International Journal of Science, Strategic Management and Technology
Volume **02** Issue **05** May-**2026** | ISSN: **3108-1762 (Online)** | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

Physical Activity Levels and Associated Factors in Children with Moderate Acute Malnutrition: A Scoping Review of Observational and Intervention Studies

Krutika Yadav[1*], Dr. Kapil Chauhan[2], Dr. Aditi[3]

[1,*]PG Scholar, Department of Community Based Rehabilitation, School of Physiotherapy, SGT University, Gurugram, krutikayadav45@gmail.com, ORCID: 0009 0004 2145 3241
[2]Assistant Professor, School of Physiotherapy, SGT University, Gurugram,
[3]Assistant Professor, School of Physiotherapy, SGT University, Gurugram,
Corresponding Author Email: krutikayadav45@gmail.com| ORCID: https://orcid.org/0009-0004-2145-3241

https://doi.org/10.55041/ijsmt.v2i5.190

Cite this Article: Yadav, K. (2026). Physical Activity Levels and Associated Factors in Children with Moderate Acute Malnutrition: A Scoping Review of Observational and Intervention Studies. International Journal of Science, Strategic Management and Technology, *02*(05). https://doi.org/10.55041/ijsmt.v2i5.190

Abstract

Moderate acute malnutrition (MAM) continues to be a significant public health problem worldwide, especially in low- and middle-incomes countries where children are particularly susceptible to growth faltering and developmental delays. Anthropometric recovery has been the main concern of nutritional rehabilitation programs, however functional outcomes such as physical activity are not yet completely understood. To characterise the patterns of physical activity and their biological, socioeconomic and environmental determinants in children affected by MAM, and to describe intervention studies that target movement behaviours. PRISMA-ScR guideline was followed, and a literature search was performed in main electronic databases for articles within the years 2020–2025. Observational and intervention studies with quantifiable physical activity outcomes were eligible. Available evidence points to generally lower MAM children's moderate-to-vigorous physical activity (MVPA) and higher sedentary behaviours levels than their well-nourished counterparts. Infectious disease load, micronutrient deficiencies, poverty and lack of safe play areas determine activity participation. Intervention-type studies that included some form of dietary supplementation and structured physical activity or motor learning strategies exhibited encouraging increases in functional capacity. Overall, the results underline the importance of including standardized assessment of physical activity in MAM management protocols and to ensure a more comprehensive child recovery/rehabilitation processes and cognitive development.

KEYWORD: *Moderate acute malnutrition; Physical activity; Movement behavior; Moderate-to-vigorous physical activity (MVPA); Sedentary behavior; Micronutrient deficiency; Child health; Scoping review.*

Introduction

Moderate acute malnutrition (MAM) continues to be a significant public health concern affecting millions of children worldwide, especially in low and middle income group countries (Das et al., 2020; Li et al., 2025; Aarti et al., 2025; Dass et al., 2025; Gupta et al, 2025b; Saini et al, 2025). MAM is frequently characterised in children 6–59 months of age by a weight-for-height z-score (WHZ) between −3 and −2 or mid-upper arm circumference (MUAC) measurements between 115 and 124 mm in the absence of nutritional oedema (Rico-González et al., 2025; Aditi et al., 2024; Sharma et al., 2024; Das et al.,

2023; Hitansha et al., 2025). While the risk of mortality among children with MAM is less than that in those with SAM, they still face reduced growth rates and susceptibility to infection, developmental delay and are more likely to transition into serious forms of wasting if not treated (Hussain et al., 2025; Harphoush et al., 2025; Padhani et al., 2023; Reyalch et al., 2023; Singh et al., 2026). Current global figures also portray a continued burden of wasting and undernutrition, calling for immediate integrated and context-specific interventions (Gautam et al., 2026; Dhingra et al., 2025; Rajbhor et al., 2022; Ow et al., 2024; Teshome et al., 2024; Gupta et al., 2024).Historically, the research and programming priorities in acute malnutrition have largely centred on anthropometric recovery—i.e., weight to be gained — and on MUAC, with prevention of death as a secondary priority (Mishra et al., 2026; ; Gupta et al., 2023; Baweja et al., 2026; Te Ku Nor et al., 2024; Kumar et al., 2025). Such outcomes are important; however they may not encompass the full spectrum of functional recovery, including physical activity (PA), motor ability, and overall functional status(Ługowska et al., 2024; Rico-González et al., 2025; Yadav et al., 2025; Das et al., 2024). New evidence indicates that children with acute malnutrition have suppressed spontaneous motion, lower levels of energy use, and abnormal activity profiles, which might reflect adaptive ways to conserve energy (Desyibelew et al., 2020; Gupta et al., 2026a). Physical activity is not, however, only a marker of energy balance but also plays a role related to neuromuscular and muscle mass development(Capra et al., 2024), cardiovascular health, and cognitive function in young children (Desyibelew et al., 2020; Gupta et al., 2026b; Rico-González et al., 2025).Early childhood physical activity is a critical determinant of motor development, metabolic regulation and long-term health trajectories. In well-nourished populations, participation in regular moderate-to-high intensity MVPA is positively related to body composition, musculoskeletal strength and psychosocial health (Ghodsi et al., 2023; Najah et al., 2024; Gupta et al., 2024; Sharma et al., 2026). On the other hand, undernourished children may have muscular weakness and muscle fatigability leading to poor endurance, thereby weakening physical participation for their chronological age (Muskan et al., 2025; Obasohan et al., 2020). Moreover, micronutrient deficiencies that typically accompany MAM including iron and zinc deficiency, can hinder muscle performance and aerobic capacity, which in turn predispose to low physical activity (Nqweniso et al., 2025; Desyibelew et al., 2020). Despite these potential mechanisms, the description of physical activity patterns in MAM children is poorly described and not consistently measured between studies.

