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Recorded private-sector rehabilitation sessions relative to cases in Northern Saudi Arabia: an exploratory category-standardized analysis of the 2024 Ministry of Health yearbook

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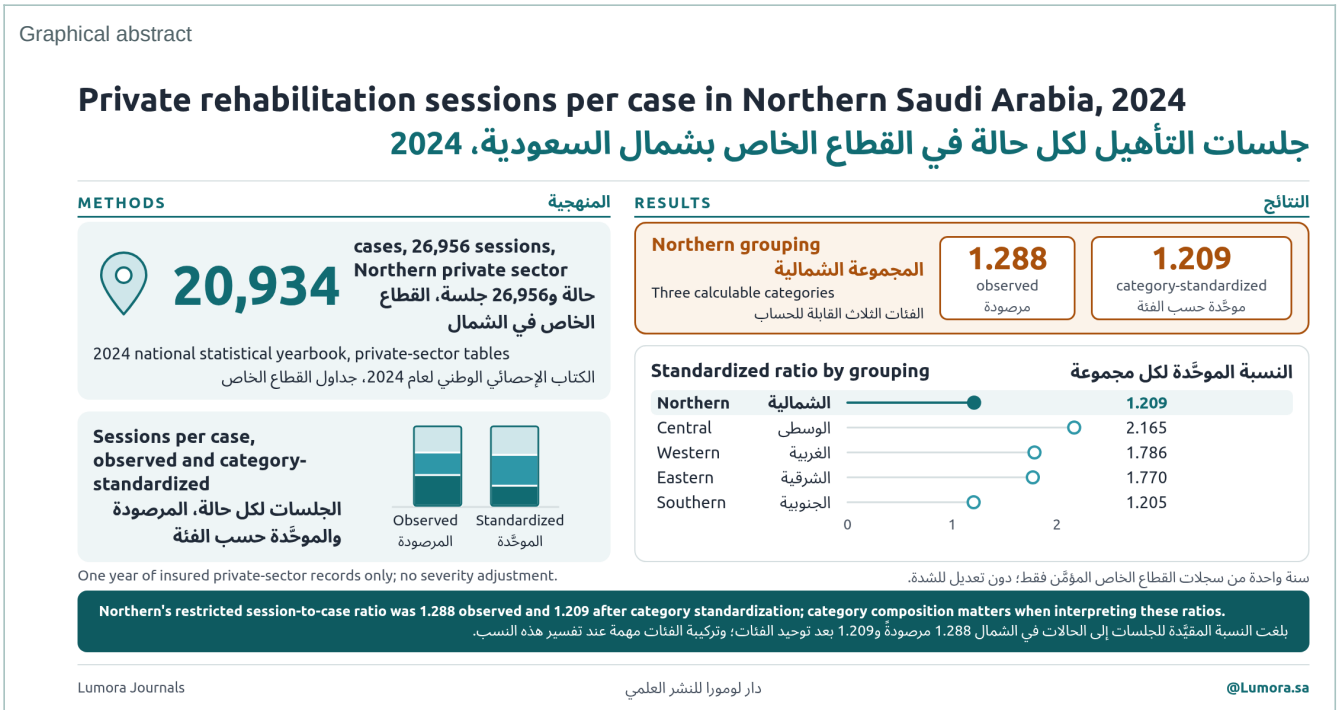
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Graphical abstract



Graphical abstract: Northern's restricted session-to-case ratio was 1.288 observed and 1.209 after category standardization; category composition matters when interpreting these ratios. Designed by the Lumora Journals production team using hand-coded HTML/SVG rendered in Google Chrome.

Abstract

Background: Annual rehabilitation service tables contain case and session counts across heterogeneous service categories. Their ratio can describe recorded activity, but it is not necessarily the mean number of sessions received by an individual patient. Category composition can also affect regional comparisons. We examined the Northern analytical grouping while preserving all thirteen Saudi administrative regions as comparators.

Methods: We reconstructed the reported counts in Ministry of Health Statistical Yearbook 2024 Tables 4-47 and 4-48 (private-sector rehabilitation; source: Council of Health Insurance). Administrative regions were retained and combined into five analytical groupings. We calculated total session-to-case ratios and a restricted ratio using physiotherapy, orthotics/prosthetics and other services. Standardization used the national case distribution across those three categories as common weights; equal weights and a standard without the “other” category were sensitivity analyses. Occupational therapy and hearing/speech/swallowing were retained descriptively but excluded from standardization because some regional case denominators were zero. The analysis is exploratory; the source was inspected before the plan was written. No patient linkage, clinical severity adjustment or sampling inference was claimed.

