Original Article

EFFECT OF PSYCHOSOCIAL STIMULATION ON TREATMENT OUTCOME OF SEVERE ACUTE MALNOURISHED CHILDREN

Nabeela Mushtaq[1], Rashiudah Javed[2], Izza Imran[3], Iqra Hamid Khan[4], Aisha Farid [5], Muhammad Khalid Masood[6]

ABSTRACT

Background: Adequate nutrition is a critical determinant of child growth and development, particularly during the early years of life. Severe acute malnutrition (SAM) exerts detrimental effects not only on somatic health but also on neurocognitive development and cognitive functioning. The absence of psychosocial stimulation—including interactive play and responsive caregiver engagement—may exacerbate these developmental impairments. Integrating nutritional rehabilitation with targeted psychosocial stimulation may therefore enhance developmental trajectories in children affected by SAM.

Methodology: A quasi-experimental design was implemented at The Children's Hospital, Lahore. Eighty children aged 6 to 59 months diagnosed with SAM were allocated into two groups. Both groups received standardized nutritional therapy in accordance with World Health Organization protocols. The intervention group additionally participated in structured psychosocial stimulation activities. Developmental status and anthropometric measures were evaluated at baseline and following a six-month intervention period.

Results: The intervention group demonstrated significantly greater improvements in developmental outcomes and mid-upper arm circumference (MUAC) ($p < 0.05$). Although gains in Z-scores were observed, these changes did not reach statistical significance.

Conclusion: Psychosocial stimulation contributes positively to developmental recovery in children with SAM and warrants integration into standard care protocols.

Keywords: Severe Acute Malnutrition, Psychosocial Stimulation, Child Development, MUAC

Date Submitted: 2025-09-16 **Last Modified:** 2025-12-05 **First Published: 2026-01-10**

INTRODUCTION

A child's optimal growth depends in large part on their nutrition, both during and even after their first 1000 days of life. Globally, malnutrition remains one of the most pressing public health issues affecting children under five, with long-term implications for individual and societal development.[1] Recent estimates from the 2023 Joint Child Malnutrition report indicate that 2.1% of children under five (equivalent to 13.7 million) suffer from severe wasting, and 6.8% (approximately 45 million) are affected by wasting overall. Stunting impacts 22.3% of this age group, with the highest

[1] Social and Paediatrics UCHS Lahore.
[2] Nutritionist UCHS Lahore
[3] Fellow Development Pediatrics UCHS Lahore.
[4] Assistant Professor Public Health UCHS Lahore.
[5] Associate Professor Development Pediatrics UCHS Lahore.
[6] Professor of Pediatrics UCHS Lahore.

prevalence observed in African and South Asian regions.[2] In children under five, undernutrition is a contributing factor in around 45% of deaths.[3] In Pakistan, four out of ten children under five are stunted, 17.7% of children have wasting, and nearly one in three children (28.9%) are underweight.[4] Because of poverty and starvation, almost 250 million children who are underage of five do not reach their full potential in terms of development. Sub-Saharan Africa has the largest prevalence of these kids who are primarily found in poor countries.[5,6,7] Children suffering from SAM due to abrupt and extreme calorie restriction may experience developmental consequences distinct from those seen in chronically malnourished, stunted children. The early years are key for fostering human capital development.[8] In addition to increasing the risk of morbidity and death for young children, undernutrition at this period has been shown to have a detrimental developmental influence on the executive system, impacting the brain's anatomical and functional ability for the rest of one's life.[9] Following nutritional rehabilitation, children often face a high risk of falling back into same condition of malnutrition, largely because they do not follow nutrition plan and live in the same conditions.[10] The combination of poor dietary intake and a lack of psychological stimulation is very damaging. Improving both nutritional status and stimulation benefits a child's development and growth. Therefore, dietary and behavioural therapies should be incorporated.[7,11] Long-term neurocognitive damages can probably be prevented best by avoiding and curing infant malnutrition and obviously psychosocial therapies play a positive role in this regard. Further research and evidence is needed to support this phenomenon.[12,13] Childhood disabilities often stem from developmental delays affecting key areas such as motor, cognitive, visual, auditory, and social functioning. Numerous studies link early-life exposure to severe acute malnutrition with impaired cognitive development, lower academic performance, and behavioural challenges.[14] These therapies focus on the caregiver-child dyad to encourage responsive interactions and build the parent-child bond.[15] The World Health Organisation (WHO) also suggests treating severe acute malnourished children with psychological stimulation. However, there is limited evidence that these interventions are beneficial for SAM children. There is limited available research in Pakistan examining impact of psychosocial stimulation on children who are severely malnourished and significant gap in its implementation. This study is being done with purpose to present data on the efficacy of these therapies, which may help shape future SAM treatment plans and policies. Mitigating the physical and mental dimensions of malnourishment can result in more enduring and significant consequences, ultimately enhancing the standard of living for millions of children around the globe. To assess the effect of psychosocial stimulation on developmental milestones of severe acute malnourished children. To assess improvement in growth of severe acute malnourished children.