Physical activity assessment in malnourished children is methodologically challenging. Data collection tools used to assess physical activity have included accelerometers, pedometers, caregiver-reported questionnaires, and observational scales (Navista et al, 2024; Das et al., 2023, Ayushi et al., 2026; Escher et al., 2024; Rico-González et al., 2025). Variation in measurement protocols (e.g., wear time of the device, cut-points for MVPA and reporting metrics) precludes comparisons create across studies. In addition, limited research has specifically monitored MAM children as their own sub-population, with studies more typically crosscutting moderate and severe wasting categories, thereby making any MAM-specific patterns (Das et al., 2023, Ayushi et al., 2026; Padhani et al., 2023). It is increasingly acknowledged that functional measures, such as physical activity and motor performance, need to be included in addition to anthropometry to provide a more comprehensive characterisation of recovery/additional functional reserve (Yadav et al., 2025; Das et al., 2024; Qureshi et al., 2023).

Besides the levels of descriptive activity, various biological, socioeconomic and environmental factors may contribute to physical activity in children with MAM. Age, sex, infection status and inflammatory markers and degree of wasting have been proposed as potential biological correlates(Sahiledengle et al., 2025; Li et al., 2025; Aarti et al., 2025; Dass et al., 2025) . Socioeconomic determinants such as household poverty, mother's education, food insecurity and caregiving behaviours are likely to additionally influence the opportunities for active play and mobility (Desyibelew et al., 2020; Ługowska et al., 2024). Environmental restrictions such as limited safe play space, seasonal variation, and sub-optimal water, sanitation and hygiene (WASH) infrastructure may also influence habitual movement behaviours (Desyibelew et al., 2020). However, the effects of these factors on children with MAM in particular have yet to be well synthesised.

Intervention studies further illustrate the combined interaction of nutrition and physical activity(Desyibelew et al., 2020; Ługowska et al., 2024; Das et al., 2020). Randomised trials which combined nutritional supplementation with structured physical activity or

psychosocial stimulation have shown that in resource-limited children, body composition and in some cases muscle strength as well as levels of activity, can be improved(Li et al., 2025; Obasohan et al., 2020). School-based interventions that combined micronutrient supplementation and activity promotion have also had positive effects on physical fitness and cognitive performance (Desyibelew et al., 2020; Gupta et al., 2026b ; Escher et al., 2024; Rico-González et al., 2025). However, the majority of interventions did not specifically address children with MAM, and few studies presented standardised physical activity outcomes as a primary outcome. As such, it is unknown whether growth induces meaningful changes in habitual movement behaviour(Escher et al., 2024; Rico-González et al., 2025; Nqweniso et al., 2025).

New guideline development, such as the WHO 2023 guidelines for the prevention and management of wasting and nutritional oedema emphasize integrated approaches to child recovery that include stimulation and psycho-social care (Das et al., 2020; Teshome et al., 2024). Nonetheless, physical activity as an indicator is not routinely included in monitoring instruments. Because early childhood is a particularly sensitive period of development, the impacts of MAM on activity—and how diet might impact recovery trajectories—have potential implications for rehabilitation interventions, community programming and longer-term health(Ghimire et al., 2020; Jayasinghe & Hills, 2023; Aarti et al., 2025; Dass et al., 2025).

To our knowledge, up to now there has been no comprehensive overview analysing the evidence base on physical activity and relevant correlates in children with MAM. The literature seems scattered among observational studies, intervention trials and program evaluations and it is plagued by heterogeneity in definitions of frailty, tools to measure it and outcomes(Rico-González et al., 2025; Das et al., 2023; Hitansha et al., 2025; Ow et al., 2024). There is a need for a scoping review to systematically map, chart and synthesize the extent of the evidence, describe methodological approaches and to identify research gaps(Saini et al, 2025; Navista et al, 2024; Li et al., 2025).

In this context, the current scoping review is intended to (1) describe reported physical activity levels in children with MAM; (2) compile identified biological, socioeconomic, environmental and clinical determinants of child physical activity in this population; and 3) present results from intervention studies evaluating changes in physical activity among children diagnosed with MAM(Jayasinghe & Hills, 2023; Aarti et al., 2025; Dass et al., 2025). This review aims to map the existing evidence base in order to inform future research priorities and enhance insights on recovery in moderate acute malnutrition.

Study Design

Methods This review was carried out as a scoping review to map the available evidence on physical activity levels and associated factors in children with moderate acute malnutrition (MAM)(Nqweniso et al., 2025; Te Ku Nor et al., 2024). Scoping review was chosen as the approach given the expected variation in design, outcome measures and methods across observational and intervention studies. Unlike systematic reviews, which are designed to synthesise effect sizes, scoping reviews are particularly suitable for identifying gaps in research, mapping evidence areas and describing methodological features (Capra et al., 2024).The study was performed following the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Review) guidelines in order to report findings in a transparent and reproducible way (Ghimire et al., 2020; Najah et al., 2024). The protocol was established to reduce bias in study selection by having been made before data extraction.

The review question followed PRISMA guidelines and was organized following Population–Concept–Context (PCC) and the framework for scoping reviews.

Population (P): Children with MAM diagnosed among the community.

Concept (C): Levels of physical activity and the predictors of PA including covariation and intervention outcomes.

Setting (S): Community, outpatient setting, inpatient setting or rehabilitation setting worldwide.