Results: Northern recorded 20,934 cases and 26,956 sessions (total session-to-case ratio 1.288). Across the three eligible standardization categories, it recorded 20,924 cases and 26,944 sessions, yielding an observed restricted ratio of 1.288 and a category-standardized ratio of 1.209. Northern administrative-region standardized ratios were 1.215 in Tabuk, 1.142 in Hail, 1.247 in Northern Borders and 1.163 in Al Jouf. The five-group standardized ratios were 2.165 in Central, 1.786 in Western, 1.770 in Eastern and 1.205 in Southern. With equal weights, the Northern standardized ratio was 1.200.

Conclusions: Category composition contributes to the interpretation of recorded private-sector session-to-case ratios, but the standardization does not identify clinical need, appropriate treatment dose, patient

recovery or service quality, and the results do not describe Ministry of Health or other government rehabilitation activity.

Keywords: Rehabilitation; Physical Therapy Modalities; Facilities and Services Utilization; Health Services Administration; Saudi Arabia

Introduction

Rehabilitation services respond to a broad range of functional limitations and clinical circumstances. Their administrative reporting can include physiotherapy, occupational therapy, hearing/speech/swallowing services, orthotics/prosthetics and other categories. These categories represent different forms of care and may have different patterns of repeated attendance. A count of recorded cases and a count of recorded sessions therefore offer complementary descriptions. Combining them into a ratio is useful only when the counting units, reporting period and category composition are made explicit. Without that clarification, an administrative ratio can be mistaken for a patient-level measure of treatment intensity or quality.

Saudi rehabilitation literature addresses workforce, service provision, referral and clinical case mix from several perspectives. A published analysis of rehabilitation workforce supply and demand offers directly relevant capacity context [1]. Studies of lymphedema service provision, the occupational-therapy profession and cardiac or pulmonary rehabilitation describe specialty organization and implementation [2–6]. Those sources help explain why aggregate service categories are not interchangeable. They do not establish that annual counts can measure unmet need or the adequacy of treatment. For that purpose, information about the eligible population, functional status, referral pathways and outcomes would be necessary.

Rehabilitation utilization also depends on how cases enter and leave a service. Saudi publications have examined delayed discharges at a tertiary rehabilitation centre, stroke occupational-therapy goal achievement, age-related functional outcomes and cancer rehabilitation [7–10]. These clinical settings may involve differing durations and levels of care. Their findings cannot be transferred directly to a national table in which “case” and “session” are unlinked aggregate fields. They nevertheless show why a regional difference in recorded sessions relative to cases needs to be examined as a service description rather than interpreted as a difference in individual recovery or treatment dose.

The Ministry of Health yearbook provides a public source that can be reconstructed with explicit source-row mappings and arithmetic checks. Its private-sector tables, compiled from Council of Health Insurance records, report both rehabilitation cases and sessions by administrative region; Ministry of Health activity is reported by health cluster and other-government activity by agency. This structure permits a comparison of total ratios and a limited standardization for recorded category composition. It does not provide individual patient identifiers, diagnoses, treatment goals, severity, episode lengths or functional outcomes. Consequently, the standardized measure in this study is deliberately described as category-standardized. The word “case mix” refers to the mix of reported service categories and is not used as a claim that clinical severity or need has been adjusted.

The Northern analytical grouping comprises Tabuk, Hail, Northern Borders and Al Jouf. Their combined totals are of interest as one geographical summary, but differences within that grouping remain visible in the administrative-region results. The study retains all thirteen regions as comparators, including those belonging to the other four analytical groupings. This avoids interpreting Northern activity in isolation and allows the reader to see how the broad grouping compresses different local category distributions. The five-

region convention is an attributed analytical grouping, not a replacement for Saudi Arabia's official administrative boundaries.

The study has three related objectives. First, it reconstructs the published national and regional counts from the two tables. Second, it describes the Northern total session-to-case ratio and the restricted ratio for categories with positive denominators throughout the administrative-region dataset. Third, it compares that restricted observed ratio with a ratio standardized to the common national category distribution. The comparison is descriptive; no clinical threshold for appropriate sessions per patient was available, and none was assumed.

