Assessment of clinic-biochemical parameters in severe acute malnutrition children admitted in a tertiary care hospital of Western Uttar Pradesh, India

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ABSTRACT

Background: Severe acute malnutrition (SAM) is one of the major causes of mortality and morbidity among children in developing countries and is an important contributing factor to deaths occurring from preventable causes in children <5 years of age. Decreasing child mortality and improving maternal health depends heavily on reducing malnutrition. **Aims and Objectives**: To study the prevalence, risk factors, medical complications, and outcome (morbidity and mortality) of children admitted with SAM along with biochemical changes. **Materials and Methods**: This was an observational cross-sectional study conducted in the Department of Pediatrics, Uttar Pradesh University of Medical Sciences, Saifai, Uttar Pradesh, India. Indoor Patient admitted in the department of pediatrics with SAM between ages 6 and 59 months. A total of 100 children were included in the present study. This study was done from January 2019 to June 2020. **Results:** Approximately 59% of admitted SAM patients were under 1 year of age and 24% were between 1 and 2 years. Most of the patients have rural residences nearly 93%, as most of the vicinity of our institute belonged to rural areas. According to Modified Kuppuswamy's socio-economic status (SES) 46% that is maximally belonged to the Lower middle class and 45% belonged to the Lower class of SES. Out of 100 children, 20% were having magnesium deficiency and 56% children were having phosphate deficiency. **Conclusion**: Survival of children was significantly associated with random blood sugar, mg, and PO_4 level. Therefore, timely identification and intervention of biochemical derangement in SAM patients are necessary to improve the survival of SAM patients.

Key words: Severe acute malnutrition; Socioeconomic status; Risk factor; Uttar Pradesh

INTRODUCTION

Malnutrition is an atypical physiological condition caused by deficiencies, in protein, imbalances in energy, and other nutrients. The physiology of an individual is impaired to the point where they can no longer sustain adequate bodily performance, like recovering from disease and growth.[1] According to the World Health Organization (WHO), severe acute malnutrition (SAM) among children 6–59 months of age is defined by a very low weight for height (below-3 z scores of the median WHO growth standards) or the presence of bilateral pitting edema of nutritional origin, or a mid-upper-arm circumference of <11.5 cm in children age 1–5 years.[2]

SAM is one of the major causes of mortality and morbidity among children in developing countries and is an important contributing factor to deaths occurring from preventable causes in children <5 years of age.[3] Improving maternal health and reducing child mortality depend closely on

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reducing malnutrition. 35% of deaths among children under-5 can be prevented by addressing malnutrition. SAM remains a major killer of children as mortality rates are 9 times higher than those in well-nourished children.[4]

Worldwide SAM is the common cause of mortality and morbidity among under-five children. The highest concentration is in Sub-Saharan Africa and South-East Asia.[5] SAM is common in children of developing countries affecting nearly 20 million children worldwide, with a majority of the cases in developing countries.[6] In India, National Family Health Survey-4 shows that about 35.7% of the children in India under 5 years of age are underweight, 38.4% are stunted, and approximately 21% are moderately to severely wasted.[7] In India prevalence of SAM is 6.4% in children below 5 years of age with 100 focus districts having a high prevalence of malnutrition being situated in 6 states, Bihar, Jharkhand, MP, Rajasthan, Odisha, and UP. The prevalence of SAM children in the urban region of Uttar Pradesh is 6.6% and in the rural region of Uttar Pradesh is 5.8% and the total prevalence is 6%.[8]

SAM is a significant preventable and treatable cause of mortality and morbidity in children. For improvement, there is a need for standardized protocol-based management for the outcome of severely malnourished children.

Although there are a few studies on the association of SAM with refeeding syndrome, hypophosphatemia, and hypomagnesemia but most of these studies have been done in Western countries.

At present, there are limited studies on their outcome in SAM children especially related to refeeding syndrome along with electrolytes imbalance mainly magnesium and phosphate in children with SAM in North India. Hence, the aim is to study the incidence, risk factors, medical complications, and outcome (morbidity and mortality) of children admitted with SAM along with biochemical changes.

Aims and objectives
To estimate prevalence, risk factors, medical complications, and outcome (morbidity and mortality) of children admitted with SAM.