OPERATIONAL DEFINITIONS

Severe Acute Malnutrition (SAM):

Weight for Height/Length <-3Z score or MUAC 11.5 cm of children from 6m to 59m.[16]

Psychosocial Stimulation:

It refers to activities and interactions that promote cognitive and social development in children. WHO guidelines include the curriculum for psychosocial stimulation. It emphasises interactive toy play, language development, and motor skills. Singing, vocabulary development, crawling, walking, and the use of toys like dolls, blocks, rings, and drums to teach words, coordination, and problem-solving are all part of the sessions.[17]

Developmental Milestones:

It includes motor, cognitive, self-help, language and social skills of a child assessed with help of Portage Guide to Early Education.

Growth:

It refers to improvement in Z-score and MUAC of child.

MATERIAL AND METHODS

The study was conducted at University of Child Health Sciences, The Children's Hospital Lahore using Quasi experimental study design. Ethical approval was taken from university and committee's rules were followed throughout the research procedure, and the rights of research participants were upheld. The study duration was 9 months after the approval of synopsis.

The sample size was calculated with a 0.05 significance level and a 95% confidence level using the WHO calculator. The trial involved 80 patients over a six-month period. Every participant was selected by non-probability convenience sampling technique.

$$n = \frac{\sigma 2(z1-\alpha/2+z1-\beta)2}{=(\mu 0-\mu a)2}$$

n = required **sample size per group**

α level of significance= 5%

$1-\beta$ power of the study= 80%

$Z_{1-\alpha/2}$ Z-score corresponding to significance level=1.96

$Z_{1-\beta}$ Z-score corresponding to power=0.84

σ^2 Pooled variance =24.5

$\mu_0 - \mu_a$ Expected difference in mean between two groups.

All children aged 6m to 59m admitted to stabilization centre fulfilling criteria of severe acute malnutrition were included in study. Children with chronic diseases like cystic fibrosis, cerebral palsy, celiac disease, congenital cardiac disease, chronic kidney disease, chronic liver failure, inborn error of metabolism, cleft lip and palate were excluded from study.

Equipment/ Tool

Portage Guide to Early Education:

The portage project was founded by David E. Shearer in 1969 to provide services to small children ranging from birth to 6 years of age. The portage project started as a project funded by US Department of education in 1969. It was named after town of portage in Wisconsin where project started.[18] Up till the age of six, Portage covers the five development core areas. These are language (L), self-help (SH), socialization (S), gross motor (GM), and cognition (C). Age-specific checklists were available for each category. There are 140 motor items, 108 cognitive things, 105 self-help items, 83 socialization items, and 99 language items in all.[18,19]

Growth assessment tool:

Growth and nutritional assessment was done by performing anthropometric measurements i.e., weight and height and plotting them on WHO z-score charts. A special tape was used to measure Mid upper arm circumference (MUAC).

DATA COLLECTION PROCEDURE:

All children aged 6–59 months who were admitted to the stabilization unit and met the criteria for severe acute malnutrition according to WHO guidelines were included in the study. After informed consent was obtained from the caregivers, developmental and anthropometric assessments were conducted during the Transition Phase of nutritional treatment. A systematic proforma was used to gather sociodemographic information from the parents or guardians. Anthropometric measurements including weight, height, Z-score and MUAC were recorded by a trained staff nurse at baseline, at discharge, and during the 6-month follow-up.