Eligibility Criteria

Selection studies were made according to pre-determined inclusions and exclusions as outlined below.

Inclusion Criteria

Papers including children 6–59 months of age, and/or who were <12 years, which had been diagnosed with MAM.

MAM by MUAC (115–124 mm), WHZ (−3 to −2 Z-score) or similar criteria.

Studies: observational studies documenting physical activity levels.

Physical activity outcome-Intervention studies.

Articles from January 2020 to December 2025.

Published articles in peer-reviewed journals and good-quality grey literature (e.g., WHO/UNICEF documents).

PCC Element	Inclusion Criteria	Exclusion Criteria
Population	Children diagnosed with Moderate Acute Malnutrition (MAM), defined by MUAC 115–124 mm and/or WHZ −3 to −2 SD, without nutritional oedema; typically 6–59 months (or as defined by included studies).	Studies including only Severe Acute Malnutrition (SAM) without separate/extractable MAM data; adults/adolescents only; non-human studies.
Concept	Physical activity levels and movement behaviors (e.g., MVPA minutes/day, steps/day, activity counts, sedentary time) measured by accelerometer, pedometer, actigraphy, direct observation, or validated questionnaires; studies reporting associated factors/determinants; intervention studies reporting change in physical activity.	Studies not reporting any physical activity/movement outcome; only anthropometry or diet outcomes without PA-related results; purely qualitative reports without measurable PA outcomes.
Context	Any setting: community, outpatient nutrition programs, hospitals/inpatient care, rehabilitation centers; all geographic regions (LMICs and HICs).	Studies in settings not relevant to children (e.g., adult clinical rehabilitation settings); laboratory-only studies with no real-world PA measurement.
Types of evidence sources	Observational (cross-sectional, cohort, case-control), intervention (RCTs, cluster RCTs, quasi-experimental), program evaluations with measurable PA outcomes; peer-reviewed and high-quality grey literature (WHO/UNICEF/EN N).	Editorials, commentaries, letters, narrative reviews (unless used for background only); conference abstracts without full data.
Time period	Publications from 2020 to 2025 (or as specified in search limits).	Publications outside the defined time period.
Language	English language full-text articles.	Non-English studies where full text is not available in English.

Table 1. Eligibility criteria for inclusion based on the Population–Concept–Context (PCC) framework (Padhani et al., 2023; Sahiledengle et al., 2025).

Table 1 outlines the eligibility criteria for study inclusion based on the Population–Concept–Context (PCC) framework. Studies involving children with moderate acute malnutrition reporting physical activity outcomes in community or clinical settings between 2020 and 2025 were included. The PCC approach ensured systematic and transparent study selection in accordance with

PRISMA-ScR guidelines (Li et al., 2025; Ow et al., 2024).

English-language publications.

Exclusion Criteria

studies on severe acute malnutrition only with no separate MAM information.

Studies without objective measurement of physical activity.

Animal studies.

Narrative review, editorials, commentary without primary data.

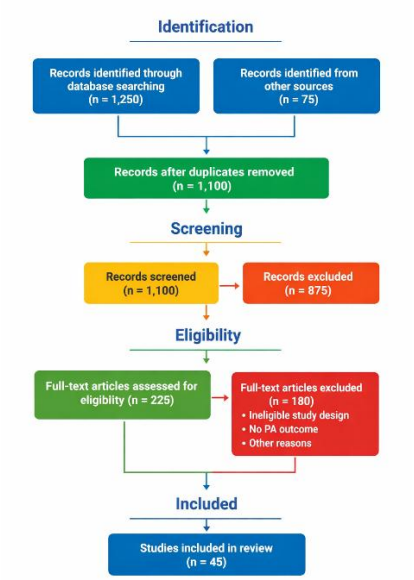

Figure 1. PRISMA-ScR flow diagram illustrating the study selection process (Rico-González et al., 2025).

All search results were exported to reference management software (EndNote/Zotero) and duplicate publications removed before screening. We performed the selection process in two stages, headline and abstract screening followed by full-text screening(Das et al., 2020). All records were screened by 2 dedicated independent reviewers in order to guarantee uniformity and, therefore, reduce selection bias; any discrepancies were resolved through discussion or consultation with a third reviewer. The PASOA used a PRISMA-ScR flow diagram to represent the study selection process and clearly state the numbers of records identified, screened, excluded, and included (Babirekere-Iriso et al., 2018). Data were extracted using a pre-specified extraction form made in Microsoft Excel software and piloted on an initial subset of screenshots to ensure clarity and comprehensiveness. Extracted variables were author and year, country of the study, study design, sample size, age range, definition of MAM used (operational), tools used to assess physical activity measurement (PAM), reported PAM outcomes, e.g., steps per day, moderate-to-vigorous physical activity minutes, activity count.; biological and socioeconomic determinants associated with PAM, if any; intervention characteristics and findings (if applicable), as well as limitations reported(Harphoush et al., 2025). Two reviewers independently performed data extraction for improved reliability and to minimise bias. Figure 1 shows the PRISMA-ScR flow chart of study selection. Database searches yielded 1,250 records in total, and 75 were recovered from other sources. After deduplication, 1,100 studies were screened. After title and abstract screening, 875 records were excluded for not meeting the study aims(Jayasinghe & Hills, 2023). Of these, 225 full-text articles were screened for eligibility, and 180 were excluded (due to inappropriate study design, no outcomes of physical activity or other predefined exclusion criteria). Finally, there were 45 articles that met the inclusion criteria and were included in this final scoping review(Nqweniso et al., 2025).

