revises the workbook, the revision should be identified and compared with the analyzed version. Reproducible computational work requires a stable source and documented calculation steps. [16, 17]

A cross-format discrepancy also requires a declared hierarchy. Here the workbook is the analytic source, and the publication PDF is a contextual cross-check. Agreement between formats would still not independently validate the underlying registry, because both belong to one release. Disagreement is retained in a source-conflict register rather than silently reconciled. This hierarchy is specific to the present question; another study could choose a different authoritative source if justified in advance and clearly

described. A subsequent publisher explanation should update the interpretation without rewriting the historical provenance.

Strengths and limitations

Strengths include an explicitly frozen public source, extraction with cell coordinates, declared formulas, preserved nonnumeric states and a complete record of the selected numerical checks. We present both denominator interpretations rather than selecting one without explanation. We also keep occupation-specific totals separate, avoid unsupported regional workforce conclusions and disclose the use of a source previously analyzed for a different question. These decisions make the analysis easier to audit and reduce opportunities for inadvertently overstating what aggregate data can show.

Several limitations remain material. The study examines a single annual release and cannot establish trends or policy effects. It lacks individual records, facility assignment, hours worked, contract status, detailed allied-health classifications, training location and information on patient need. Independent verification of source coverage and unique-person counting was not possible with the selected tables. The arithmetic checks are deliberately limited and should not be described as a comprehensive audit of the publication. Independent re-extraction from the original workbook and a second review of denominator definitions are needed to confirm reproducibility beyond these internal checks.

Conclusion

Saudi Arabia's 2024 public workforce tables support a reproducible description of occupation, recorded sex and nationality, with all eligible selected count margins reconciling. Denominator reconstruction shows that subgroup workforce densities use total population and that subgroup nurse-to-physician cells use all physicians. Clear formulas and labels are necessary to distinguish these contributions from within-subgroup ratios. The findings describe the fixed published aggregates and do not establish staffing adequacy, service access, causal mechanisms or unique-person totals. Preserving unavailable cells and, after lawful review, depositing the extraction and code with versioned documentation would allow subsequent reviewers to assess the calculations without treating internal arithmetic as proof of broader validity.

Declarations

Ethics: The study was exempt from ethical review because it analyses only publicly available, aggregate national statistical tables; no identifiable individual records were accessed.

Funding: This research received no external funding.

Competing interests: The authors declare no competing interests.

Data availability: The source workbook is publicly available at the URL in reference 11. The analysis scripts, cell-level extraction and derived tables are available from the corresponding author on request. No patient-level data were used.

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