Original Article

Prevalence of disease related malnutrition assessed by NRS2002, STAMP, MNA-SF, one-step and two-step GLIM at admission and discharge: A systematic review and meta-analysis

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Background and Objectives: Disease-related malnutrition (DRM) mandates routine screening in many nations to ensure quality care as nutritional status often deteriorates during hospitalization. This study aimed to establish tool-specific prevalence benchmarks at admission and discharge, investigate sources of heterogeneity and evaluate diagnostic yields of one-step versus two-step GLIM approaches. **Methods and Study Design:** A systematic search of Embase, PubMed, Web of Science, Cochrane Library, and CINAHL was conducted for cross-sectional studies on nutritional status published between 1 January 2018 and 30 Nov 2025 (PROSPERO ID: CRD42023480467). Eligible studies were pooled in a meta-analysis of proportions using a random-effects model. **Results:** Of 9,693 records retrieved, 179 studies involving 755,092 patients from 30 countries were included. At admission, the pooled prevalence was 0.41 (95% CI 0.35–0.49, I^2 = 99.9%) by NRS2002 (≥3, adults), 0.62 (95% CI 0.57–0.67, I^2 = 99.3%) by MNA-SF (≤11, older adults), 0.55 (95% CI 0.44–0.68, I2 = 98.5%) by STAMP (≥2, pediatric patients), and 0.39 (95% CI 0.35–0.44, I^2 = 99.6%) by GLIM (adults). At discharge, three studies reported a pooled prevalence of 0.19 (95% CI 0.09–0.40, I^2 = 94.6%) by NRS2002 for adults, significantly lower than admission (p = 0.044). Comparing GLIM strategies, no statistically significant difference was observed between one-step and two-step GLIM approaches (p = 0.062). **Conclusions:** DRM prevalence remains high at both admission and discharge, varying widely across countries and by tools. Discharge data are critically limited, reflecting gaps in routine screening practices. Regarding diagnosis, findings support a risk-adapted strategy. Pooled estimates may overestimate the true prevalence and should be interpreted with caution.

Key Words: nutritional risk, malnutrition, hospitalized patients, prevalence, disease-related malnutrition

INTRODUCTION

Disease related malnutrition (DRM) occurs when nutrient intake is insufficient or nutrient utilization is impaired during a disease state, leading to weight loss, skeletal muscle loss, physical and mental dysfunctions, and poorer clinical outcomes.[1] This condition is highly prevalent globally and is independently associated with adverse clinical outcomes, including increased infection rates, prolonged hospital stays, and mortality.[2, 3] Historically, DRM affects 30–50% of hospitalized patients,[4] with 6%–65% experiencing further deterioration by discharge.[5-9] Given that nutritional support for inpatients who are at nutritional risk or already malnourished has been shown to improve both nutritional and clinical outcomes, practice guidelines recommend a proactive, screening-based approach to initiating nutritional support during hospitalization.[10]

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In pursuit of a world free from all forms of malnutrition, including DRM,[11] WHO established the Sustainable Development Goals (SDGs) and launched the Ambition and Action in Nutrition 2016–2025 initiative.[12, 13] Following these global calls,[14] several countries have implemented national nutrition strategies. For example, China initiated the Healthy China 2030 and National Nutrition Plan (2017–2030),[15, 16] while Lebanon, Vietnam, and Togo published similar plans emphasizing clinical nutrition.[17-20] In parallel, some countries have mandated routine malnutrition screening at hospital admission to trigger subsequent assessment, diagnosis and treatment,[21] aiming to achieve the vision of "hunger-free hospitals".[22]

In clinical nutrition practice, over 60 screening and diagnostic instruments are currently used, and new tools continue to emerge for specific diseases and settings.[23-26] To ensure comprehensive coverage across all inpatient age groups, we selected four tools that are widely used in routine services and together constitute a representative clinical nutrition workflow: the Nutritional Risk Screening 2002 (NRS2002) and the Global Leadership Initiative on Malnutrition (GLIM) criteria for adults, the Mini Nutritional Assessment–Short Form (MNA-SF) for older adults, and the Screening Tool for the Assessment of Malnutrition in Pediatrics (STAMP) for children.[23-28] These instruments serve distinct roles: NRS2002, MNA-SF, and STAMP are screening tools used to identify patients at nutritional risk who may require further evaluation, while GLIM is a consensus-based diagnostic framework intended to confirm malnutrition based on phenotypic and etiologic criteria.

Despite global and national initiatives, data on DRM prevalence remain fragmented and inconsistent. Reported trends vary widely, with studies showing conflicting trajectories between admission and discharge.[9, 29, 30] Moreover, the comparative impact of one-step (direct diagnosis) versus two-step (screening followed by diagnostic confirmation) GLIM diagnostic approaches on prevalence estimates remains unquantified. A systematic synthesis is therefore essential not only to aggregate these dispersed findings but to establish statistical benchmarks and investigate the sources of variation across diverse global populations.

As many countries approach the midpoint of their national clinical nutrition action plans, tool-specific prevalence estimates offer vital reference points for benchmarking. In China, for instance, screening for nutritional risk within 24 hours of admission is a mandated quality indicator.[31] Robust, synthesized estimates are therefore needed to establish reliable benchmarks for such routine quality monitoring.

Therefore, we conducted a systematic review and meta-analysis to synthesize the available evidence for benchmarking and to explore global variations. Specifically, this study aimed to: (1) establish tool-specific prevalence benchmarks across countries at admission and discharge; (2) investigate the sources of variation across diverse global populations to assess data consistency; and (3) quantitatively evaluate the diagnostic yields of one-step versus two-step GLIM approaches.

METHODS

Study design, protocol registration and reporting guideline compliance

This was a systematic review and meta-analysis of proportions conducted in accordance with the Reporting Guidelines for Meta-analyses of Observational Studies (MOOSE).[32] This study followed a pre-registered protocol registered in the International Prospective Register of Systematic Reviews (PROSPERO; registration ID: CRD42023480467). To ensure methodological robustness, align with contemporary clinical standards, and address data availability, we implemented specific deviations from the original protocol, including: omitting Subjective Global Assessment (SGA) / Patient-Generated Subjective Global Assessment (PG-SGA) to focus on universal tools (NRS2002, GLIM); updating the timeframe to 2018–2025; reporting prevalence rates exclusively due to data scarcity on screening coverage; and supplementing the Agency for Healthcare Research and Quality (AHRQ) assessment with the Hoy et al. tool.[33] We also restricted inclusion to English-language databases. A detailed summary of all deviations and their scientific justifications is provided in Supplementary Table 1. As this study involved only secondary analysis of published data, no ethical approval or patient informed consent was required.