MATERIALS AND METHODS

Study design
This was an observational cross-sectional study.

Study area
Department of Pediatrics, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Uttar Pradesh.

Study population
Indoor patient admitted to the Department of Pediatrics with SAM between ages 6 and 59 months. The study was duly approved by the Institutional Ethical Committee of the University. A written and informed consent was taken from one of the parents or any other adult relative present after explaining them the study through consent form.

Study duration
This study was done from January 2019 to June 2020.

Inclusion criteria
Children admitted to the Department of Pediatrics, UPUMS, Saifai from January 2019 to June 2020 and fulfilling WHO criteria for SAM.[9]

For 6 months–59 months' age group: Presence of any of the following-
a. Weight for length/height ≤3 standard deviation (SD) (WHO median height)
b. Bilateral pedal edema
c. Grossly visible severe wasting
d. Mid upper arm circumference <11.5 cm.

Exclusion criteria
a. Children who were born either premature or post-mature and/or were small for gestational age or large for gestational age
b. Children who are known case of lactogen Intolerance and meconium aspiration syndrome
c. Children having clinical evidence of any chronic disease (e.g., cerebral palsy, congenital heart diseases, hemolytic anemia, malignancies, known metabolic disorders, known malabsorption syndromes, chromosomal abnormalities, and chronic renal disorders) as a cause of severe malnutrition
d. Attendant not given informed and written consent for participation in a study
e. Children who fail to hemodynamically stabilize within 48 h of admission and die within 48 h of admission.

Sample size
Sample size=4pq/d²

According to NHFS-4 studies, the prevalence (p) of SAM in Uttar Pradesh is 6% and q will be 1-p. d is precision and precision will be allowed up to 5% in this study.[9]

So sample size=90.2.

A total of 100 children were included in the present study.

Ethical consideration
The ethical clearance was obtained from the UPUMS ethical review committee. For voluntary participation,

parents/guardians of the selected children signed an informed consent based on the explicit information of any possible risk, harm and even discomfort caused by data/sample collection procedures.

Study techniques

A purposive sampling method was used to select children with SAM who full fill the inclusion criteria and was enrolled after written consent was taken from parents or those responsible for them after explaining the procedure and purpose. A full history was taken. Socio-demographic history, sign and symptoms, and investigations were done. Anthropometric measurements were done under standard conditions by two observers.

Weight is measured with a digital weighing machine, Phoenix, NBY 30 Model III with an accuracy of 10 g for infants and Phoenix electronic weighing NEP-150A for children usually >2 years with an accuracy of 10 g and can measure up to 150 kg.

Discharge criterion

A child is considered ready for discharge when he/she fulfills the following criteria:

- Is alert and active eating at least 120–130 kcal/kg/day with a consistent weight gain of at least 5 g/kg/day on exclusive oral feeding
- Receiving adequate micronutrients
- Free from infection
- Completed immunization appropriate for age
- Care-taker has been sensitized to home care.

Statistical analysis

The data were entered into MS EXCEL spreadsheet and analysis was done using the statistical package for social sciences version 22.0. Categorical data were presented in frequency and percentage (%). For association Chi-square test and Fisher's exact test was used. A P<0.05 was considered statistically significant.

RESULTS

Table 1 shows that nearly 59% of admitted SAM patients were under 1 year of age, 24% between 1 and 2 years and 17% between 3 and 5 years. SAM was nearly equally distributed in both males and females. Most of the patients have rural residences nearly 93%, as most of the vicinity of our institute is belonging to rural area, while only 7% belongs to urban area. According to Modified Kuppuswamy's socio-economic status (SES) socioeconomic scale 4% belonged to the upper middle class, 46% that is maximally belonged to lower middle class, 5% belonged to the upper lower class and 45% belonged

Table 1: Socio-demographic characteristics of severe acute malnutrition in children

Characteristics	Classifications	Frequency (%)
Age	6–12 months	59 (59.0)
	13–24 months	24 (24.0)
	3–5 years	17 (17.0)
Gender	Male	49 (49.0)
	Female	51 (51.0)
Place of residence	Rural	93 (93.0)
	Urban	7 (7.0)
Socioeconomic status	Upper	0
	Upper middle	4 (4.0)
	Lower middle	46 (46.0)
	Upper lower	5 (5.0)
	Lower	45 (45.0)
Immunization status	Complete	20 (20.0)
	Partial	49 (49.0)
	Unimmunized	31 (31.0)
Malnutrition type	Marasmus	30 (30.0)
	Kwashiorkor	12 (12.0)
	Marasmic–Kwashiorkor	58 (58.0)

to the lower class of SES. Out of 100 patients, 20% were completely immunized. In 100 admitted children, 58% had Marasmic–Kwashiorkor, 30% had Marasmus and 12% had Kwashiorkor.