The Intervention

A playroom and a playground were already part of the stabilization unit and were furnished with basic facilities to engage children with severe acute malnutrition (SAM) in play-based motor, language, and cognitive activities. The children in the intervention group were given stimulation with help of play activities. The psychosocial stimulation was given in two phases: the in-patient phase (at the stabilization unit) and the post-discharge phase (at the outpatient therapeutic centre). Play sessions with the healthcare worker were done fortnightly, each lasting approximately 20–30 minutes in the presence of the caregiver. A variety of sensory motor training exercises, encompassing both fine and gross motor exercises, were incorporated into the intervention. Promoting a child's cognitive, linguistic, physical, and social development through an integrated approach utilizing age-appropriate play materials, cultural tools, and locally accessible resources was the guiding philosophy. According to WHO training course on in patient management of Severe Acute Malnutrition (2021), following psychosocial stimulation activities are advised to enhance developmental performance of SAM children.[17]

Play Sessions:

SC Nurse was responsible for developing a plan of play activities and for leading the play sessions.

individually, for 15–30 minutes each day, in addition to informal group play.

Language Activities

- At every play session, teach the child local songs, and games using the fingers and toes.
- Encourage the child to laugh, vocalize and describe what he or she is doing.
- Teach the child to use words such as “bang” when beating the drum, “bye” when waving goodbye, and “thank you” when given something.
- Teach child to point at familiar objects and name them.

- Name toys, family members, colors and body parts.
- Ask short questions and encourage children to answer with gestures and words.

Self-help Activities

- Teach to hold bottle and feed with fingers.
- Encourage to eat with spoon and cup and clean face.
- Practice to take off shoe and clothes.
- Teach gestures and words indicating need to go washroom.
- Show the child to wash hands and face, dry with towel.
- Encourage to put on socks and clothes.

Cognitive activities

- Removes cloth from face that obscures vision.
- Give toys to place and remove from container.
- Play with toys that make sound.
- Ask to make simple gestures like bye, no.
- Give pencil to scribble on paper, make circles in imitation.
- Play with blocks and stack them.
- Make puzzles in imitation.
- Ask the child to count toys and objects.
- Encourage the child to learn about surroundings.

Motor activities

- Allow passive limb movements and splashing in a warm bath.
- Give colourful object to hold.
- Activities as rolling on a mattress, running after and tossing a ball, climbing stairs, and walking
- Bounce the child up and down and hold the child under the arms so the child's feet support his or her weight
- Help the child to sit up by propping him or her up with cushions or any other appropriate materials
- Roll toys out of reach to encourage the child to crawl after them.
- Show how to clap and wave.
- Hold the child's hands and help to walk.
- Give the child a push-along toy and later a pull-along toy
- Give ball to throw and follow.

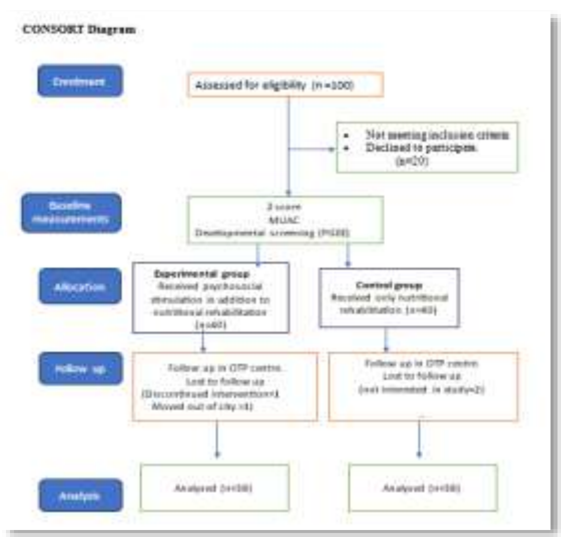
Socialization activities

- Interact with child, give gestures, respond to cues.

- Group play sessions with other children.
- Play peek-a-boo.
- Clap hands and show to say bye bye.
- Call child by name and show age-appropriate response.
- Let child explore environment and share toys.
- Always appreciate the child.

DATA ANALYSIS PROCEDURE

SPSS version 26.0 (SPSS Inc., IBM, Chicago, IL, USA) and R-Studio (Version 4.0.3) were used for data collection and analysis. The mean and standard deviation were displayed since the data is normally distributed. Categorical variables were described using percentages and frequencies. Appropriate statistical tests were employed to compare scores between the two groups at baseline and 6 month follow up for growth and development outcomes. Parametric tests independent samples t-test was used and results were described. A p-value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS and R-Studio.