Two publications overlap partly with this topic. A longitudinal analysis of Ministry of Health yearbooks for 2016–2024 examined regional trends in eight capacity and utilization indicators, none of which concerned rehabilitation or private-sector services [11]. A national study of the 2023–2024 yearbook rehabilitation tables described encounters by specialty, region, sector and paediatric age group, with a focus on speech-language pathology and audiology [12]. Neither related sessions to cases or examined how category composition affects that relationship, which is the focus of this article. STROBE and RECORD principles guide the reporting of source selection, data definitions, processing and limitations [13,14].

Methods

Study design and source preservation

This is a descriptive administrative-data reanalysis of the complete recorded counts represented in the selected yearbook tables. The official Statistical Yearbook 2024 workbook was downloaded from the Saudi Ministry of Health website and retained as an original file. Its recorded Secure Hash Algorithm with a 256-bit digest (SHA256) was 959a27fbe4a7ef7b5726c679303d3251aea8b638370289b8d055705e53ea2649. Table 4-47 supplied private-sector case counts and Table 4-48 private-sector session counts; both tables name the Council of Health Insurance as their source. Source-row exports preserve the relationship between the workbook entries, administrative-region assignments and analytical outputs, allowing the reconstruction to be inspected independently. The primary workbook is cited as the analytical source [15]. General national statistical definitions provide administrative context without resolving every table-specific counting rule [16].

The private-sector tables were analysed because they are the only rehabilitation tables in the yearbook that give both cases and sessions by administrative region. The Ministry of Health table (Table 4-44) reports cases by health cluster without sessions, and the other-government table (Table 4-46) reports activity by agency rather than by region, with incomplete session counts. Totals from these two tables are reported for context only. For that purpose, health clusters were assigned to administrative regions by name; for example, the Bishah cluster was assigned to Asir and the Qurayyat cluster to Al Jouf.

The source was reviewed before the written analysis plan was drafted, so the categories available for standardization, the geographical focus and the feasibility of calculations were established after seeing the source structure. The work is therefore exploratory rather than a prospectively registered confirmatory comparison.

No individuals were recruited, and no treatment strategy was assigned. The analytical observations are the administrative regions and their reported service-category totals, not a sample of clinical participants. The

tables do not identify whether a case is a unique individual, an episode or another reporting unit, so “case” is retained as the source's administrative label and is not translated into “patient”.

Categories, denominators and missing information

The five source categories were physiotherapy, occupational therapy, hearing/speech/swallowing, orthotics/prosthetics and other services. Each category was retained in the descriptive extraction along with the total case and session fields. We checked that the component counts reconciled with their source totals. A recorded zero was preserved as a zero and was not automatically relabeled as missing or as proof that a geographical population had no clinical need. In particular, a category with no recorded cases cannot supply a finite session-to-case ratio for standardization merely by assigning it an arbitrary value.

Annual session counts can relate to ongoing care that began in an earlier period, while annual case counts can use another ascertainment rule. The tables do not contain linked episode histories that resolve this issue. The ratio calculated here is consequently the number of reported sessions divided by the number of recorded cases in the corresponding geographical category. It is not asserted to be the individual mean number of sessions received. A true patient or episode mean would require that sessions be linked to the same defined population of cases and observed over an appropriately aligned interval.

The source does not contain clinical diagnosis, baseline impairment, functional goals, referral reason, treatment duration, discharge status or patient-reported outcomes, which prevents adjustment for clinical severity and need. Standardizing the coarser category distribution does not control all meaningful differences between regional case populations, and the standardized measure is not a risk-adjusted clinical performance score.

Administrative and analytical geography

The administrative-region set comprised Riyadh, Makkah, Madinah, Qassim, Eastern, Asir, Tabuk, Hail, Northern Borders, Jazan, Najran, Al Baha and Al Jouf. The yearbook's official mapping information was retained as the source for administrative assignments. Counts were organized by these thirteen regions before any broader aggregation. This order ensures that a source reporting unit is not silently treated as a separate administrative region and that a total row is not added to its constituent counts. National rows were used to check the reconstruction rather than counted as additional regional observations. The source label “Northern” denotes the Northern Borders region, and source spellings (for example Qaseem, Aseer, Tabouk and Al-Bahah) are given in the standard English forms used throughout.

The five analytical groupings were Central, containing Riyadh and Qassim; Western, containing Makkah and Madinah; Eastern, containing the Eastern administrative region; Southern, containing Asir, Jazan, Najran and Al Baha; and Northern, containing Tabuk, Hail, Northern Borders and Al Jouf. The grouping was attributed separately to a published analytical convention. It was not described as an official five-region administrative system. Both the full administrative-region table and the broad-group table are preserved, because regional planning and source interpretation may depend on variation that disappears after aggregation. The published grouping source is cited for this analytical convention [17].