Table 2 shows that mean±SD heart rate and respiratory rate of admitted children were 136.04±17.29 and 40.76±13.61, respectively. Mean±SD for weight on admission and discharge were 6.25±1.92 and 6.89±1.99, respectively.

Table 3 shows that 73% of children were admitted with fever and 27% of children were afebrile. 67% children had significant pallor. 36% of children were admitted with complaints of loose stool. 34% children were admitted with complaints of vomiting. 33% children were admitted with complaints of cough and cold. 45% children were admitted with dehydration. Most susceptible age for dehydration was <1 year representing nearly 42% of total cases of some dehydration and nearly 34% of total cases of severe dehydration. 4% children were admitted with clinical presentation of Meningitis. Out of which 75% children were in the age group of 6–12 months and rest 25% belongs to the age group of 3–5 years. Majority of children had significant hair changes present. Out of 100 patients, 78% children had lusterless, brownish hairs and 22% children had normal hair appearance. We had taken the cut-off value for the Glasgow coma scale (GCS) <7. Out of 100 children admitted with SAM, 10% children had GCS <7, and 90% children had GCS >7. Out of 100 children, 59% children had open anterior Fontanelle, and 41% children had closed anterior Fontenelle.

Table 2: Examination finding of admitted severe acute malnutrition children

Features	Mean±SD
Heart rate (beats/min)	136.04±17.29
Respiratory rate (breaths/min)	40.76±13.61
Weight on admission (kg)	6.25±1.92
Weight on discharge (kg)	6.89±1.99

SD: Standard deviation

Table 3: Sign and symptoms of admitted severe acute malnutrition patients

Sign and symptoms	Frequency (%)
Fever	
Present	73 (73.0)
Absent	27 (27.0)
Pallor	
Present	67 (67.0)
Absent	33 (33.0)
Loose stool	
Absent	64 (64.0)
Present	36 (36.0)
Vomiting	
Absent	66 (66.0)
Present	34 (34.0)
Cough and cold	
Absent	67 (67.0)
Present	33 (33.0)
Dehydration	
Absent	55 (55.0)
Present	45 (45.0)
Meningitis	
Absent	96 (96.0)
Present	4 (4.0)
Hair changes	
Normal	22 (22.0)
Lusterless	78 (78.0)
GCS	
Normal	90 (90.0)
<7	10 (10.0)
AF	
Closed	41 (41.0)
Open	59 (59.0)

GCS: Glasgow coma scale

Table 4: Investigations (n=100)

Biochemical factors	Mean±SD	Minimum	Maximum
TLC	13.84±6.86	1.26	39.00
Hb	7.72±3.12	2.00	15.70
PLT	2.87±2.09	0.07	10.00
Serum Ca^{++}	8.83±1.47	2.62	12.88
Serum Na^{+}	141.32±7.37	126.90	165.30
Serum K^{+}	4.49±1.03	2.30	6.90
Serum albumin (g/dL)	3.91±0.78	1.98	5.84
SGOT (IU/L)	51.04±26.40	12.00	186.00
SGPT (IU/L)	41.52±28.66	7.00	149.00
Serum ALP (IU/L)	402.89±259.09	157.00	1940.00
Serum urea (mg/dL)	38.59±27.88	1.30	178.60
Serum creatinine (mg/dL)	0.64±0.34	0.20	2.45
Serum Mg^{++}	2.19±0.94	0.40	4.90
Serum PO4^{---}	2.22±1.18	0.70	5.40