Data sources

We systematically searched five databases for eligible English-language studies published between 1 January 2018 and 30 November 2025, including Embase, PubMed, Web of Science, Cochrane, and CINAHL.

PICOS statement and search strategy

The brief PICOS statement of the study was as follows: patient problem or population (hospitalized patients), intervention or exposure (nutritional risk or malnutrition with or without severity grading as defined by the NRS2002, STAMP, MNA-SF; one-step GLIM or two-step GLIM, i.e., any screening tool we selected combined with GLIM at hospital admission or discharge), comparison or control (not applicable), outcome measure (NRS2002, MNA-SF, STAMP, GLIM positive rate at admission or discharge) and study design (cross-sectional studies). For a detailed PICOS overview and search strategies used for each database, along with their original results (Supplementary Table 1 and 2).

Inclusion and exclusion criteria

We excluded several types of publications from our analysis: editorials, dissertations, books, articles not published in English, conference papers, and news articles. Furthermore, we omitted studies where the full text or nutritional data was inaccessible, even after attempting to contact the authors, as well as those employing alternative designs, and non-original studies, including meta-analyses and reviews. In cases where multiple articles reported on the same population (for instance, when different articles enrolled the same participants but presented results at various time points), we selected only the most recent publication or the one with the largest sample size. Additionally, we excluded non-representative studies, such as those with unclear descriptions of study sites.

Study selection workflow and conflicts settlement

First, DM conducted a comprehensive database search to export records for each paper, including titles, abstracts, authors, publication years, keywords, etc. Next, the retrieved records were deduplicated using Endnote 21 and Rayyan, then meticulously screened based on predefined protocol. Papers requiring further full-text evaluation were compiled into a single file for subsequent review. Then, two researchers (DM and QZ) independently performed full-text screening, with any discrepancies resolved by senior researchers (YC, YL, and LS).

Data extraction

The initial draft of the data extraction form was developed by DM. Its final content and format were established after discussions with all researchers and methodologists (YQ, JY, LNZ, LLZ). Subsequently, two independent investigators (DM and QZ) extracted data from the included studies. Further information was documented in Supplementary Table 3. The primary extracted data encompassed basic article details (e.g., author, publication year, study region, study design, screening/assessment tool, sample size), patient characteristics (e.g., mean/median age, female, male), and other relevant data (e.g., timing of nutrition screening/assessment, prevalence of malnutrition at admission/discharge).

Risk of bias assessment

We assessed the risk of bias and methodological quality of the included studies using two distinct instruments. Study quality was evaluated using AHRQ checklist, with studies categorized as high (8–11 points), fair (4–7 points), or low (0–3 points) quality based on their cumulative scores.

Additionally, we used a validated 10-item tool (Q1-10) specifically designed for prevalence studies by Hoy et al.[33] This tool evaluates four domains: selection, non-response, measurement, and analysis bias. To standardize the application of the 11th item (the overall summary judgment, Q11), we implemented a predefined scoring rule: each preceding item was rated as “yes” (low risk) or “no” (high risk). A study was classified as having a “low risk of bias” if it had fewer than three “no” ratings, “moderate risk” if it had exactly three, and “high risk” if it had four or more. We refined the descriptive criteria for each item to ensure relevance to the specific research context. Two reviewers (DM and QZ) independently performed the assessments immediately following data extraction, with any disagreements resolved through discussion with the broader research team. Detailed assessments are provided in Supplementary Table 4.

Malnutrition screening and diagnostic tools

The malnutrition screening and diagnostic tools yield different outcome definitions: screening tools (NRS2002, MNA-SF, STAMP) identify “nutritional risk” or “risk of malnutrition,” whereas the diagnostic tool (GLIM) defines “malnutrition.” Accordingly, prevalence estimates were pooled separately within each tool and were not combined across tools, as these outcomes represent distinct conceptual constructs.

NRS2002

The NRS2002, developed by Kondrup et al. for inpatients aged 19 to 90, was formulated based on 12 randomized controlled trials (RCTs) and retrospectively validated using data from 128 RCTs.[34-36] An NRS2002 score of 3 or higher is called “nutritional risk” and signifies the need for a follow-up nutritional assessment or diagnosis to ascertain whether the patient suffers from malnutrition.

MNA-SF

The MNA-SF, a malnutrition screening tool originally devised for elderly inpatients aged 65 and over,[37, 38] has also proven effective in those aged 60 and above.[39] This abbreviated version, consisting of 6 items compared to the full MNA's 30 items,[40] cuts screening time to roughly 5 minutes without sacrificing key predictive factors. Scores of 7 or fewer on the MNA-SF indicate “malnutrition”, whereas scores between 8 and 11 suggest a “risk of malnutrition”. In brief, any score of 11 or less on the MNA-SF necessitates a deeper evaluation.[28]

STAMP

The STAMP serves as a screening tool specifically designed for children and teenagers aged 2 to 17 years in hospital settings.[41] Its initial phase involves a growth assessment, evaluating age-specific height/weight percentiles or Z-scores to pinpoint deviations from expected growth patterns. This aspect differentiates STAMP from other pediatric screening instruments, such as Screening Tool for Risk On Nutritional status and Growth (STRONGkids).[42] A STAMP score of 2 or higher signifies that the patient faces a medium or high “risk of malnutrition".

GLIM

The GLIM,[27] a diagnostic tool and consensus framework for DRM in adults, emerged in 2019 from the collaborative efforts of five prominent global nutrition societies. Their goal was to standardize the diagnostic criteria for malnutrition.[43] Under GLIM, malnutrition is diagnosed when at least one phenotypic and one etiologic criterion are met. The framework is structured into two main components: an initial screening to pinpoint patients "at risk" through validated tools like NRS2002 or MNA-SF, followed by a diagnostic evaluation to verify malnutrition and determine its severity based on phenotypic criteria. However, in fact, screening may be omitted, leading to

the implementation of either the "one-step GLIM" or "two-step GLIM" approach, i.e., one-step GLIM: applying GLIM diagnostic criteria directly to all subjects without prior screening; two-step GLIM: applying GLIM diagnostic criteria only after a positive nutrition risk screening result.[27, 44] For detailed definitions, target populations, and scoring criteria for each of abovementioned four tools, refer to Supplementary Table 5.