RESULTS

The majority of patients in both groups were aged between 6 months and 2-year, accounting for 67.5% in control and 70.0% in experimental group. Only a smaller proportion fell in the 2–5 years' age category (32.5% in control and 30.0% in experimental). Males comprised 55.0% of both control and experimental, while females made up the remaining 45.0% in each group Pneumonia was the most common diagnosis (32.5% in control, 30.0% in experimental), followed by acute watery diarrhea (30.0% vs. 27.5%), and sepsis (15.0% in both groups). Less frequent conditions included septic shock, nutritional anaemia, and tuberculosis.

Between Groups

Table 1:

Table 1: Development Score Comparison between groups

Variable	Time Point	Control Group (Mean ± SD)	Experimental Group (Mean ± SD)	p-value
Self-Help Score	Baseline	13.607 ± 10.708	12.965 ± 10.448	0.787
	6 Months	15.531 ± 11.202	21.250 ± 12.208	0.044
Motor Score	Baseline	12.825 ± 9.2921	12.488 ± 8.9879	0.869
	6 Months	15.211 ± 9.915	21.544 ± 11.760	0.017
Cognitive Score	Baseline	13.035 ± 9.5800	12.378 ± 9.7058	0.761
	6 Months	14.849 ± 10.177	21.225 ± 11.937	0.018
Language Score	Baseline	11.963 ± 8.5349	11.993 ± 9.0217	0.988
	6 Months	14.180 ± 9.585	19.781 ± 10.802	0.024
Socialization Score	Baseline	12.353 ± 9.0228	12.288 ± 9.4978	0.975
	6 Months	13.214 ± 9.115	20.436 ± 10.912	0.004

Developmental Score Comparison Between Groups

Self-help Scores showed no significant difference between both groups at baseline (p = 0.787). After six months' Experimental group (21.250 ± 12.208) showed significantly greater improvement compared to Control group (15.531 ± 11.202; p = 0.044). This indicates that experimental group participants may have benefited more from interventions impacting daily living independence or support systems during the follow-up period.

Motor Scores of both groups were similar at baseline (p=0.869). Both groups showed a significant difference at six months, where Experimental (21.544 ± 11.760) outperformed Control group (15.211 ± 9.915; p = 0.017). This suggests better motor recovery or developmental support in experimental group, highlighting an important domain of functional improvement over time in response to intervention.

Cognitive Scores were statistically similar at baseline (p = 0.761). At six months, however, Experimental group (21.225 ± 11.937) showed significantly higher scores compared to Control group (14.849 ± 10.177; p = 0.018). This result underlines a potential long-term cognitive benefit in experimental group, possibly linked to differences in psychosocial stimulation, parental involvement, or rehabilitation services.

Language Scores were nearly identical at baseline (p = 0.988). By six months, Experimental group (19.781 ± 10.802) showed significantly better language performance than Control group (14.180 ± 9.585; p = 0.024). The difference suggests greater advancement in communicative ability in experimental group, emphasizing the role of sustained language-related interventions or caregiver-child interaction.

Socialization Scores remained stable and comparable at baseline between both groups (p = 0.975). However, a significant divergence was noted at six months with Experimental group (20.436 ± 10.912) outperforming Control group (13.214 ± 9.115; p = 0.004). This highlights the greater impact of interventions or environmental enrichment in promoting social development in experimental group.

Growth Parameter Comparison Between Groups

This table compares Mid-Upper Arm Circumference (MUAC) at baseline and 6 months. At baseline, there was no significant difference between control (10.723 ± 0.643) and experimental group (10.793 ± 0.550; p = 0.602). By six months, both groups showed substantial improvement; however, experimental group (12.733 ± 0.215) showed a statistically significant advantage over control group (12.589 ± 0.246; p = 0.010). This suggests a measurable difference in nutritional recovery at follow-up, likely influenced by intervention effects or post-discharge care.

Nutritional Z-scores were comparable at baseline (Control: 3.450 ± 0.504; Experimental: 3.625 ± 0.490; p = 0.119). At six months, Z-scores continued to improve with Control group scoring 1.200 ± 0.406 and Experimental group 1.060 ± 0.232. Although the p-value (0.069) borders on significance, it indicates a trend favouring experimental group. This near-significant difference suggests potential clinical relevance that warrants further investigation with a larger sample.

