

# IMPACT OF THE SEVERITY OF DISEASE-RELATED MALNUTRITION (DRM) ON HEALTHCARE RESOURCE UTILISATION IN PAEDIATRIC PATIENTS

Authors: **Istamto T<sup>1</sup>**, **Alderson D<sup>2</sup>**, **Ricci M<sup>2</sup>**, **Tchoukouaha T<sup>2</sup>**

<sup>1</sup>Danone Nutricia Research, Hoofddorp, Netherlands, <sup>2</sup>Cogentia Healthcare Consulting, Cambridge, Cambridgeshire, UK

## Background and aims

- Disease-related malnutrition (DRM) refers to malnutrition that arises because of an underlying disease; It is important to distinguish it from the aspects of malnutrition due to food insecurity.
- Paediatric DRM can be caused by inadequate intake of quality food, increased nutritional requirements, nutrient deficiency, or impaired absorption.<sup>1,2</sup> Where food intake is insufficient to meet specific nutritional deficiencies or needs arising from diseases, oral nutritional supplements (ONS) can be prescribed as a supplement to the regular diet to manage DRM.<sup>3</sup>
- ONS are ready-to-use liquid, semi-solid, or powdered food for special medical purposes (FSMP) nutritional products that deliver energy, protein, and essential vitamins and minerals in a concentrated form.<sup>4</sup>
- DRM prevalence in children varies by demographic and setting. Malnutrition affects 6–11% of children in Europe and up to 73.6% of hospitalised children. Hospitalised children in Asia have a comparable frequency of DRM (24–69%), although data is limited and DRM-specific cases are challenging to identify.<sup>5–11</sup>
- The costs of malnutrition in children with underlying diseases is not well documented despite their substantial contribution to healthcare utilisation and economic burden.

## Objective

Describe the impact of DRM on healthcare resource utilisation (HRU) in the paediatric population (1 year and older).

## Results

- Seven papers showed that HRU increased with malnutrition in chronic diseases including neurological conditions and congenital heart disease (**Table 1**)
- A multi-centre European study indicated that moderately malnourished children (BMI <-2 to >-3SDs) had 1.3 days longer length of stay (LoS) than well-nourished peers, while severely malnourished children (BMI <-3SDs) had 1.6 days longer LoS (**Table 2**)
- A US study associated worsening malnutrition with an increase rate of reoperations (p=0.04) and longer median and post-operative LoS (p<0.01) (**Fig. 1**)
- A study in China showed a significant association between malnutrition after congenital heart defect (CHD) surgery with cardiac residual abnormalities, high Ross classification, and long-term oral diuretics usage (OR= 35.3, p<0.0001, p=27.1, p<0.0001, and OR=20.5, p=0.001) (**Fig. 2**)