Data synthesis and statistical analysis

We used R (v4.4.2) to perform descriptive analysis and meta-analysis. The prevalence (p') was computed as the number of events (x) divided by the sample size (n) (i.e., p' = x/n). Prior to pooling, prevalence data underwent log transformation (log p') to stabilize variance, as the Shapiro–Wilk normality test indicated that log-transformed data exhibited better normality than raw, logit, arcsin, and double arcsin transformations. The pooled prevalence was then derived as an effect size with corresponding 95% confidence intervals (95%CI), using a two-sided significance level of $\alpha = 0.05$. A continuity correction was applied by adding 0.5 to x and 1 to n, a common practice to handle extreme proportions (e.g., 0% or 100%).[45]

Given the heterogeneity among studies, we adopted a random-effects model utilizing the DerSimonian and Laird approach. Heterogeneity among studies was evaluated using forest plots, Cochrane's Q test, and the I^2 statistic, with I^2 values of 25%, 50%, and 75% indicating low, moderate, and high heterogeneity, respectively ($p < 0.1$). A leave-one-out sensitivity analysis was conducted to assess the stability of the results.

Subgroup analyses and meta-regressions were conducted to explore sources of variability. Potential covariates were pre-specified based on demographic (gender, gender ratio, mean age group), geographic and socioeconomic (region, country, income level), procedural (timing of assessment, assessor type) and methodological quality (individual items from the Hoy et al. and AHRQ tools) factors.

It was followed by univariable meta-regression for each potential covariate in tool groups with more than 10 studies. Covariates that showed statistical significance were then included in the multivariable model. The adjusted pooled prevalences were calculated as model-predicted proportions and converted from the log scale to the original proportion scale, reflecting covariate-adjusted prevalences instead of simple subgroup-specific prevalences.

Publication bias was assessed using funnel plots, Peters' test, and Duval and Tweedie's trim-and-fill method. For outcomes with significant asymmetry ($p < 0.01$), a Bayesian meta-analysis of log-transformed proportions was performed using a normal–normal hierarchical model with a Half-Normal prior on heterogeneity, to obtain robust credible intervals (CrI). This analysis was limited to subgroups with strong evidence of bias and was not part of the primary analysis.

RESULTS

Study selection

Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 (Figure 1), we initially identified 9,693 records. After Endnote 21 and Rayyan removed 2,625 duplicates, 7,068 records were screened by two independent researchers (DM and QZ). After title and abstract screening, the reviewers reached consensus on 729 records, while 6,339 records were excluded as irrelevant. Of the remaining records, 718 full-text reports were assessed for eligibility, with an additional 11 reports being unavailable.

A total of 515 articles were subsequently excluded for the following reasons: 354 were cohort studies, 49 involved irrelevant populations (e.g., outpatients, post-discharge individuals, or community-dwelling populations), 39 focused on tool validation or threshold development, 30 were conference paper, 16 did not provide the necessary numerator and denominator for calculating prevalence, 13 were secondary analysis, 13 were published in Portuguese, Spanish, Russian or French, 11 was a case-control study, 9 only included patients already identified as having nutritional risks, 5 were pilot studies, 5 were interventional and 2 was reviews. After removing 24 repeated reports, 179 studies (represented in 203 reports) were included in the qualitative synthesis, of which 170 were eligible for quantitative analysis.[46-224] Study characteristics were presented in Supplementary Table 6.

Overview of the included studies

The final analysis included 179 cross-sectional studies published between 2018 and 2025, reporting on 755,092 hospitalized patients across 30 countries. Thirty-one studies were multicenter, and seven reported prevalence at both admission and discharge; only three met both criteria. NRS2002 (n=114) and GLIM (n=82) were the most used tools, followed by MNA-SF (n=36) and STAMP (n=6); sample sizes ranged from 33 to 324,140. Female-to-male ratios were 0.8 (NRS2002), 0.7 (GLIM), 1.0 (MNA-SF), and 0.8 (STAMP). Mean ages were 62.2 years for NRS2002 and 63.1 for GLIM, compared with 74.3 for MNA-SF and 4.7 for STAMP.

By WHO region,[225] 82 studies (45.8%) were from the Western Pacific, 65 (36.3%) from Europe, 15 (8.4%) from the Americas, 12 (6.7%) from the Eastern Mediterranean, and 5 (2.8%) from South-East Asia. According to World Bank classification,[226] 106 studies (59.2%) were conducted in upper middle income countries, 62 (34.6%) in high income countries, and 11 (6.2%) in lower middle income countries.

Across 201 records, 43 department types were represented. The most common were internal medicine and oncology (each 9.0%), followed by general surgery (8.5%), intensive care (7.0%), gastroenterology (6.5%), and geriatrics (5.0%). Grouped by broader categories, these comprised medical specialties (42.3%), surgical specialties (24.9%), oncology (8.5%), critical care (7.5%), geriatrics and palliative care (5.5%), and other specialties (11.4%).