For each broad group and service category, case counts and session counts were summed across its constituent administrative regions. The category-specific ratio was then calculated from those combined counts. We did not average individual regional ratios with equal weights. An equal-weight average would give regions with very different numbers of recorded cases the same numerical contribution and would not reproduce the combined group's aggregate ratio. The same distinction applies to a broad group's

standardized value: it is computed using ratios from the group's pooled category counts, not by simply averaging the administrative-region standardized values.

Restricted category standardization

Physiotherapy, orthotics/prosthetics and other services had positive case denominators in every administrative region in the reconstructed dataset. These three categories were therefore selected for the restricted standardization. Occupational therapy and hearing/speech/swallowing remained in the complete descriptive tables but were not included in the standardized comparison. This restriction prevents a zero-denominator category from being imputed as an observed ratio and avoids creating an apparently complete adjusted score by adding assumptions that the data cannot support. The restriction is part of the estimand and is not hidden as a cleaning decision.

The standard distribution was the national case distribution across the three retained categories (weights reported in the Results, “Source totals and standard distribution”). Its weights were the national case count in each category divided by the sum of cases across those categories. For a geographical unit, the standardized ratio was the sum of each retained category's session-to-case ratio multiplied by its common national weight. In words, every geographical unit was evaluated using the same recorded-category mixture while preserving its own category-specific ratios. The weights sum to one within the restricted set. They do not assign a clinical severity score or a population-need weight to a case.

We also calculated the restricted observed ratio by dividing the total recorded sessions in the three retained categories by their total recorded cases. Comparing this measure with the standardized ratio isolates the arithmetic contribution of using a common category distribution rather than each unit's own distribution. The difference is a descriptive consequence of the chosen standard. It is not an estimate of a causal effect of changing service mix, and it does not show what outcomes would occur if patients received another distribution of treatment. Those interpretations would require clinical and longitudinal information absent from the tables.

Two alternative standards were examined as sensitivity analyses. The first gave each of the three retained categories an equal weight of one third. The second removed the heterogeneous “other” category and used the national distribution of physiotherapy and orthotics/prosthetics cases alone (weights 0.770 and 0.230). Neither standard was chosen to favour a particular regional ordering.

Table 1. Operational definitions and interpretation limits of the descriptive quantities

Quantity	Source-bound calculation/definition	Claims the quantity does not support
All-category ratio	Total sessions divided by total recorded cases	Individual treatment mean or effectiveness
Restricted observed ratio	Sessions divided by cases in three universally positive-denominator categories	All rehabilitation categories or equal clinical case severity
Category-standardized ratio, national weights	Weighted category-specific ratios using national recorded case-category shares	Individual risk/need/severity adjustment
Category-standardized ratio, equal weights (sensitivity analysis)	Category-specific ratios weighted one third each	Individual risk/need/severity adjustment

Notes. Definitions apply to Tables 2 and 3 and Figure 1. Symbol/units: / means division of aggregate totals; % means percentage; − means subtraction. Source: Ministry of Health Statistical Yearbook 2024, Tables 4-47 and 4-48 (private sector; source agency: Council of Health Insurance).

Reconciliation, uncertainty and reporting

National component totals and overall totals were reconciled with the corresponding source rows in both tables. The extraction supplied 13 administrative-region observations for cases and 13 for sessions. The joined region-category data retained the original counting labels and source-defined zeros. Separate result files preserve unrounded ratios, standard weights and the relationship between restricted and total measures. The published figure uses the administrative regions as its comparison set and distinguishes observed from standardized ratios, with a footnote explaining the three-category restriction and the absence of patient-level interpretation.

No p-values, sampling confidence intervals or causal effects were calculated, because the administrative records are not a probability sample of independent cases with linked outcomes. The analysis reports exact source counts and reproducible arithmetic; passing the reconciliation checks addresses calculation accuracy but not uncertainty in coverage, definitions or comparability.

Results

Source totals and standard distribution

The reconstructed national private-sector case total was 993,851 and the session total was 1,930,695. The five case-category totals were 372,475 for physiotherapy, 3,836 for occupational therapy, 500 for hearing/speech/swallowing, 110,973 for orthotics/prosthetics and 506,067 for other services. The corresponding session totals were 985,321, 19,810, 1,450, 132,578 and 791,536. Every retained national field reconciled with the official source table.