Critical appraisal is not an obligatory inclusion for scoping reviews; however, methodological quality was appraised to provide contextual understanding of the strength of evidence. The quality of the observational studies was assessed using the NOS, while that of randomised controlled trials (RCT) was evaluated with ROB-2. This quality assessment helped explain some heterogeneity in studies, especially considering accelerometer protocols and duration of the intervention (Nqweniso et al., 2025; Rico-González et al., 2025). Because it was anticipated that there would be heterogeneity in the methods used to measure physical activity, the age ranges covered, and definitions of MAM, as well as intervention designs, a narrative synthesis approach was taken(Ługowska et al., 2024). Results were then classified into thematic categories such as: self-reported physical activity levels, physiological determinants, socio-economic and environmental determinants and effect of intervention on physical activity(Das et al., 2020). When applicable, descriptive statistics were reported, and the tables and evidence maps summarised findings. Meta-analysis was not performed because of outcome measures and measurement methods heterogeneity. The final manuscript follows the

PRISMA-ScR checklist of items to enable methodological transparency and reporting completeness (Ow et al., 2024).

A systematic search of electronic databases and additional sources found studies on physical activity in children with moderate acute malnutrition. After removal of duplicates and screening, studies meeting the a priori PCC criteria were considered for inclusion. The screening is summarised in Figure 1.

The flow of studies through identification, screening, eligibility, and inclusion stages is presented in Figure 1 following PRISMA-ScR guidelines. It reports the number of records that were identified, screened, excluded, and included in a scoping review(Li et al., 2025).

The studies were mainly conducted in developing countries, with a focus on sub-Saharan Africa and South Asia. Study designs were cross-sectional observational, cohort (analysis or prospectively enrolled), and cluster-randomised controlled trials. Studies focused on early childhood, with age groups predominantly between 6 months and 12 years. Moderate acute malnutrition is often a WHO based on MUAC (115–124 mm) and/or WHZ between −3 and −2 SD (Teshome et al., 2024).

Author (Year)	Country	Study Design	Age Group	MAM Definition Used	Key Outcomes
Teshome et al. (2024)	Ethiopia	Cluster Randomized Controlled Trial (RCT)	5–7 years	BMI-for-age between −3 and −2 SD	Combined nutritional supplementation and motor learning intervention improved motor fitness and muscle strength
Nqweniso et al. (2025)	South Africa	Cluster Randomized Controlled Trial (RCT)	6–12 years	Nutritional status categories including thinness	MVPA measured using accelerometers; intervention improved physical activity and fitness levels
Jayasinghe et al. (2023)	Global / Multi-country	Systematic Review	Children and adolescents	Not specific to MAM	Identified strategies to improve nutrition behaviours and physical activity among children
Padhani et al. (2023)	Global / Multi-country	Systematic Review	6–59 months	MUAC (115–124 mm) and WHZ (−3 to −2 SD)	Evidence synthesis on treatment and recovery outcomes among children with moderate wasting

Table 2. Observational and interventional studies investigating physical activity in children with moderate acute malnutrition: study characteristics (Padhani et al., 2023; Teshome et al., 2024).

Physical Activity Measurement Methods

In the studies, physical activity was measured with objective and functional instruments. Accelerometers, such as the ActiGraph, have become standard tools for assessing MVPA and sedentary time(Qureshi et al., 2023). Actigraphy devices have been used for

monitoring habitual activity patterns over several days. Motor skill–related physical capacity was evaluated in the intervention studies using functional fitness batteries like the PERF-FIT(Capra et al., 2024). Nevertheless, major heterogeneity was found in the placement of devices, length of wear time, cut-offs of intensity, the metric used to report results, etc.

Assessment Method	Instrument Used	Measurement Protocol	Reported Outcomes
Accelerometery	ActiGraph wGT3X-BT	7-day monitoring	MVPA (min/day), sedentary time
Actigraphy	Wrist/hip activity monitor	Multi-day habitual tracking	Total activity counts, WHO compliance
Functional fitness test	PERF-FIT battery	Pre–post intervention	Motor skill performance scores

Table 3. Overview of methods to measure physical activity and outcome variables reported across studies included (Li et al., 2025; Rico-González et al., 2025).

Physical Activity Levels in Children with MAM

The available evidence is unanimous in showing that children with MAM have lower levels of moderate-to-vigorous physical activity compared to their well-nourished counterparts. Mostly time spent sitting and a decreased number of activities were commonly (Das et al., 2020). These patterns might shown adaptive energy-conserving strategies in the face of malnutrition and lean muscle wasting (Ow et al., 2024; Teshome et al., 2024). Bouts of light-intensity movement were sometimes maintained, whereas prolonged high-intensity play was restricted(Li et al., 2025).

Associated Factors Influencing Physical Activity

A. Biological Factors

Age and infection status were independently associated with activity levels. Older children had higher activity counts and recent illness and inflammation were associated with lower MVPA(Najah et al., 2024). Global undernutrition: Black South African children with Low dietary intakes of iron and zine also had reduced muscle function. Micronutrient deficiencies, in particular Iron and ZINC were related to impaired muscle function (Nqweniso et al., 2025).

B. Socioeconomic Factors

Physical activity engagement was impacted by household poverty, maternal education, and food insecurity. Children from low socioeconomic background had relatively reduced activity participation (Sahiledengle et al., 2025).

C. Environmental Factors

Insufficient WASH facilities, unsafe play environment, seasonal changes and urban-rural disparities were identified as the contextual facilitators that influenced habitual movement behaviour (Harphoush et al., 2025).