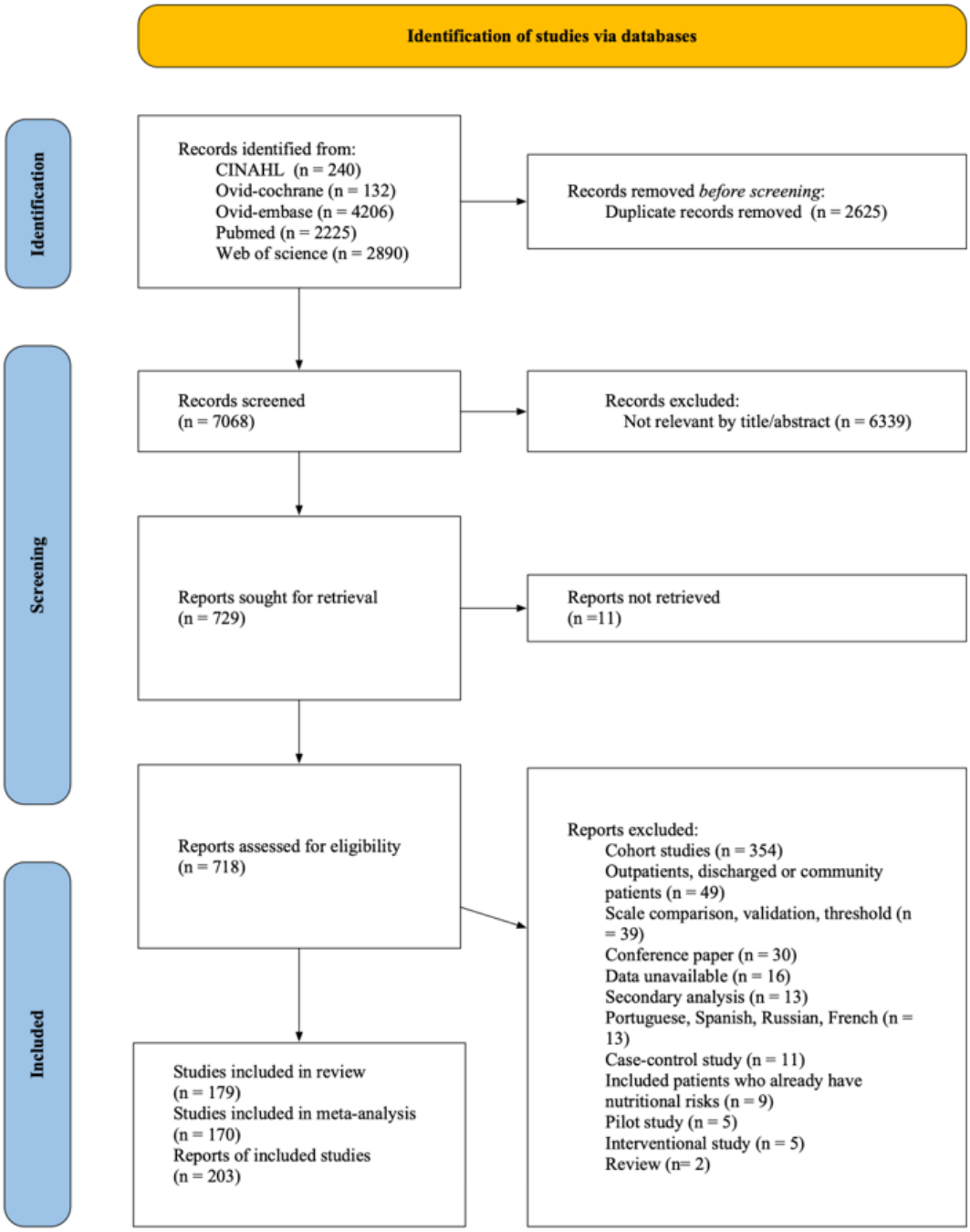

Figure 1. PRISMA 2020 flow diagram of study selection

Risk of bias summary

Methodological quality varied across the 179 included studies. According to the AHRQ checklist, the majority of studies (n=136, 76.0%) were of fair quality, while 37 (20.7%) were rated as low quality and only six (3.4%) as high quality. When evaluated using the Hoy et al. tool, 73 studies (40.8%) were classified as having a low risk of bias, 55 (30.7%) as moderate risk, and 51 (28.5%) as high risk.

Specific methodological weaknesses were identified in the following areas:

(1) Participant Selection and Representation: 146 studies (81.6%) were at high risk of bias in population representation due to inadequate accounting for demographics such as age and sex. Limitations in sampling frames were noted in 129 studies (72.1%), and 95 (53.1%) relied on convenience sampling rather than consecutive or random selection.

(2) Assessment Timing: 79 studies (44.1%) failed to conduct nutritional screening or assessment within an appropriate timeframe following hospital admission.

(3) Analytical Reporting: Only two studies (1.1%) explicitly described the management of missing data, and six (3.4%) provided adequate details on response rates and data completeness.

(4) Blinding: Reporting of outcome assessor blinding for subjective measurements was rare, occurring in only five studies (2.8%).

Regional and sample size distribution

Geographic distribution of included studies was uneven. China contributed nearly half the studies for the

NRS2002 analysis (k = 42/90, 46.7 %; 47.2% total weight) and was the predominant source for GLIM analysis (k=34, 42.5 %). However, the random-effects model effectively mitigated the influence of large-sample studies. For adult populations (NRS2002, MNA-SF, GLIM), no single study contributed >5 % to the total weight, indicating pooled estimates were not driven by individual datasets. In the pediatric STAMP analysis, higher individual weights (15.9 % – 17.3 %) reflected the small number of studies (k=6) rather than sample size disparities. These pooled estimates should be interpreted in the context of this regional dominance.

Prevalence of nutritional risk and malnutrition

Prevalence at admission

Main results are summarized in Table 1 and detailed in Supplementary Table 7, with corresponding forest plots shown in Figures 2-5 (Supplementary Figure 1 and 2). Figure 6 illustrates the pooled prevalence at admission across countries. Key findings are highlighted below.

The pooled prevalence of nutritional risk among adult inpatients (NRS2002 ≥3) was 0.41 (95% CI, 0.35–0.49), based on 90 studies (k = 90). However, substantial heterogeneity was observed (I^2 = 99.9%, p <0.001), indicating significant variation across studies. Similarly, for older adults screened with MNA-SF (≤11), the pooled prevalence was 0.62 (95% CI 0.57 –0.67; k = 30, I^2 = 99.3%). Pediatric malnutrition risk (STAMP ≥2) was estimated at 0.55 (95% CI 0.44–0.68; k = 6, I^2 = 98.5%). For adults diagnosed via GLIM criteria, the pooled prevalence was 0.39 (95% CI 0.35 – 0.44; k = 80, I^2 = 99.6%).

GLIM subtypes

One-step GLIM yielded a pooled malnutrition prevalence of 0.42 (95% CI, 0.37 – 0.48; k = 44, I^2 = 99.1%). Two-step GLIM showed varying estimates depending on the initial screen: 0.34 (95% CI 0.26 – 0.46; k =18, I^2 = 99.7%) when preceded by NRS2002, and 0.49 (95% CI 0.35 – 0.68; k=7, I^2 = 99.3%) when preceded by MNA-SF. In all cases, the extremely high I^2 values (>98%) suggest that these pooled estimates represent an average of widely dispersed data points rather than a precise global parameter and should be interpreted with caution.

Prevalence at discharge

Discharge-time data were limited. Pooled NRS2002 ≥3 prevalence at discharge for adult inpatients was 0.19 (95% CI, 0.09 – 0.40; k = 3, I^2 = 94.6%), representing a significant decrease from admission (p = 0.044). For GLIM-defined malnutrition, only two isolated estimates were available (0.50 for adults via one-step GLIM;[147] 0.33 for older adults via NRS2002-GLIM),[152] precluding meta-analysis. Given the limited number of studies and high heterogeneity, these findings should be viewed as preliminary.

Subgroup analysis and meta-regression

Subgroup analyses and meta-regressions explored heterogeneity (Supplementary Table 7 and 8). Given the extreme heterogeneity (I^2 >95%) across most stratifications, reported associations should be interpreted as exploratory trends rather than definitive quantifications.

'Country' showed significant subgroup differences (p <0.05) in univariable analysis, though meta-regression did not confirm it as a moderator. In nations with >3 studies, estimates varied widely within instruments (e.g., NRS-2002 prevalence ranged from 0.32 to 0.68 among adults).