For context, the Ministry of Health table lists 1,883,000 rehabilitation cases by health cluster (described as visits in the table title) without session counts, and the other-government table lists 1,096,211 cases by agency, so neither supports a regional session-to-case ratio. The four Northern health clusters recorded 187,461 Ministry of Health cases, compared with 20,934 private-sector cases; private-sector records were therefore 10.0% of the cases recorded by the two sectors in Northern and 34.5% nationally; because the Ministry of Health table describes its counts as visits, these shares combine different recording units and are approximate.

The restricted standardization used physiotherapy, orthotics/prosthetics and other services. Their national case weights were 0.3764, 0.1121 and 0.5114, respectively, when rounded for display. The largest standard weight belonged to the heterogeneous “other” category, so the standardized result depends heavily on a category whose internal composition is not reported. The weights are descriptive shares of recorded national cases, not a clinically desirable service distribution.

Northern aggregate activity

Northern recorded 20,934 private-sector cases and 26,956 sessions in total, producing a total session-to-case ratio of 1.288. Its category case counts were 12,245 physiotherapy, 10 occupational therapy, zero hearing/speech/swallowing, 2,150 orthotics/prosthetics and 6,529 other services. The corresponding recorded sessions were 17,647, 12, zero, 2,356 and 6,941. These values describe the aggregated reported activity of Tabuk, Hail, Northern Borders and Al Jouf. They do not identify the distribution of sessions across individual recipients, the duration of care or the number of unique people treated.

Across the restricted three categories, Northern recorded 20,924 cases and 26,944 sessions. The restricted observed ratio was 1.288 and the category-standardized ratio was 1.209, a reduction of approximately 0.079 in the displayed ratio. The near equality of the total and restricted observed values reflects the small number of recorded cases and sessions in the excluded Northern categories. The excluded categories remain visible in the full tables.

Northern administrative-region differences

Administrative-region values are shown in Table 2. Tabuk recorded 8,685 total cases and 11,674 sessions. Its restricted observed ratio was 1.344 and its standardized ratio was 1.215. Hail recorded 6,492 cases and 7,286 sessions, with a restricted observed ratio of 1.122 and a standardized ratio of 1.142. Northern Borders recorded 4,027 cases and 5,919 sessions, with corresponding restricted observed and standardized ratios of 1.470 and 1.247. Al Jouf recorded 1,730 cases and 2,077 sessions, with corresponding ratios of 1.201 and 1.163. The direction and magnitude of the standardization change therefore differed within Northern.

Hail's standardized ratio was slightly higher than its restricted observed ratio, whereas the other three Northern regions had lower standardized values. This follows from the category weights and the regions' category-specific ratios and does not indicate better or worse care.

Five-group comparison and retained thirteen-region context

The restricted observed and standardized ratios were 2.188 and 2.165 in Central, 1.793 and 1.786 in Western, 1.815 and 1.770 in Eastern, 1.233 and 1.205 in Southern, and 1.288 and 1.209 in Northern (Table 3). Each pair uses the same restricted set and the same national standard distribution. Category composition affected the comparison to differing degrees across the groupings.

With equal weights, the standardized ratios were 2.038 in Central, 1.628 in Western, 1.676 in Eastern, 1.204 in Southern and 1.200 in Northern (Table 3). Eastern therefore ranked above Western, and Southern above Northern, whereas their national-weight ratios had differed by 0.016 and 0.004, respectively. The “other” category accounted for 51.1% of national restricted cases but 31.2% of Northern restricted cases, and its session-to-case ratio was 1.063 in Northern and 1.564 nationally. Without that category, the Northern observed and standardized ratios were 1.390 and 1.362; the corresponding standardized ratios were 2.977 in Central, 1.751 in Western, 2.082 in Eastern and 1.307 in Southern.

The administrative-region table (Table 2) and figure (Figure 1) retain all thirteen observations behind those broad summaries, because a group's pooled ratio can conceal regional differences and the groupings contain unequal numbers of administrative regions. The figure displays observed, national-weight and equal-weight standardized ratios for every region.