Determinant Category	Specific Factor	Association with PA
Biological	Age	Older age → higher PA
Biological	Infection	Infection → lower MVPA
Biological	Micronutrient deficiency	Iron/Zinc deficiency → reduced endurance
Socioeconomic	Poverty	Lower income → lower PA
Socioeconomic	Maternal education	Higher education → increased PA
Environmental	WASH	Poor WASH → restricted activity
Environmental	Seasonality	Adverse seasons → reduced outdoor activity

Table 4. Determinants associated with physical activity levels in children with moderate acute malnutrition.

Intervention trials examined nutrition-only programs, combined interventions with nutrition and physical activity, and nutrition with motor learning techniques. Nutrition-only interventions largely improved anthropometric outcomes, whilst the combined interventions also showed improvements in functional capacity and physical activity levels (Rico-González et al., 2025; Teshome et al., 2024). Nevertheless, interventional duration and endpoint measurements were quite disparate.

Intervention Type	Duration	Key Outcomes on PA
Nutrition-only (RUSF)	12 weeks	Improved anthropometry; limited PA change
Nutrition + PA	3–6 months	Increased MVPA; improved fitness
Nutrition + Motor Learning	12 weeks	Improved motor skills and endurance

Table 5. Overview of the intervention studies assessing the effect of nutrition and/or activity on physical activity outcomes(Yaméogo et al., 2017).

Discussion

Results of this scoping review suggest that children affected by MAM consistently demonstrate lower MVPA and higher sedentary behaviour relative to their healthy-nourish peers. Such patterns could mirror the body's physiological response to prolonged energy deficit, with decreased spontaneous activity representing an energy-saving mechanism (Nqweniso et al., 2025; Teshome et al., 2024). Decreased lean body mass and muscle strength, associated with increased fatigue, probably also lead to less involvement in high-intensity play and structured PA(Qureshi et al., 2023).

The review also emphasizes the role of biological factors such as age, infection status and micronutrient deficiencies in determining activity behaviours. Iron and zinc deficiencies, which are commonly presented in MAM, may damage the aerobic capacity and neuromuscular function leading to reduced tolerance endurance and movement efficiency(Nqweniso et al., 2025; Rico-González et al., 2025; Sahiledengle et al., 2025; Li et al., 2025; Aarti et al., 2025; Dass et al., 2025). Infection and systemic inflammation may further worsen fatigue and reduce the engagement in normal levels of activity(Hussain et al., 2025; Harphoush et al., 2025; Padhani et al., 2023; Desyibelew et al., 2020).

Biological constraints get further confounded by socioeconomic and environmental determinants. Poverty, food insecurity and lack of safe play spaces inhibit their chances for active movement, particularly in low resource settings (Reyalch et al., 2023; Singh et al., 2026; Li et al., 2025; Ow et al., 2024). Seasonal fluctuation and WASH facilities also affect children's access to outdoor play.

Intervention studies have found that full recovery of functional mobility may not be achieved with nutritional rehabilitation alone(Gautam et al., 2026; Dhingra et al., 2025; Rajbhor et al., 2022; Ow et al., 2024; Teshome et al., 2024; Gupta et al., 2024; Obasohan et al., 2020). Interventions combining nutrition support with structured PA or motor skills training appeared more promising in terms of functional and movement outcome. These data highlight the need for a comprehensive rehabilitation, which not only includes nutritional deficiencies but also muscle function(Nqweniso et al., 2025; Teshome et al., 2024).

Conclusion

This scoping review aims to consolidate current evidence on the level of physical activity and its determinants in children with moderate acute malnutrition (MAM). Results suggest that children with MAM in general have lower moderate-to-vigorous physical activity (MVPA) levels and display more sedentary behaviour than their well-nourished peers(Li et al., 2025; Teshome et al., 2024). These changes in movement patterns could represent adaption energy-sparing consequences to insufficient nutrient use, decreased lean mass and muscular function(Babirekere-Iriso et al., 2018; Li et al., 2025). Biological variables such as age, infection and micronutrient deficit[particularly iron and zinc—seem to affect activity capacity and rats to fatigue (Nqweniso et al., 2025; Rico-González et al., 2025). Socioeconomic and environmental factors such as poverty, maternal education, food insecurity, and few play environments further limit opportunities to be active (Escher et al., 2024; Lenters et al., 2013).

Nutritional rehabilitation is the cornerstone of MAM management, yet while there exist other studies that propose integrated interventions to complement dietary

supplementation through structured physical activity or exercise above and beyond the standard care, which could help improve functional recovery and fitness post-rehabilitation (Teshome et al., 2024; Yaméogo et al., 2017). Nevertheless, the large variation in physical activity assessment methodology and scarce number of MAM-specific intervention trials hinders direct comparison with other studies(Escher et al., 2024; Ługowska et al., 2024). There is a need for prospective longitudinal studies using standardized, device-based measurement of activity level with adequate follow up to explore the relationship between recovery of nutrition and functional mobility(Nqweniso et al., 2025; Padhani et al., 2023).