Meta-regression identified potential sources of variation, though caution is warranted due to high residual heterogeneity:

NRS2002: A model incorporating sampling frame (Q2) and non-response bias (Q4) explained 54.5% of heterogeneity. High risk of bias in Q4 predicted lower prevalence (ratio 0.40, 95% CI 0.20–0.78; p = 0.007), suggesting systematic exclusion of high-risk patients in studies. Conversely, sampling frame deficiencies (Q2) showed a non-significant trend towards overestimation (ratio 1.27; p = 0.061).

MNA-SF: A multivariable model explained 78.0% of the heterogeneity (Akaike Information Criterion, AIC = 48.4), identifying age and risk of bias as key factors. Prevalence was higher in patients ≥80 years compared with those ≥60 (β = 0.25, p <0.001). Methodologically, high risk of bias in summary item (Q11) was associated with lower prevalence (β = −0.30, p <0.001). While this suggests a quantitative reduction, the association primarily indicates bias direction rather than a precise adjustment magnitude.

GLIM & NRS2002–GLIM: High risk of bias in item Q1 (population representation) was consistently associated with higher reported prevalence. For GLIM, Q1 bias explained 49.3% of heterogeneity, associated with a 1.62-fold increase in prevalence (β = 0.48, p <0.001; 95% CI 1.22–2.14). Similarly, for NRS2002–GLIM, Q1 bias predicted a 1.86-fold increase (β = 0.62, p = 0.049; 95% CI 1.00 – 3.46).

Crucially, despite the explanatory power of these covariates, considerable residual heterogeneity remained, indicating that unmeasured factors—likely specific clinical protocols or local patient case-mix—drive much of the observed variation.

Sensitivity analysis and publication bias

Leave-one-out sensitivity analyses confirmed that the pooled estimates were robust to individual study exclusion, with no single dataset disproportionately driving the results. Furthermore, excluding studies from China yielded a pooled NRS2002 prevalence of 44% (95% CI 0.33 – 0.59), slightly higher than the overall estimate (41 %). This indicates that the inclusion of Chinese data did not inflate the global benchmark, but rather contributed to a slightly more conservative estimate.

However, publication bias was detected for NRS2002 (Peters' test t = 3.72, p <0.01), GLIM (t = 4.38, p <0.01), and one-step GLIM (t = 2.39, p = 0.02), with visible asymmetry in funnel plots. Trim-and-fill adjustment imputed 43, 34, and 11 missing studies respectively, reducing the pooled prevalence estimates significantly: NRS2002 dropped from 0.41 to 0.22 (46.3% reduction); GLIM from 0.39 to 0.26 (33.3% reduction); and one-step GLIM from 0.42 to 0.35 (16.7% reduction). These substantial adjustments suggest a potential overestimation of

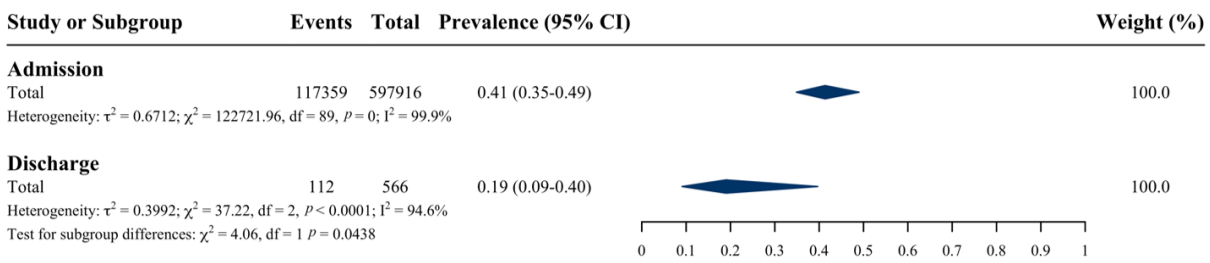

Figure 2. Summary forest plot of pooled prevalence of NRS2002 at admission and discharge (details in Supplementary Figure 1)