Table 2. Recorded private-sector rehabilitation cases, sessions and session-to-case ratios across thirteen administrative regions, 2024

Administrative region	Cases (all categories)	Sessions (all categories)	All-category ratio	Restricted observed ratio	Category-standardized ratio, national weights	Category-standardized ratio, equal weights
Riyadh	367,918	799,684	2.174	2.161	2.141	2.017
Makkah	261,482	485,348	1.856	1.851	1.851	1.682

Administrative region	Cases (all categories)	Sessions (all categories)	All-category ratio	Restricted observed ratio	Category-standardized ratio, national weights	Category-standardized ratio, equal weights
Madinah	58,583	90,004	1.536	1.536	1.492	1.381
Qassim	19,141	51,458	2.688	2.688	2.610	2.441
Eastern	244,465	450,951	1.845	1.815	1.770	1.676
Asir	11,988	14,503	1.210	1.210	1.198	1.199
Tabuk	8,685	11,674	1.344	1.344	1.215	1.204
Hail	6,492	7,286	1.122	1.122	1.142	1.137
Northern Borders	4,027	5,919	1.470	1.470	1.247	1.258
Jazan	5,195	6,444	1.240	1.241	1.223	1.223
Najran	2,698	3,436	1.274	1.274	1.172	1.174
Al Baha	1,447	1,911	1.321	1.321	1.289	1.251
Al Jouf	1,730	2,077	1.201	1.201	1.163	1.154

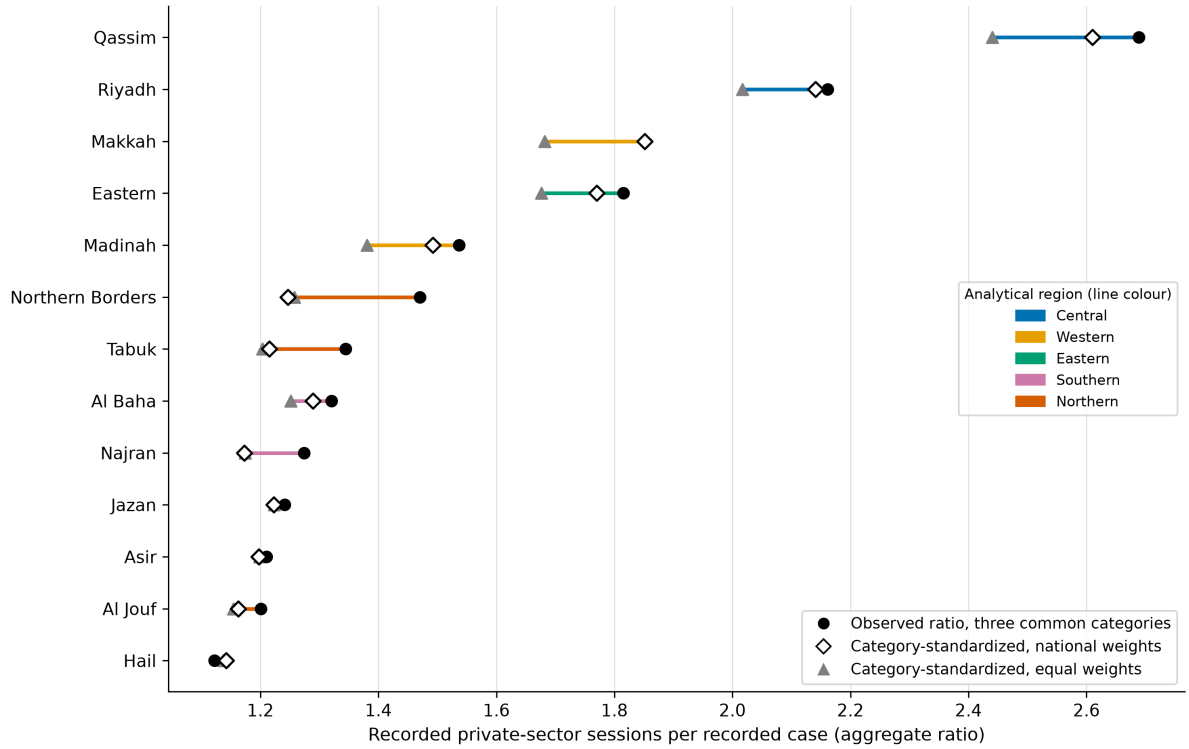
Notes. Source: Ministry of Health Statistical Yearbook 2024, Tables 4-47 and 4-48 (private sector; source agency: Council of Health Insurance). Thirteen official administrative regions are retained; five broad groups are published analytical aggregates, not replacement administrative divisions. Cases and sessions are all-category totals. Ratios divide aggregate sessions by aggregate cases; they are not individual means. Restricted and standardized quantities include physiotherapy, orthotics/prosthetics and other services only. National weights: physiotherapy 0.3764217824, orthotics/prosthetics 0.1121488810, other 0.5114293366; equal weights: one third each.