ALP: Alkaline phosphatase, TLC: Total leukocyte count, PLT: Platelet, Hb: Hemoglobin, SD: Standard deviation, SGOT: Serum glutamic-oxaloacetic transaminase, SGPT: Serum glutamic-pyruvic transaminase

Table 4 shows that out of 100 patients enrolled in this study, we have done laboratory investigations such as complete blood count, electrolytes, liver function test, and kidney function test. The mean value of TLC, Hemoglobin, Platelets, Calcium, Sodium, and potassium were, 13.84, 7.72, 2.87, 8.83, 141.32, and 4.49, respectively. The mean value of Serum Urea and Serum creatinine were 38.59 mg/dL and 0.64 mg/dL, respectively. The mean value for magnesium and phosphate were 2.19 and 2.22 respectively with 0.94 and 1.18 SD.

Table 5 shows that out of 100 admitted children, we had seen association of laboratory parameters with outcome of patients with SAM in 85 children. Out of 7 deaths 28.6% were died having hypoglycemia and this data had significant P-value. Out of 7 deaths 28.6% were died having hypocalcemia, 42.9% were having hypokalemia, and 42.9% were having hemoglobin <7 g/dL.

Table 6 shows that odds of death was (OR=36.55, 95% C.I=4.01–333.5) in magnesium deficient as compared to the normal and odds of death was (OR=0.84, 95% CI.=0.74–0.96) phosphate deficient as compared to normal.

DISCUSSION

Out of 100 children in the present study the mean age of children was 19.6 months. The most enrolled cases were in the age group of 6–12 months, i.e., 59%. 24% were in the age group of 13–24 months and rest 17% were in the age group of 25–59 months. Both genders were almost equally affected in the present study with males 49% and females 51%, with a male: female ratio of 0.96:1.

In a study of the clinical spectrum of SAM in children in Cameroon, the median age was 9 months and nearly equal gender-wise distribution was observed with 50.8% of male and 49.2% female.[10] In a similar study over 130 SAM patients is a hospital-based time-bound, cross-sectional study with a follow-up component of Children aged 1–60 months admitted to Subhash Chandra Bose Medical College and Hospital and Sardar Vallabhbhai Patel Post Graduate Institute of Pediatrics during September 2013 and September 2015 there is no variation in sex both males and femalesm respectively.[11]

Children included in the present study were mainly from a rural background, i.e., 93% were from rural area and 7%

Table 5: Association of laboratory parameters with outcome of patients with severe acute malnutrition

Parameters	Survivals		OR (95% CI)	P
	Expired, n (%)	Discharged, n (%)		
RBS				
Hypoglycemia	2 (28.6)	2 (2.6)	15.20 (1.76–131.64)	0.029
Normal	5 (71.4)	76 (97.4)		
Ca				
Hypocalcemia	2 (28.6)	16 (20.5)	1.55 (0.28–8.74)	0.986
Normal	5 (71.4)	62 (79.5)		
K				
Hypokalemia	3 (42.9)	11 (14.1)	4.57 (0.89–23.25)	0.152
Normal	4 (57.1)	67 (85.9)		
Serum/albumin				
Hypoalbuminemia	0	0	NA	
Normal	7 (100.0)	78 (100.0)		
Hb				
Hb <7	3 (42.9)	32 (41.0)	1.08 (0.23–5.15)	1.000
Normal	4 (57.1)	46 (59.0)		

CI: Confidence interval, OR: Odds ratio, Hb: Hemoglobin, RBS: Random blood sugar, NA: Not available

Table 6: Association of magnesium and phosphate with outcome of patients with severe acute malnutrition

Serum electrolytes	Survivals		OR (95% CI)	P
	Expired, n (%)	Discharged, n (%)		
Mg				
Deficiency	6 (85.7)	11 (14.1)	36.55 (4.01–333.5)	<0.001
Normal	1 (14.3)	67 (85.9)		
PO4				
Deficiency	7 (100.0)	37 (47.4)	0.84 (0.74–0.96)	0.023
Normal	0	41 (52.6)		

CI: Confidence interval, OR: Odds ratio

remaining were from urban area. Up to 90% of children belong to lower SES according to the modified Kuppuswamy scale. Maximum incidence was found in 13–24 (39.7%) months age group followed by 6–12 months (36.3%). In the present study, 20% were completely immunized and 49% were partially immunized while 31% were not immunized at all. Furthermore, this study found that children were completely immunized in 13% of cases and 62.3% were partially immunized and 24.6% were not immunized.[12]