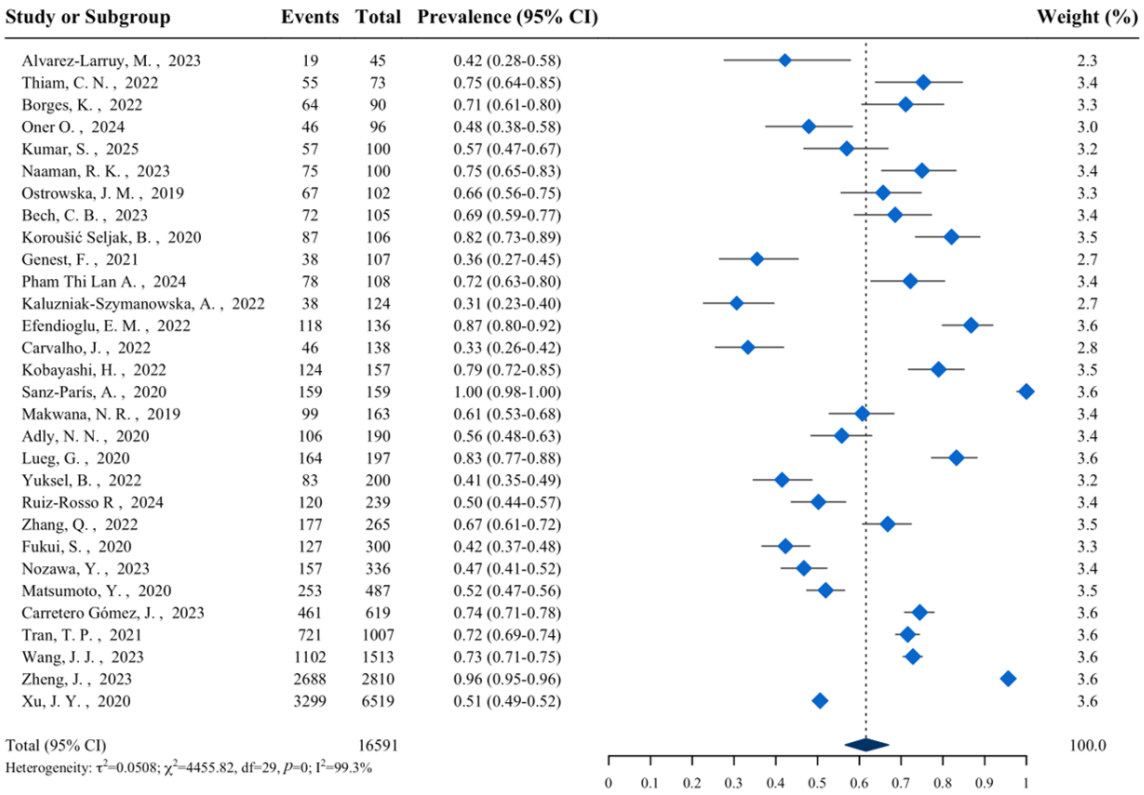

Figure 3. Forest plot of pooled prevalence of MNA-SF at admission

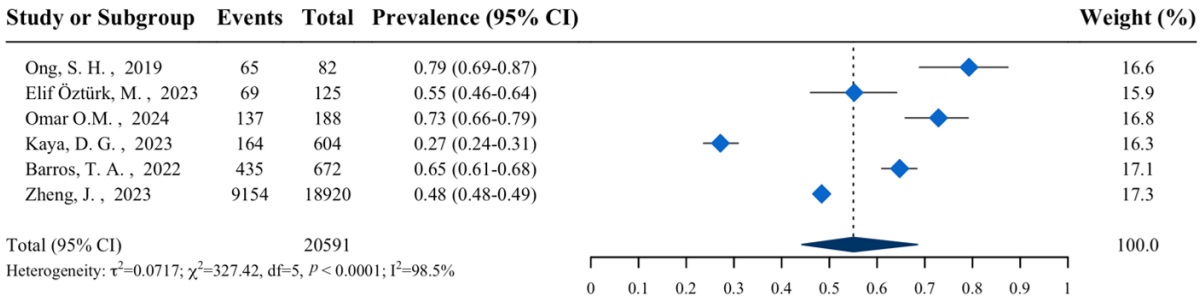

Figure 4. Forest plot of pooled prevalence of STAMP at admission

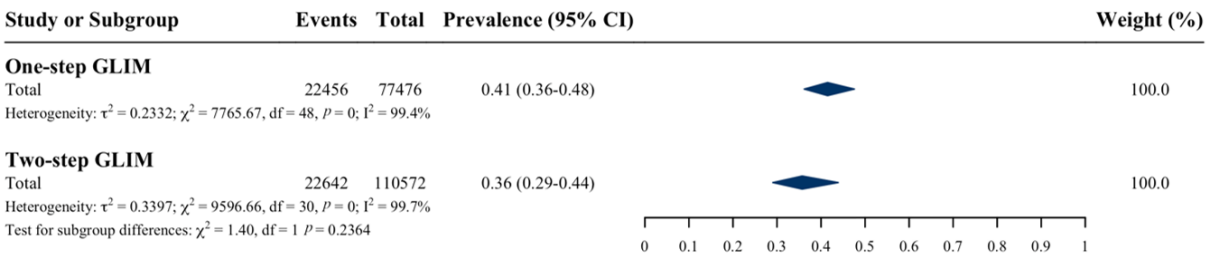

Figure 5. Summary forest plot of pooled prevalence of One-step GLIM and Two-step GLIM at admission (details in Supplementary Figure 2)

Table 1. Pooled prevalence estimates of nutritional risk or malnutrition by screening tool and assessment timepoint

Tool	Target Population	Type / meaning	Time	Number of studies included / I^2	Pooled prevalence (95% CI)	Publication bias (Peters' *p*)†	Adjusted prevalence (Trim-and-fill / Bayesian)
NRS2002 ≥ 3	Adults (19–90y)	Screening / at nutritional risk	Discharge	3 / 94.6%	0.19 (0.09, 0.40)	– ‡	–
			Admission	90 / 99.9%	0.41 (0.35, 0.49)	< 0.001	0.22 (0.18, 0.27) / 0.40 (95% CrI, 0.36, 0.45)
	Elderly (≥60y)		Admission	23 / 99.9%	0.53 (0.40, 0.71)	0.141	–
MNA-SF ≤ 11	Elderly (≥60y)	Screening / at risk of malnutrition	Admission	30 / 99.3%	0.62 (0.57, 0.67)	0.977	–
STAMP ≥ 2	Children (2–17y)	Screening / at medium and high risk of malnutrition	Admission	6 / 98.5%	0.55 (0.44, 0.68)	–	–
GLIM	Adults	Diagnosis / malnutrition	Admission	80 / 99.6%	0.39 (0.35, 0.44)	< 0.001	0.26 (0.23, 0.30) / 0.39 (95% CrI, 0.35, 0.43)
One-Step GLIM	Adults	Diagnosis / malnutrition	Admission	44 / 99.1%	0.42 (0.37, 0.48)	0.021	0.35 (0.30, 0.40) / 0.42 (95% CrI, 0.37, 0.47)
	Elderly (≥60y)			5 / 99.5%	0.38 (0.21, 0.72)	–	–
Two-Step GLIM	Adults (19–90y)	Diagnosis after NRS2002 malnutrition	Admission	18 / 99.7%	0.34 (0.26, 0.46)	0.016	0.20 (0.15, 0.26)/ 0.34 (95%CrI, 0.27, 0.43)
	Elderly (≥60y)			6 / 97.8%	0.28 (0.21, 0.37)	–	–
	Elderly (≥60y)	Diagnosis after MNA-SF / malnutrition	Admission	7 / 99.3%	0.49 (0.35, 0.68)	–	–

CI: confidence interval; CrI: credible interval; I^2: measure of heterogeneity; –: not assessed/not applicable.
†*p* values in the Publication Bias column are based on Peters' test