Table 2: Growth Parameter Comparison Between Groups

Table 2:
Growth Parameter Comparison Between Groups

Variable	Time Point	Control Group (Mean ± SD)	Experimental Group (Mean ± SD)	p-value
MUAC	Baseline	10.723 ± 0.643	10.793 ± 0.550	0.602
	6 Months	12.589 ± 0.246	12.733 ± 0.215	0.010
Z - Score	Baseline	3.450 ± 0.504	3.625 ± 0.490	0.119
	6 Months	1.200 ± 0.406	1.060 ± 0.232	0.069

DISCUSSION

In the current experimental study, we enrolled 80 children aged 6 to 59 months with severe acute malnutrition (SAM) to evaluate the impact of psychosocial stimulation on both developmental milestones and nutritional outcomes. The present study evaluated the impact of psychosocial stimulation (PS) on developmental milestones and growth outcomes in children aged 6–59 months with severe acute malnutrition (SAM), aligning with the WHO's recommendation to integrate stimulation in the medical-nutritional care protocol. Our findings demonstrated significant improvements in self-help, motor, cognitive, language, and socialization domains among the intervention group, particularly at the six-month follow-up. These findings support that psychosocial stimulation positively affects both development and growth in SAM children. Our results are strongly corroborated by the Ethiopian EPSoSAMC study, where psychosocial stimulation significantly improved developmental outcomes and showed trends toward better growth and treatment response in SAM children.[20] Similarly, Abessa et al and others reported statistically significant improvements in gross and fine motor functions in Ethiopian children receiving play-based stimulation alongside nutritional rehabilitation.[21] In Pakistan, Afzal and co-workers identified a strong association between MUAC and various developmental quotients in children with SAM, further supporting the notion that nutritional status closely interacts with developmental progress.[19] Nazir et al provided additional local evidence, demonstrating that malnutrition significantly impairs motor development, with both Z-score and MUAC closely correlating with motor delays.[22] The hypothesis that growth would improve with PS also found partial support. While our study found a significant improvement in MUAC and a near-significant difference in Z-scores at six months, Tessema et al and Abessa et al found inconsistent results in linear growth, suggesting that while developmental recovery may be immediate, nutritional catch-up might require more intensive or longer-term intervention.[20,21] International evidence provides further validation. Grantham-McGregor et al showed that structured psychosocial interventions can help malnourished children reach cognitive and developmental parity with well-nourished peers over time.[23] Long-term follow-up studies, such as those by Yousafzai and others and Worku and colleagues, reinforce the lasting effects of psychosocial stimulation, particularly when delivered through community-based or home-visiting models.[24] These interventions not only improve developmental scores but also enhance caregiver-child interactions and maternal knowledge, mechanisms likely contributing to sustained gains.[25] Recent studies in Tanzania underscore the value of integrating culturally relevant PS within community and facility-based programs. These findings mirror our experience of involving a multidisciplinary team and caregivers in play-based, sensory-motor interventions.[7,2] Another study done in Mali emphasises integration of psychosocial stimulation into malnutrition treatment programs showing its overall impact on mother-child interaction and child development.[27] Similarly, a recent experimental study from Kanam, Plateau State, Nigeria, evaluated the effect of an integrated intervention—combining psychosocial stimulation, locally produced nutritional supplements (millet, soybean, sesame), and water-sanitation-hygiene (WASH) support—on the developmental status of 16 malnourished children over four months. Using anthropometric tracking, play assessments, and structured caregiver counselling, the study reported significant post-intervention gains in developmental outcomes. The findings underscore the effectiveness of holistic interventions in resource-limited settings and complement our own results in supporting the use of multi-pronged strategies to improve child outcomes in SAM populations.[28] Several Pakistani studies from 2002 to 2016 provide context for the high burden of malnutrition and its associated risk factors, including poverty, maternal illiteracy, poor hygiene, large family size, and food insecurity. This social and environmental background underscores the need for integrated interventions like ours that address not only nutrition but also developmental and caregiver education components.[10,29,30] The theoretical foundation is further supported by systematic reviews showing that while nutritional interventions improve growth, stimulation is the more consistent driver of improved child development. Combined interventions yield complementary but not necessarily synergistic effects, reinforcing the importance of implementing each component effectively.[23,31] Our study also aligns with findings by Nahar et al emphasizing that while psychosocial stimulation may not dramatically accelerate anthropometric gains, it plays a critical role in improving mental, motor, and social outcomes.[32] Similar results were found in another study which also highlights the need for its integration into routine inpatient and outpatient care of SAM children.[33]