In the present study, clinical and biochemical factors were also studied. A total of 100 children with SAM were included. The present study found that of all the patients, fever, pallor, loose stool, cough and cold, dehydration, meningitis, hair changes were present in 73%, 67%, 36%, 33%, 45%, 4%, and 78%, respectively.10% of children have GCS <7.33% children had pneumonia with cough and cold as an associated symptom. Shah and Javedkar found some and severe dehydration were (18.33%) and (13.33%) respectively.[13]

The prevalence of these comorbidities was more in children with severe than in mild and moderate malnutrition. In this study, 112/402 (27.9%) undernourished children had pneumonia out of which 77 (68.7%) had severe malnutrition.

We in the present study also found that hypoglycemia, hypocalcemia, hypokalemia, and anemia were 4%, 18%, 14%, and 35%, respectively. Death because of hypoglycemia had a significant P-value, i.e., 0.029. Gangaraj et al., found hypoglycemia in only 3.9% in their study of electrolytes and blood sugar Changes in Severely Acute malnourished Children and its association with diarrhea and vomiting.[14] Shah and Javedkar found hypoglycemia in 5% of cases in their study at the Nutrition Rehabilitation Centre at Baroda, Gujarat in April 2014.[13]

In the present study, edema was present in 22% of children with SAM. A study by Sharma et al., bilateral nutritional edema was noted in 16.5% of patients.[15]

We in the present study did blood and biochemical investigations to see their level in SAM, effect, and any association with mortality and hypophophatemia with hypomagnesemia. The mean value of Serum potassium, S. sodium, S. calcium, S. Albumin, and hemoglobin were 4.49 meq/L, 141.32 meq/L, 8.83 meq/L,3.91 g/dL, and 7.72 g/dL, respectively. Shah and Javedkar found hypoglycemia in 5% of cases in their study at the Nutrition Rehabilitation Centre at Baroda, Gujarat in April 2014.[13]

Factors predicting final outcome in patients with SAM
We studied the various epidemiological, clinical, and laboratory variable to see their association with the outcome of SAM patients. In a study done by Roy et al., also concluded that hypothermia is a major risk factor for

mortality among the severely-malnourished children with diarrhea and pneumonia led to an increased risk of death in children by 3.9.[16]

In the present study group of 100 patients 78 patients were discharged successfully while 15 patients leave against medical advice. Mortality in the present study is 7% and is the maximum among infants age group but the association is not statistically significant. The Death rate in study of Ganesh et al., was 13.6% and 0.68% in a study of Syed Tariq et al., while 10.7% in study of Alasad et al.[12,17,18]

Strengths of the study

- WHO classification was used in the classification of SAM patients which was helpful in comparison of study findings
- Since re-feeding syndrome is a metabolic response involving the endocrine system, it was strictly followed to exclude disorders which may influence serum magnesium and phosphorus levels.

Limitations of the study

- This was only one and half year study so the sample size was small
- As the study was conducted in a tertiary care, referral Centre so it may not reflect the actual conditions of the society. Majority of the patients had other coexisting illnesses which affected the final outcome
- No interventions were done in the study to see the effect of magnesium and phosphate supplementation on the outcome
- There was no control group to compare our outcome with
- Follow-up of the patients was not done. So we could not predict the residual burden and squeal of the SAM.

CONCLUSION

The most common signs and symptoms of SAM patients were loss of hair luster, fever, and pallor. Survival of children was significantly associated with RBS, Mg, and PO_4 levels. Therefore, timely identification and intervention of biochemical derangement in SAM patients is necessary to improve the survival of SAM patients.

REFERENCES

1. Global Nutrition Report 2015: Action and Accountability to Advance Nutrition and Sustainable Development. This Report is Found the Link. Available from: https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/129444/filename/129655.pdf [Last accessed on 2023 Apr 25].

2. Paul VK, Bagga A and Ghai OP. Essential Pediatrics: Nutrition WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children. A Joint Statement by WHO and UNICEF. 9th ed. United States: CBS Pbl; 2009. p. 93.