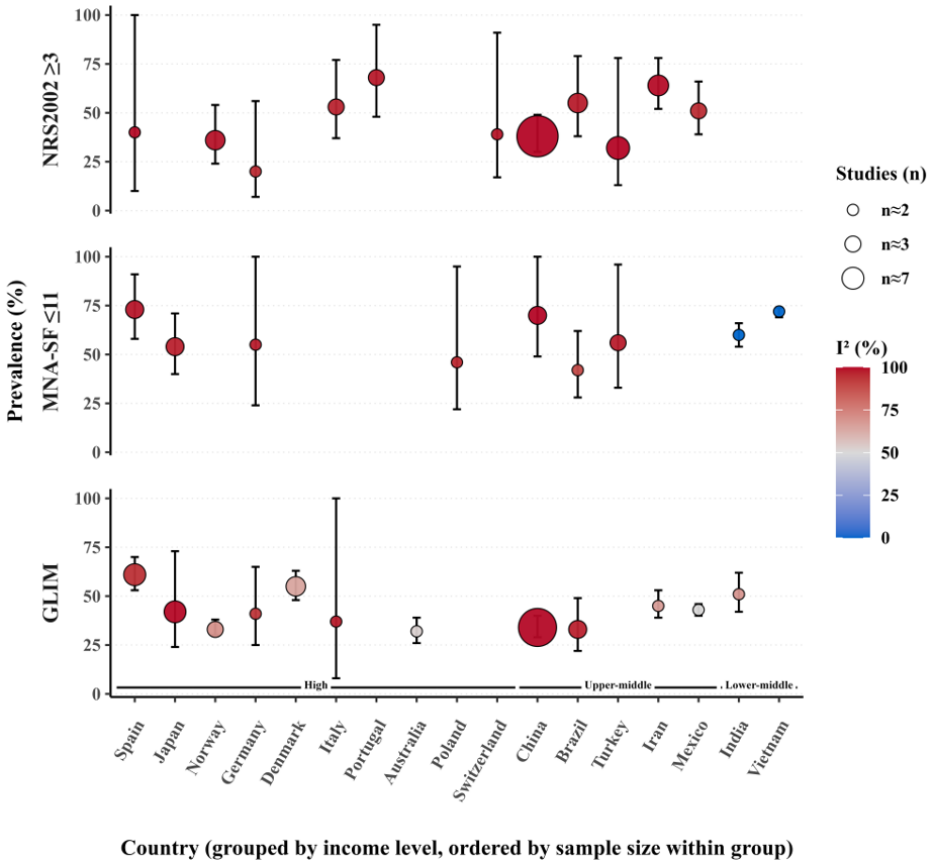

Figure 6. Summary of pooled prevalence at admission across countries

prevalence in the published literature due to small-study effects.

DISCUSSION

Prevalence differences of DRM across tools at admission and discharge

This study synthesized data from 170 studies to benchmark DRM prevalence across varying tools and populations. Based on the available evidence, which is predominantly weighted towards East Asia, our meta-analysis indicates that nutritional risk and malnutrition remain highly prevalent but widely variable.

At admission, 55% of pediatric inpatients were at nutritional risk (STAMP), while in older adults, malnutrition risk reached 62% (MNA-SF). For the general adult population, prevalence estimates were lower, ranging from 39% (GLIM) to 41% (NRS2002). At discharge, data were scarce, with adult nutritional risk estimated at 19% (NRS2002). Crucially, these figures represent an average of highly heterogeneous data rather than uniform global parameters.

Risk was particularly pronounced in older adults. The higher prevalence detected by MNA-SF (62%) versus NRS2002 (53 % in elderly subgroup) aligns with prior comparative research (45% vs. 38%),[227] likely reflecting the MNA-SF's focus on established malnutrition rather than just acute nutritional risk.

While previous reports suggest malnutrition worsens during hospitalization (e.g., 31% vs 36%),[29] our pooled estimates did not reflect this increase. This discrepancy likely stems from data limitations (k = 3 at discharge) and our reliance on cross-sectional comparisons rather than longitudinal monitoring of the same cohort. Regardless of trends, discharge screening remains a critical quality indicator for ensuring effective transitional care. Yet routine implementation is rare; for instance, Singaporean hospitals lack mandatory discharge screening protocols,[228] potentially explaining the global scarcity of data on this outcome.

Factors and considerations in GLIM-based diagnosis

When comparing diagnostic strategies, we found no statistical difference between one-step and two-step approaches (p = 0.062). This lack of significance is likely attributable to the extreme heterogeneity (I^2 >99%) within subgroups, which widened confidence intervals and masked potential variations.

However, numerical trends indicate a higher yield for the one-step method (42%) compared to the two-step NRS2002–GLIM approach (34%). This mirrors findings from Bian et al.,[44] who attributed the deficit in two-step models to the imperfect sensitivity of screening tools,[229, 230] which create a diagnostic bottleneck. Notably, tool-specific nuances emerged: while NRS2002–GLIM showed a visible numerical reduction compared to one-step (34% vs 42%), MNA-SF–GLIM estimates were nearly identical (39% vs 42%). This suggests that the impact of the bottleneck varies depending on the sensitivity of the initial risk tool.

Crucially, the recent GLIM 5-year update addresses this dichotomy.[27] It explicitly acknowledges that in high-prevalence settings (e.g., oncology, geriatrics), the

screening step may be redundant and should be bypassed to avoid missed diagnoses. Conversely, for general hospital populations, the two-step framework remains the pragmatic standard for resource allocation. Given global dietitian shortages (e.g., 1:807 beds in China),[231] using screening to triage low-risk patients is essential for feasibility. Therefore, we advocate the risk-adapted strategy endorsed by the update: one-step diagnosis for high-risk units, and two-step triage for general wards.

Influence of assessor and timing

Assessor background did not significantly influence pooled estimates overall (Supplementary Table 9). However, a consistent trend toward higher prevalence was observed when dietitians participated in assessments, particularly for GLIM-based diagnoses. This likely reflects the value of specialized expertise in identifying subtle phenotypic signs (e.g., muscle loss),[232] whereas non-specialists may prioritize acute medical tasks over comprehensive nutritional evaluation, a common barrier driven by time constraints.[233]

Regarding timing, prevalence estimates did not differ significantly across assessment timepoints (p >0.05). While current guidelines generally recommend screening within 24–48 hours of admission,[3, 234, 235] these findings suggest that extending the window to 24–72 hours may still be acceptable for stable adult inpatients, at least in terms of detection rates, offering valuable flexibility for overburdened wards.

However, earlier assessment remains preferable where feasible. Our data showed that the most substantial numerical prevalence drop (20% relative reduction) occurred when comparing NRS2002 and NRS2002–GLIM within the first 24 hours. This suggests that for this specific pathway, immediate comprehensive assessment is highly effective for rapidly excluding false positives and initiating care.

For critically ill patients, this speed is essential. Nutritional evaluation is ideally completed within 48 hours to allow the timely initiation of enteral nutrition. As guidelines recommend starting feeding within 24–48 hours,[236] aiming to meet approximately 80% of energy and protein requirements within 48–72 hours,[237, 238] delays in identification could compromise these therapeutic targets.

Workforce constraints and future directions

Yet, achieving such timely compliance is constrained by workforce shortages. Compressing the diagnostic workload into the first 24–48 hours exacerbates the strain on limited staff.[239] Reported staffing ratios highlight this gap: while U.S. guidelines recommend 1 dietitian per 65–75 patients,[240] actual ratios lag significantly, ranging from 1:73–212 in India to approximately 1:807 beds in China (vs recommended 1:150).[231, 241] Even in specialized settings like Canadian NICUs, ratios can vary widely (median 1:25.3).[242]

These constraints underscore the urgent need for automated solutions. Emerging artificial intelligence (AI) tools offer a promising avenue to alleviate manpower limitations.[243] Early applications have already demonstrated feasibility, including the automated calculation of NRS2002 scores via algorithms and machine learning models using electronic health records to predict malnutrition risk.[244, 245] By automating the initial screening or assessment step, AI could enable hospitals to meet tight diagnostic timelines without overwhelming clinical staff or sacrificing accuracy.[246]

Beyond screening, AI shows potential in guiding personalized nutritional therapy. By analyzing inflammatory markers, energy balance, body composition, and disease severity in real time, algorithms can integrate complex clinical signals to predict nutritional trajectories.[247] This capability enables dynamic adjustments to feeding strategies, thereby shortening clinical decision-making cycles and potentially reducing complications such as gastrointestinal intolerance and fluid overload.[248, 249]

Potential overestimation and reference benchmarks

Given the predominance of data from China, authoritative Chinese multicenter surveys provide a valuable benchmark for assessing bias direction.