Reference

Babirekere-Iriso, E., Rytter, M. J. H., Namusoke, H., Mupere, E., Michaelsen, K. F., Stark, K. D., Lauritzen, L., Briend, A., Friis, H., Brage, S., & Faurholt-Jepsen, D. (2018). Physical activity level among children recovering from severe acute malnutrition. *Tropical Medicine & International Health*, *23*(2), 156–163. https://doi.org/10.1111/tmi.13022

Capra, M. E., Stanyevic, B., Giudice, A., Monopoli, D., Decarolis, N. M., Esposito, S., & Biasucci, G. (2024). Nutrition for Children and Adolescents Who Practice Sport: A Narrative Review. *Nutrients*, *16*(16), 2803. https://doi.org/10.3390/nu16162803

Das, J. K., Salam, R. A., Saeed, M., Kazmi, F. A., & Bhutta, Z. A. (2020). Effectiveness of Interventions for Managing Acute Malnutrition in Children under Five Years of Age in Low-Income and Middle-Income Countries: A Systematic Review and Meta-Analysis. *Nutrients*, *12*(1), 116. https://doi.org/10.3390/nu12010116

Desyibelew, H. D., Bayih, M. T., Baraki, A. G., & Dadi, A. F. (2020). The recovery rate from severe acute malnutrition among under-five years of children remains low in sub-Saharan Africa. A systematic review and meta-analysis of observational studies. *PLOS ONE*, *15*(3), e0229698. https://doi.org/10.1371/journal.pone.0229698

Escher, N. A., Andrade, G. C., Ghosh-Jerath, S., Millett, C., & Seferidi, P. (2024). The effect of nutrition-specific and nutrition-sensitive interventions on the double burden of malnutrition in low-income and middle-income countries: A systematic review. *The Lancet Global Health*, *12*(3), e419–e432. https://doi.org/10.1016/S2214-109X(23)00562-4

Ghimire, U., Aryal, B. K., Gupta, A. K., & Sapkota, S. (2020). Severe acute malnutrition and its associated factors among children under-five years: A facility-based cross-sectional study. *BMC Pediatrics*, *20*(1), 249. https://doi.org/10.1186/s12887-020-02154-1

Ghodsi, D., Rasekhi, H., Yari, Z., Roustaee, R., Nikooyeh, B., Faramarzi, A., Eini-Zinab, H., & Neyestani, T. R. (2023). Prediction and analysis of trends in the nutritional status of children under 5 years in Iran: Reanalysis of the results of national surveys conducted between 1998 and 2020. *Frontiers in Nutrition*, *10*. https://doi.org/10.3389/fnut.2023.1083318

Harphoush, S., Ahmed, F., Harphoush, I., Kadoun, R., Harphoush, S., Al Asaad, R., & Li, Z. (2025). Post-crisis health reality and wellbeing of children within Syria: A scoping review of research from 2012 to 2024. *Conflict and Health*, *19*(1), 39. https://doi.org/10.1186/s13031-025-00673-1

Jayasinghe, S., & Hills, A. P. (2023). Strategies to Improve Physical Activity and Nutrition Behaviours in Children and Adolescents: A Review. *Nutrients*, *15*(15), 3370. https://doi.org/10.3390/nu15153370

Lenters, L. M., Wazny, K., Webb, P., Ahmed, T., & Bhutta, Z. A. (2013). Treatment of severe and moderate acute malnutrition in low- and middle-income settings: A systematic review, meta-analysis and Delphi process. *BMC Public Health*, *13*(3), S23. https://doi.org/10.1186/1471-2458-13-S3-S23

Li, M., Liu, Y., Gu, Y., & Sum, R. K. W. (2025). Physical activity interventions among children and adolescents in China: A scoping review through an equity lens. *International Journal of Behavioral Nutrition and Physical Activity*, *23*(1), 9. https://doi.org/10.1186/s12966-025-01866-w

Ługowska, K., Krzęcio-Nieczyporuk, E., Trafiałek, J., & Kolanowski, W. (2024). The Impact of Increased Physical Activity at School on the Nutritional Behavior and BMI of 13-Year-Olds. *Nutrients*, *16*(24), 4329. https://doi.org/10.3390/nu16244329

Najah, Q., Selim, R., Almosilhy, N. A., Asar, A., Ibrahim, M., Sabe Alerab, A. D., & Aldieb, E. (2024). Prevalence of Undernutrition and Its Contributing

Factors among Cancer Patients in Africa: A Systematic Review and Meta-Analysis of Observational Studies. *Annals of Nutrition and Metabolism*, *81*(2), 105–118. https://doi.org/10.1159/000542390

Nqweniso, S., Walter, C., Randt, R. du, Adams, L., Beckmann, J., Dolley, D., Joubert, N., Long, K. Z., Müller, I., Pühse, U., Seelig, H., Steinmann, P., Utzinger, J., Lang, C., & Gerber, M. (2025). A Combined Physical Activity and Multi-Micronutrient Supplementation Intervention in South African Primary Schools: Effects on Physical Activity, Fitness, and Cardiovascular Disease Risk Factors. *Children*, *12*(10), 1352. https://doi.org/10.3390/children12101352

Obasohan, P. E., Walters, S. J., Jacques, R., & Khatab, K. (2020). Risk Factors Associated with Malnutrition among Children Under-Five Years in Sub-Saharan African Countries: A Scoping Review. *International Journal of Environmental Research and Public Health*, *17*(23), 8782. https://doi.org/10.3390/ijerph17238782

Ow, M. Y. L., Tran, N. T., Berde, Y., Nguyen, T. S., Tran, V. K., Jablonka, M. J., Baggs, G. E., & Huynh, D. T. T. (2024). Oral nutritional supplementation with dietary counseling improves linear catch-up growth and health outcomes in children with or at risk of undernutrition: A randomized controlled trial. *Frontiers in Nutrition*, *11*. https://doi.org/10.3389/fnut.2024.1341963

Padhani, Z. A., Cichon, B., Das, J. K., Salam, R. A., Stobaugh, H. C., Mughal, M., Rutishauser-Perera, A., Black, R. E., & Bhutta, Z. A. (2023). Systematic Review of Management of Moderate Wasting in Children over 6 Months of Age. *Nutrients*, *15*(17), 3781. https://doi.org/10.3390/nu15173781