CONCLUSION

Our findings support both alternate hypotheses: psychosocial stimulation significantly improves developmental milestones and shows promising effects on growth indicators in SAM children. Integration of culturally sensitive, caregiver-involved, structured play and stimulation strategies into nutritional rehabilitation programs is essential to achieve holistic child recovery. Continued investment in such multidimensional care models can substantially improve the developmental trajectories of children recovering from malnutrition in resource-constrained settings. Policymakers should prioritize capacity building of healthcare providers, inclusion of developmental stimulation modules in standard SAM management guidelines, and intersectoral collaboration between nutrition, early childhood development, and primary healthcare programs to improve developmental trajectories of malnourished children.

LIMITATIONS

The study employed a non-probability convenience sampling technique, which may limit the generalizability of the findings. Follow-up adherence may have varied, affecting outcome consistency at the 6-month time point. The study focused on short-term outcomes; long-term developmental and educational impacts were not assessed. Potential confounders such as home environment, maternal education, maternal mental health, and concurrent infections were not fully controlled.

REFERENCES

1. Akeberegn A, Shifeta M. Treatment outcome from severe acute malnutrition among children 6–59 months admitted to Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia. Ethiop J Pediatr Child Health.2023;18(1).
2. UNICEF, WHO, World Bank Group. Joint child malnutrition estimates: levels and trends 2023 edition. Geneva: WHO; 2023.
3. Gupta A, Grover S, Kumar A, Kumawat P, Meena S. Profile and outcome of children with malnutrition admitted at malnutrition treatment centre. J Family Med Prim Care. 2023;12(10):2287-91.
4. Ministry of National Health Services Regulations and Coordination, Government of Pakistan. National Nutrition Survey Pakistan. Islamabad; 2018.
5. David BE, Kumar S. Child development beyond nutrition-specific models: bridgingpathways via psychosocial stimulation. Front Psychol. 2023;14: 1273591.
6. Fernandez Rao S, Bentley ME, Balakrishna N, Griffiths P, Creed-Kanashiro H, Vazir S, et al. Complementary feeding and play intervention improves home environment and mental development among toddlers in rural India. Matern Child Nutr. 2020;16: e13066.
7. Mwita FC, PrayGod G, Sanga E, Setebe T, Joseph G, Kunzi H, et al. Developmental and nutritional changes in children with severe acute malnutrition receiving psychosocial support. Nutrients. 2024;16(5):692.
8. Sharma P, Budhathoki CB, Maharjan RK, Singh JK. Nutritional status and psychosocial stimulation associated with cognitive development in preschoolchildren. PLoS One. 2023;18(3): e0280032.
9. Khandelwal N, Mandliya J, Nigam K, Patil V, Mathur A, Pathak A. Determinants of developmental delay in complicated severe acute malnutrition. PLoS One. 2020;15(6): e0233949.
10. Girma T, James PT, Abdissa A, Luo H, Getu Y, Fantaye Y, et al. Nutrition status and morbidity after recovery from severe acute malnutrition: prospective matched cohortstudy. PLoS One. 2022;17(3): e0264719.
11. Bliznashka L, Rattigan SM, Sudfeld CR, Isanaka S. Analysis of postdischarge interventions for children treated for moderate or severe wasting: a systematic review. JAMA Netw Open. 2023;6(5): e2315077.
12. Jeong J, Franchett EE, Ramos de Oliveira CV, Rehmani K, Yousafzai AK. Parenting interventions to promote early child development: systematic review and metaanalysis. PLoS Med. 2021;18(5): e1003602.
13. Kirolos A, Goyheneix M, Eliasz MK, Chisala M, Lissauer S, Gladstone M, et al. Neurodevelopmental impairments following childhood malnutrition: systematic review. BMJ Glob Health. 2022;7(7): e009330.
14. Banerjee A, Chattopadhyay N. Impact of malnutrition on neurodevelopment in children from a marginalized rural community in India. Int J Sci Res. 2019;8(2).
15. UNICEF, World Health Organization, World Bank Group. Nurturing care for early