For NRS2002, our pooled estimate for China (38%; overall 41%) is similar to the 35.5% reported in the landmark 2008 tertiary hospital survey,[250] but substantially exceeds the 12.0%–17.8% reported in NutritionDay assessments.[127, 251] Crucially, the NutritionDay surveys excluded ICU patients, whereas our meta-analysis incorporated studies with mixed or higher-acuity populations, capturing a sicker segment of the inpatient population compared with general census surveys.

Regarding the overall direction of bias, our analysis presents competing influences but points to a net overestimation. Initial meta-regression suggested that high non-response bias might lead to underestimation due to the exclusion of critically ill patients. However, this effect appears to be outweighed by the inflating factors observed in the benchmark comparison above. Furthermore, publication bias analysis using the trim-and-fill method reduced the estimate to 22%. Yet we must interpret this adjustment with caution: given the extreme heterogeneity (I^2 >98%), the funnel plot asymmetry may reflect small-study effects (e.g., smaller studies focusing on higher-acuity populations) rather than true publication bias, and the trim-and-fill algorithm might impute "spurious" studies and over-correct the pooled estimate. Thus, the adjusted estimate of 22% should be viewed as a conservative lower bound rather than a definitive correction.[252] Therefore, despite the potential for underestimation in specific high-bias studies, the aggregate evidence suggests that the pooled estimate likely overestimates the true prevalence in the general inpatient population.

Similarly, for NRS2002–GLIM, our estimate (34%) is higher than the 12.5% reported in the China Nutrition Fundamental Data 2020 (CNFD 2020) study,[49] which specifically excluded critically ill patients. Therefore, our results likely overrepresent populations with higher clinical acuity rather than the general inpatient census.

For one-step GLIM, the evidence presents a mixed but precautionary picture. The Bayesian meta-analysis remained consistent with the crude estimate (42%), suggesting statistical robustness based on the available data, whereas the trim-and-fill analysis identified potential publication bias and suggested a downward correction of the prevalence to 35%. Given this signal, it is possible

that the current pooled estimate for one-step GLIM may overestimate the true prevalence.

Limitations related to high heterogeneity and regional overrepresentation

A fundamental limitation of this study is the extreme heterogeneity (I^2 >95%) observed across all analyses. Consistent with Cochrane guidance, we explicitly acknowledge that pooling such disparate data carries the risk of producing an invalid average. Consequently, the pooled prevalence rates reported here should not be interpreted as precise global parameters, but strictly as descriptive summaries of the currently available, fragmented literature. In the same vein, the apparent reduction in NRS2002-defined malnutrition from admission to discharge is based on only three highly heterogeneous discharge studies and should therefore be interpreted as a tentative signal rather than firm evidence of a true change over time. By contrast, the comparison between one-step and two-step GLIM strategies did not show a statistically significant difference despite a larger evidence base, and we accordingly treat this as inconclusive rather than proof of equivalence, highlighting the need for further, more standardized data.

Critically, this heterogeneity was not resolved by extensive subgroup stratification or meta-regression. This persistent variability mirrors findings from other meta-analyses,[253, 254] where heterogeneity typically remains extreme despite rigorous adjustment.

However, our analysis enables us to dissect the sources of this variation more granularly. Methodologically, as detailed in our results, study quality indicators — specifically sampling bias (e.g., reliance on single-department convenience sampling) and representativeness bias (e.g., lack of hospital-wide census)— accounted for approximately half of the heterogeneity (54% for NRS2002 and 49% for GLIM). Clinically, variability was driven by four key dimensions (Supplementary Table 8): For NRS2002, (1) hospital setting, with intensive care unit (ICU) prevalence (60%) far exceeding general wards (39%); (2) patient demographics, where older inpatients (age ≥65y) show double the risk of younger ones (51% vs 21%); (3) regional disparities, ranging from 39% in Europe to 74% in South-East Asia; for GLIM, (4) economic context, with lower-middle-income nations reporting higher rates (49%) than upper-middle-income ones (35%).

Even after accounting for these factors, substantial unexplained variance remains. This likely stems from the inherent imprecision in defining "malnutrition" itself, coupled with unmeasured variations in local screening protocols driven by administrative mandates, timeframes, and economic levers. For instance, China and Portugal not only enforce mandatory screening via national health commissions as a quality indicator, but also stipulate distinct time windows (e.g., within 24 hours in China versus 48 hours in Portugal), effectively broadening the screened denominator and capturing different patient profiles.[14, 255-257] Furthermore, reimbursement policies in China and Switzerland link insurance payments directly to positive screening results (NRS2002 ≥3), creating strong economic incentives for rigorous identification.[257, 258] Thus, we interpret these variations as a reflection of the real-world diversity in clinical nutrition practice.

Furthermore, studies from China contributed nearly half of the data for NRS2002 and GLIM analyses. While our random-effects model mitigated the statistical dominance of large-sample studies (no single study weighted >5%), the pooled estimates inevitably reflect the epidemiological characteristics of East Asian inpatient populations more heavily. Data from the African Region remain scarce, limiting the generalizability of our benchmarks to these settings.

Conclusions

The prevalence of DRM among hospitalized patients remains high at both admission and discharge, though estimates vary across countries and by the screening and diagnostic tool used. Discharge-time data were rarely reported, likely reflecting limited implementation of routine discharge screening in clinical practice.

Regarding diagnosis, GLIM-based diagnostic approaches showed no significant differences between one-step and two-step strategies. Consequently, our findings support the adoption of a risk-adapted strategy: one-step diagnosis for high-risk units to ensure detection, and two-step triage for general wards to optimize limited workforce resources.

Methodologically, these meta-analytic estimates may tend to overestimate the true prevalence and should be extrapolated with caution. Further observational studies assessing nutritional status at both admission and discharge are needed to better capture in-hospital nutritional trends and support nutrition-related quality assurance efforts.

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DISCLOSURE ON THE USE OF AI AND AI-ASSISTED TECHNOLOGIES

AI-assisted technology was used solely for language proofreading.

The authors reviewed and edited the content and take full responsibility for the content of the publication.

CONFLICT OF INTEREST AND FUNDING DISCLOSURES

The authors declare no conflict of interest.

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