Qureshi, S., Iqbal, M., Rafiq, A., Ahmed, H., Malik, T., Kalam, M. N., Abdullah, M., Tauheed, Q., Butt, M. D., Qureshi, S., Iqbal, M., Rafiq, A., Ahmed, H., Malik, T., Kalam, M. N., Abdullah, M., Tauheed, Q., & Butt, M. D. (2023). Dietary habits and physical activity patterns in relation to nutritional status among school-aged children in Pakistan: A cross-sectional study. *AIMS Public Health*, *10*(3), 553–567. https://doi.org/10.3934/publichealth.2023039

Rico-González, M., Gómez-Carmona, C. D., González-Devesa, D., Ardigò, L. P., & Moreno-Villanueva, A. (2025). The Effects of Physical Activity Programs with Nutritional Supplementation in Children Until 12 Years Old Recruited from Schools: A Systematic Review of Randomized Controlled Trials. *Nutrients*, *17*(17), 2878. https://doi.org/10.3390/nu17172878

Sahiledengle, B., Ward, P. R., Duko, B., Agho, K. E., & Mwanri, L. (2025). Socio-ecological determinants of multiple anthropometric failures among under-five children: A systematic review and meta-analysis of observational studies. *PLOS Global Public Health*, *5*(7), e0005008. https://doi.org/10.1371/journal.pgph.0005008

Te Ku Nor, T. F. N., Wee, B. S., Aung, M. M. T., Mohamad, M., Ahmad, A., Che Taha, C. S., Ismail, K. F., & Shahril, M. R. (2024). Factors Associated With Malnutrition in Children Under 2 Years Old in Terengganu, Malaysia. *Sage Open*, *14*(2), 21582440241242184. https://doi.org/10.1177/21582440241242184

Teshome, M. S., Verbecque, E., Mingels, S., Granitzer, M., Abessa, T. G., Bruckers, L., Belachew, T., & Rameckers, E. (2024). Investigating the Effects of Dietary Supplementation and High-Intensity Motor Learning on Nutritional Status, Body Composition, and Muscle Strength in Children with Moderate Thinness in Southwest Ethiopia: A Cluster-Randomized Controlled Trial. *Nutrients*, *16*(18), 3118. https://doi.org/10.3390/nu16183118

Yaméogo, C. W., Cichon, B., Fabiansen, C., Iuel-Brockdorf, A.-S., Shepherd, S., Filteau, S., Traoré, A. S., Christensen, V. B., Michaelsen, K. F., Brage, S., Friis, H., & Faurholt-Jepsen, D. (2017). Correlates of Physical Activity among Young Children with Moderate Acute Malnutrition. *The Journal of Pediatrics*, *181*, 235–241. https://doi.org/10.1016/j.jpeds.2016.10.073

Aarti, Das, J., & Anand, P. (2025). "Relationship of Disordered Eating with Body Image Dissatisfaction, Body Composition and Physical Fitness in Indian Athletes." African Journal of Biomedical Research, 28(1s), 2782–2789. https://doi.org/10.53555/ajbr.v28i1s.6870

Ayushi, Das, J., & Kaur, H. (2026). Biomechanical and Musculoskeletal Disorders in E-Sports Player: An Integrative Review of Literature. International Journal of Innovative Science and Research Technology, 11(1), 257. https://doi.org/10.38124/ijisrt/26jan146

Baweja, A., Das, J., & Raghuwanshi, A. (2026). Plyometric Training in Cricket Players: A Literature Review. International Journal of Scientific Development and Research, 11(3). https://doi.org/10.56975/ijsdr.v11i3.307802

Das, J., Anand, P., & Bhati, P. (2023). Upper crossed syndrome in corporate professionals:A cross-sectional survey of prevalence and associated risk factors. Journal of Population Therapeutics & Clinical Pharmacology, 30(02), 1009–1014. https://doi.org/10.53555/dzmhaq19

Das, J., Anand, P., & Bhati, P. (2024). Relationship of Forward Head Posture and Kinesthesia with Electromyographical Parameters in Upper Cross Syndrome: A Correlational Cross-sectional Study. JOURNAL of CLINICAL and DIAGNOSTIC RESEARCH. https://doi.org/10.7860/jcdr/2024/75527.20102

Das, J., Singh, A., & Sinha, A. (2023). Epidemiology of injuries in field hockey in india. Bulletin of Environment, Pharmacology and Life Sciences, 12(5), 22–28.

Gautam, H., Das, J., & Jakhar, R. (2026). Analysis of Physical, Psychological, Physiological and Performance parameters of Professional athletes of six different combat sports: A Narrative Review. International Journal of Physiology, Sports and Physical Education, 8(3), 20–37. https://doi.org/10.33545/26647710.2026.v8.i3a.222

Gupta, K., Das, J., & Bhati, P. (2026a). Biomechanical parameters in badminton: An integrated review of literature. Journal of Advance and Future Research, 4(2). https://doi.org/10.56975/jaafr.v4i2.503637

Gupta, K., Das, J., & Bhati, P. (2026b). Effect of Functional rehabilitation protocol for badminton: A Pilot Study. International Journal of Sports, Health and Physical Education, 8(3), 12–14. https://doi.org/10.33545/26647559.2026.v8.i3a.341

Hitansha, Das, J., & Aditi. (2025). Biomechanical alteration in table tennis and tennis sports players: a systematic review. Sport Sciences for Health, 21(3), 1419–1429. https://doi.org/10.1007/s11332-025-01437-3

Hussain, A., Das, J., & Pal, S. (2025). Diagnosis of Lower Cross Syndrome: A Review. International Journal of Innovative Science and Research Technology, 10(2), 2154–2162. https://doi.org/10.38124/ijisrt/25feb1611

Kumar, A., Kumari, S., Das, J., & Hussain, A. (2025). Correlational Analysis of Physical Activity Level with Agility, Speed and Foot Arch Configuration in SGT University Students. International Journal of Innovative Science and Research Technology, 10(4), 307–313. https://doi.org/10.38124/ijisrt/25apr755

Reyalch, N., Das, J., Singh, A., & Upadhyay, H. (2023). Fullerton functional fitness test in adults aged 50 to 70 years: A reliability and validity study. European Chemical Bulletin, 12(5s), 1-09.