Table 3. Observed and category-standardized private-sector rehabilitation ratios across five analytical regions, 2024

Analytical region	Cases (three categories)	Sessions (three categories)	Restricted observed ratio	Category-standardized ratio, national weights	Difference	Category-standardized ratio, equal weights
Central	385,845	844,088	2.188	2.165	−0.023	2.038
Western	318,693	571,562	1.793	1.786	−0.007	1.628
Eastern	242,762	440,584	1.815	1.770	−0.045	1.676
Southern	21,291	26,257	1.233	1.205	−0.028	1.204
Northern	20,924	26,944	1.288	1.209	−0.079	1.200

Notes. Source: Ministry of Health Statistical Yearbook 2024, Tables 4-47 and 4-48 (private sector; source agency: Council of Health Insurance). Five broad groups are published analytical aggregates of the thirteen official administrative regions. Cases and sessions are restricted to physiotherapy, orthotics/prosthetics and other services, the categories used for every ratio in this table; all-category totals are given in Table 2 and the text. National weights as in Table 2. Difference is the national-weight standardized ratio minus the restricted observed ratio, calculated from unrounded values.

Figure 1. Observed and category-standardized ratios of recorded private-sector rehabilitation sessions to cases across thirteen administrative regions, 2024.



Notes. Source: Ministry of Health Statistical Yearbook 2024, Tables 4-47 and 4-48 (private sector; source agency: Council of Health Insurance). Common categories: physiotherapy, orthotics/prosthetics, other. Lines join the three values for each region and are coloured by analytical region. Where markers coincide (for example Makkah), the observed and standardized values are equal to three decimals. Ratios are not individual mean sessions or need-adjusted measures; no patient risk, causal effect or clinical recommendation is inferred.

Discussion

What category standardization adds

Using a common reported-category distribution changed the Northern session-to-case summary and moved the individual Northern regional summaries in different directions. This makes one source of variation in aggregate comparisons visible. The common weights, however, standardize only the categories that can be calculated from the tables; they cannot standardize diagnosis, functional severity, referral eligibility, treatment goals, duration or access barriers. The result is therefore an administrative comparison, not a need-adjusted or risk-adjusted clinical performance score.

Private-sector recording

Tables 4-47 and 4-48 cover private-sector rehabilitation only and are compiled from Council of Health Insurance records. A case and a session are therefore units of privately delivered activity as recorded through insurance reporting; the tables do not state whether a case is a person, a referral or an authorised episode, or whether a session is counted per claim or per attendance. Private activity outside insurance arrangements may not be captured, and Ministry of Health and other-government activity is excluded. In Northern, private-sector records were about one tenth of the cases recorded by the private sector and the Ministry of Health together, compared with about one third nationally (shares that combine different recording units), so the Northern results describe a small segment of recorded rehabilitation activity in the region. Regional differences may also reflect insurance coverage and the location of private providers rather than the overall organisation of rehabilitation services.

Why sessions relative to cases are not an individual treatment dose

An individual mean requires sessions linked to a defined set of patients or episodes. The yearbook reports unlinked annual totals, and sessions in a year may belong to cases registered earlier or continue beyond it; the ratio therefore describes a reporting-period relationship rather than an average completed course of therapy.

For the same reason, the ratio is not a dose-response measure. Studies of stroke, cancer and other rehabilitation examine outcomes in defined clinical populations [8–10], and those outcomes cannot be assigned to the yearbook categories; without linked functional measures, a ratio cannot show recovery, benefit, unnecessary treatment or an appropriate course length.

Specialty composition and zero denominators

Occupational therapy and hearing/speech/swallowing were excluded from standardization because some regional case denominators were zero; assigning a ratio to an undefined quantity, or dropping a category in one region only, would create incomparable standards. The restriction changes the question answered, so the full totals and excluded counts accompany the standardized measure.

Published Saudi work on occupational therapy and specialty rehabilitation provision [2–6] supports discussing these categories without equating a source zero with absent need; availability, referral, service designation and reporting practice could each explain where activity appears.

Workforce, access and interpretation of regional activity

Rehabilitation workforce supply and demand [1], stroke workforce requirements and the experiences of overseas-trained physiotherapists [18,19] concern capacity, which a session-to-case ratio does not measure; the ratio cannot show whether a pattern results from capacity, clinical practice, referral, recording rules or their combination.