3. Ministry of Health and Social Welfare, Government of India. Operational Guidelines on Facility Based Management of Children with Severe Acute Malnutrition. New Delhi: Ministry of Health and Social Welfare, Government of India; 2013.

4. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 2013;382(9890):427-451.
   https://doi.org/10.1016/S0140-6736(13)60937-X

5. World Health Organization. Management of Severe Malnutrition: A Manual for Physicians and other Senior Health Workers. Geneva: World Health Organization; 1999.

6. Guideline: Updates on the Management of Severe Acute Malnutrition in Infants and Children. Geneva: World Health Organization; 2013. Available from: https://www.who.int/publications-detail-redirect/9789241506328 [Last accessed on 2022 Mar 03].

7. International Institute for Population Sciences (IIPS), ICF. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: International Institute of Population Science; 2017.

8. National Family Health Survey 2015-16 (NFHS-4): India Fact Sheet. Available from: https://www.indiaenvironmentportal.org.in/content/440396/national-family-health-survey-2015-16-nfhs-4-india-fact-sheet [Last accessed on 2017 Aug 28].

9. World Health Organization Guideline. Updates on the Management of Severe Acute Malnutrition in Infants and Children. Geneva: World Health Organization; 2013.

10. Chiabi A, Malangue B, Nguefack S, Dongmo FN, Fru F, Takou V, et al. The clinical spectrum of severe acute malnutrition in children in Cameroon: A hospital-based study in Yaounde, Cameroon. Transl Pediatr. 2017;6(1):32-39.
    https://doi.org/10.21037/tp.2016.07.05

11. Das K, Swain A, Nayak AS, Behera S and Satpathy SK. Clinical profile and outcome of children with severe acute malnutrition. Pediatr Rev Int J Pediatr Res. 2017;4(5):350-356.
    https://doi.org/10.17511/ijpr.2017.05.10

12. Syed Tariq A, Naik SA, Rafiq AW and Saleem R. Demographic, clinical profile of severe acute malnutrition and our experience of nutrition rehabilitation centre at children hospital Srinagar Kashmir. Int J Contemp Pediatr. 2015;2(3):233-237.
    https://doi.org/10.18203/2349-3291.ijcp20150534

13. Shah RH and Javedkar BB. Management of children with severe acute malnutrition: Experience of nutrition rehabilitation centre at Baroda, Gujarat. Int J Contemp Pediatr. 2014;1(1):3-6.

14. Gangaraj S, Das G and Madhulata S. Electrolytes and blood sugar changes in severely acute malnourished children and its association with diarrhoea and vomiting. Int J Pharm Sci Invent. 2013;2(5):33-36.

15. Sharma IK, Garg KK, Saxena D and Sharma N. Study to determine the prevalence of urinary tract infection and to identify the causative organism and their antibiotic sensitivity pattern in severe acute malnourished children. Int Arch Integr Med. 2017;4(7):89-104.

16. Roy SK, Buis M, Weersma R, Khatun W, Chowdhury S, Begum A, et al. Risk factors of mortality in severely-malnourished children hospitalized with diarrhoea. J Health Popul Nutr. 2011;29(3):229-235.
    https://doi.org/10.3329/jhpn.v29i3.7870

17. Ganesh J, Kumaravel KS, Balaji J, Rameshbabu B and Nedunchelian K. Clinical profile of children with severe acute malnutrition attending nutritional rehabilitation centre in

Dharmapuri: Int J Pediatr Res. 2016;3(2):95-99.

https://doi.org/10.17511/ijpr.2016.i02.05

18. Alasad SM, Salih OA and Hassan M. Insight into potassium's role in childhood mortality due to severe acute malnutrition. Sudan J Paediatr. 2019;19(1):44-51.

https://doi.org/10.24911/SJP.106-1513711620

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AS- Conception and design, definition of intellectual content, literature search, manuscript preparation, editing, review, and guarantor; **GA**- Conception and design, definition of intellectual content, literature search; **AG**- Literature search, manuscript preparation, editing and review; **NK**- Definition of intellectual content, literature search, data acquisition, data analysis, statistical analysis, manuscript preparation, editing; **SKB**- Manuscript preparation.

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