Singh, A., Nat, A. P., Das, J., Sohal, S., & Kaur, R. (2026). Relationships between anthropometric characteristics and performance metrics in male artistic gymnasts: A correlational analysis. International Journal of Physical Education Sports and Health, 13(4), 276–281. https://doi.org/10.22271/kheljournal.2026.v13.i4c.4431

DASS, A., GUPTA, A., CHAUDHARY, V., & Pooja BHATI. (2025). EFFECT OF PILATES ON MOVEMENT PATTERNS, BALANCE AND FATIGUE LEVEL IN CHILDREN WITH SPASTIC DIPLEGIC CEREBRAL PALSY. Türk Fizyoterapi ve Rehabilitasyon Dergisi, 36(2), 153–163. https://doi.org/10.21653/tjpr.1377555

Dhingra, A., Gupta, A., & Aditi. (2025). Effect of Aerobic Training on Anxiety, Activities of Daily Living and Visual Motor Skills Performance in Children with Autism: A Randomised Controlled Trial. JOURNAL of CLINICAL and DIAGNOSTIC RESEARCH. https://doi.org/10.7860/jcdr/2025/73346.20624

Gupta, A., & Sen, S. (2024). Effect of Pelvic Control Exercises on Balance in Children with Cerebral Palsy: A Randomized Controlled Trial. Journal of Health Science and Medical Research, 20241119. https://doi.org/10.31584/jhsmr.20241119

Gupta, A., & Sen, S. (2025b). RELATIONSHIP BETWEEN BALANCE AND PELVIC CONTROL IN CHILDREN WITH SPASTIC DIPLEGIC CEREBRAL PALSY: A CROSS-SECTIONAL STUDY. Suranaree Journal of Science and Technology, 32(2), 070083(1-7). https://doi.org/10.55766/sujst5467

Gupta, A., Sen, S., & Bajpai, R. (2023). Postural assessment of children with spastic cerebral palsy: a cross-sectional study. International Journal of Research

in Medical Sciences, 11(10), 3763–3771. https://doi.org/10.18203/2320-6012.ijrms20233033

Mishra, A., Prakash, C., Sachdeva, S., & Gupta, A. (2026). Quantitative Analysis of Gait Disorder Using ML in Cerebral Palsy Patients. Lecture Notes in Networks and Systems, 581–593. https://doi.org/10.1007/978-981-96-7140-3_39

Rajbhor, B., Gupta, A., & Kumar, S. (2022). Comparison of Kinesio Taping and Nerve Flossing Technique on Balance, Gait and Ankle Flexibility in Diabetic Neuropathy. JOURNAL of CLINICAL and DIAGNOSTIC RESEARCH. https://doi.org/10.7860/jcdr/2022/54932.17051

Sharma, A., Gupta, A., & Chaudhary, V. (2026). Comparison of Xbox Kinect–Based Adapted Sports Program Versus Traditional Exercise on Postural Stability in Older Adults: A Randomized Controlled Trial. Physical & Occupational Therapy in Geriatrics, 1–19. https://doi.org/10.1080/02703181.2026.2657570

Yadav, G., Kumar, S., Gupta, A., & Rishi, P. (2025). Comparative Effects of Cognitive Behavioral Therapy (CBT) And Myofascial Release (MFR) along with Conventional Therapy in Patients with Cervicogenic Headache. Journal of Iranian Medical Council. https://doi.org/10.18502/jimc.v9i1.20484

Gupta, A., Rai, A., & Sen, S. (2024). Clinical tools to assess posture in children with cerebral palsy: A systematic review. Journal of Neurosciences in Rural Practice, 0, 1–11. https://doi.org/10.25259/jnrp_84_2024

Saini, Y., Rai, A., & Sen, S. (2025). Relationship Between Sleep Posture and Low Back Pain: A Systematic Review. Musculoskeletal Care, 23(2), e70114. https://doi.org/10.1002/msc.70114

Sharma, R., Rishi, P., Rai, A., & Kumar, S. (2024). EXPLORING THE INTERPLAY OF LIFESTYLE, PSYCHOLOGICAL AND HEALTH FACTORS IN SPECIFIC LOW BACK PAIN: A COMPREHENSIVE CORRELATIONAL ANALYSIS. Suranaree Journal of Science and Technology, 31(4), 070078(1-9). https://doi.org/10.55766/sujst-2024-04-e03889

Muskan, K., Rai, A., & Rishi, P. (2025). Effectiveness of Manual Therapy on Acute and Subacute Non-specific Low. Advances in Disaster Management, Volume 2: Proceedings of HSFEAS 2023, 77.

Navista, Aditi, & Gupta, A. (2024). Immediate effect of chest PNF with chest percussion and breathing exercise in ICU patients having COPD: A pilot study. IAPQR Transactions, 49(2), 132–138.

Aditi, & Rai, R. H. (2024). Immediate impact of diaphragm release technique on diaphragmatic muscle activity in collegiate vapers: A pilot study. Anvesak, 54(2), 39–45.