Studies of cardiac rehabilitation referral, trauma rehabilitation access and telerehabilitation [20–23] address mechanisms that affect who receives services, which aggregate counts cannot identify. We therefore do not rank Northern or any administrative region by access or quality.

The heterogeneous “other” category

The national standard assigns more than half of the restricted cases to “other” services, a reconciling category rather than a clinical specialty, whose internal composition may differ between regions. A common weight does not make those mixtures equivalent, and a finer category breakdown would be needed to examine narrower strata.

Because the standard is a choice, two alternatives were examined. Equal weights lowered most standardized ratios, particularly in Central and Western, and left Northern almost unchanged; the only changes in group order occurred between groups whose national-weight ratios differed by less than 0.02. Removing the “other” category raised the Northern ratios because Northern “other” activity had a lower session-to-case ratio than the national “other” activity. Northern remained the lowest or second-lowest group under every standard examined, but the absolute ratio depends materially on how the “other” category is treated.

Strengths and reproducibility

The analysis preserves the complete source, explicit sheet and row mappings, all thirteen administrative regions, the attributed five-group crosswalk and the exact arithmetic, with national reconciliation checks and unrounded outputs that make the calculation repeatable on the same workbook.

Limitations and future research

Several limitations bound the conclusions. The source covers a single annual reporting period and private-sector activity only, and cannot establish longitudinal change. Case and session fields are not linked, so individual distributions and episode timing are unknown. Category standardization is restricted to three broadly defined categories and does not adjust clinical severity. Source zeros may reflect service or reporting structures that the tables do not explain. The data also lack eligible population denominators, waiting times, functional outcomes, discharge destinations and patient experiences. No sampling inference can solve those missing-information problems merely by applying a statistical formula to the recorded totals.

A useful next study would use a source-approved episode-level dataset with linked sessions, diagnosis, functional status, referral and treatment dates and outcomes, so that treatment intensity and access could be measured on an aligned population; workforce questions would additionally require staff roles and working time. These proposals follow from the current data gaps and were not performed in this analysis.

Prior literature

The earlier regional publication reports Ministry of Health capacity and utilization indicators without rehabilitation or private-sector data, so the present results do not duplicate it [11]. The Audiology Research study used the same yearbook rehabilitation tables, including the private-sector session counts analysed here, to describe volumes by specialty, region, sector and paediatric age and population-based rates; it did not relate sessions to cases or examine category composition [12]. This article therefore adds a session-to-case description of private-sector records, its sensitivity to category composition and to alternative standards, and the separation of the Northern administrative regions. Related analyses of other tables of the same yearbook concern different services and regions and do not use Tables 4-47 or 4-48.

Conclusions

Northern Saudi Arabia recorded 26,956 private-sector rehabilitation sessions relative to 20,934 cases in the selected 2024 yearbook tables. Restricting standardization to three calculable service categories produced an observed ratio of 1.288 and a category-standardized ratio of 1.209, with differing patterns among Tabuk, Hail, Northern Borders and Al Jouf. These values support a transparent description of recorded service activity and show why category composition matters. They do not estimate an individual mean treatment dose, rehabilitation need, recovery, quality or clinical effectiveness. The results describe insured private-sector activity only and should not be read as a description of Ministry of Health or other government rehabilitation services.

Declarations

Ethics statement: This study analysed published aggregate administrative records from the publicly available Ministry of Health Statistical Yearbook 2024 [15]; it involved no recruited participants, no new clinical observations and no access to identifiable individual records. As a secondary analysis of publicly available data, the study was exempt from ethics review.

Data and code availability: The source workbook is publicly available [15]. The source-row exports, the result files with unrounded ratios and weights, and the Python scripts that reproduce all reported values and Figure 1 are provided as Supplementary Material S1.

Related submissions: Analyses of other tables of the same 2024 yearbook have been submitted separately to this journal and are listed in the cover letter; they concern different services, and none uses Tables 4-47 or 4-48.

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Conflicts of interest: The authors declare no competing interests.

Author contributions: [Pending: CRediT author contributions and confirmation that all authors approved the final version — to be supplied by the authors]

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Abbreviations

Abbreviations. RECORD, REporting of studies Conducted using Observational Routinely-collected health Data; SHA256, Secure Hash Algorithm with a 256-bit digest; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology.

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