childhood development framework. Geneva: WHO; 2018.
16. World Health Organization. Training course on the inpatient management of severe acute malnutrition: course director's guide. Geneva: WHO; 2021.
17. World Health Organization. Training course on inpatient management of severe acute malnutrition: module 7 involving mothers in care. Geneva: WHO; 2021
18. Shearer D, Billingsley J, Frohman A, Hilliard J, Johnson F, Shearer M. Portage guide to early education. Cooperative Educational Service Agency; 1972.
19. Afzal E, Khan S, Ali I, Aftab K, Arshad R, Abbas A. Developmental status in children with severe acute malnutrition**.** J Islam Int Med Coll**.** 2020;15(4):245-9.
20. Tessema TT, Alamdo AG, Yirtaw TG, Debele FA, Mekonnen EB, Abessa TG, et al. Psychosocial stimulation effects on development and growth among children with SAM. BMC Public Health. 2019; 19:1177.
21. Abessa TG, Worku BN, Wondafrash M, Girma T, Valy J, Lemmens J, et al. Effect of play-based family-centered psychomotor/psychosocial stimulation on the development of severely acutely malnourished children under six in a low-income setting: a randomized controlled trial. BMC Pediatr. 2019; 19:336.
22. Nazir I, Nawaz T, Mustafa A, Fatima M, Majeed AM. Impact of malnutrition on motor development in Pakistani children. J Health Rehabil Res. 2024;4(3):1-5.
23. Grantham-McGregor SM, Fernald LC, Kagawa RM, Walker S. Effects of integrated child development and nutrition interventions on child development and nutritional status. Ann N Y Acad Sci. 2014;1308(1):11-32.
24. Yousafzai AK, Obradović J, Rasheed MA, Rizvi A, Portilla XA, Tirado-Strayer N, et al. Responsive stimulation and nutrition interventions on child development in Pakistan. Lancet Glob Health. 2016;4(8): e548-58.
25. Worku BN, Abessa TG, Wondafrash M, Lemmens J, Valy J, Bruckers L, et al. Home-based play-assisted stimulation on developmental performance of children living in extreme poverty. BMC Pediatr. 2018; 18:321.
26. Jensen CL, Sanga E, Kitt H, PrayGod G, Kunzi H, Setebe T, et al. Developing context-relevant psychosocial stimulation intervention for children with severe acute malnutrition in Tanzania. PLoS One. 2024;19(5): e0285240.
27. Bossard C, Payotte S, Scarpa G, Diallo A, Lissouba P, Le Roch K, et al. StimNut: innovative community action research on psychosocial stimulation to improve care for severely malnourished children in Koutiala, Mali. In: MSF Paediatric Days 2024 Proceedings; 2024.
28. Jacob S, Jatau AA, Darbe JW, Olakunle FJ, Jacob HS, Buhari M. Effects of integrated psychosocial stimulation and nutritional support on malnourished children in Nigeria. Eur J Educ Pedagogy. 2023;4(3):37-41.
29. Achakzai P, Khan R. Nutritional status and associated factors among children less than five years of age in Tehsil Zarghoon Town, District Quetta, Baluchistan. J Ayub Med Coll Abbottabad. 2016;28(1):146-51.
30. Mahmood S, Nadeem S, Saif T, Mannan M, Arshad U. Nutritional status and associated factors in under-five children of Rawalpindi. J Ayub

Med Coll Abbottabad. 2016;28(1):67-71.
31. Jeong J, Pitchik HO, Yousafzai AK. Stimulation interventions and parenting in low-and middle-income countries: meta-analysis. Pediatrics. 2018;141(4):e20173510.
32. Nahar B, Hossain I, Hamadani J, Ahmed T, Grantham-McGregor S, Persson LA. Food supplementation and psychosocial stimulation effects on maternal depressive symptoms. Child Care Health Dev. 2015;41(3):483-93.
33. Daniel AI, Bwanali M, Tenthani JC, Gladstone M, Voskuijl W, Potani I, et al. Hospital-based psychosocial stimulation and counseling program for caregivers and children with severe acute malnutrition: a mixed-methods cluster randomized trial. Curr Dev Nutr. 2021;5(8): nzab100