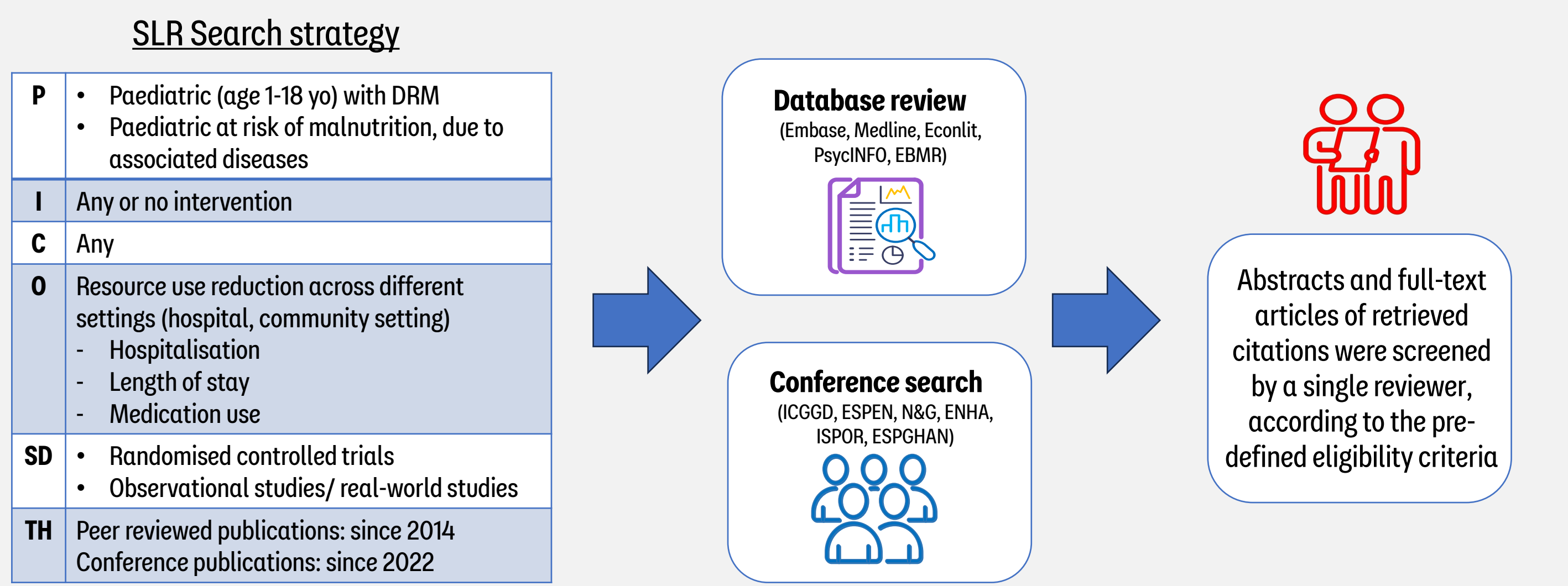
Table 1. Description of trials identified by the SLR, and the HRU endpoint measured

List of trials	Country	Patient characteristics	DRM assessment	Setting (N)	LoS	Comp. rate	Med. usage
Diamanti 2019 <sup>6</sup>	Italy	<18 yo who suffered from chronic acquired or congenital disease admitted to ICU	BMI for age z-scores & height/length for age (HFA)	Out-patient (n=177) Day hospital (n=163) Hospital (n=201)	✓	✗	✗
Freijer 2017 <sup>8</sup>	Netherlands	>1 month old - <18 yo admitted to non-academic hospital	Weight-for-age, weight-for-height and height-for-age	In-patient (n=1,813)	✓	✗	✗
Hecht 2014 <sup>12</sup>	Multi-centre (GE, CR, IS, IT, FR, UK, RO, GR, DK, NL, PO)	>1 month old - <18 yo	BMI and height/length <-2 SD	In-patient (n=2,568)	✓	✗	✗
Ladd 2018 <sup>14</sup>	USA	Between 5- 18 yo who underwent bowel surgery	BMI for age z-scores. Malnutrition levels: • none: >1, • mild: -1 to -1.9, • moderate: -2 to -2.9, severe: <-3	In-patient (n=516)	✓	✓	✗
Toole 2014 <sup>16</sup>	USA	<24 months old (gestational age >36 weeks)	Length-for-age: • Mild CPEM: 90-95% of median values • Moderate CPEM: 85-90% • Severe CPEM: <85%	Cardiovascular ICU (n=121)	✓	✗	✗
Zhang 2020 <sup>20</sup>	China	<18 yo (gestational age >36 weeks) who underwent surgery for CHD	z-scores weight-for-age, weight-for-height and height-for age Z values	In-patients (n=3,252)	✗	✗	✓
Zhang 2023 <sup>21</sup>	China	>1 month old - <18 yo	z-scores weight-for-height values	In-patient (n=1,125)	✓	✗	✗

Ref: Comp.: complication; CR: Croatia; DK: Denmark; FR: France; GE: Germany; GR: Greece; IS: Israel; IT: Italy; LoS: Length-of-stay; Med.: Medicine; NL: The Netherlands; PO: Poland; RO: Romania; UK: United Kingdom (England and Scotland)

## Methods

- Structured literature review (SLR) was conducted with a global scope to identify abstracts and posters.
- The OvidSP search platform was used, which comprised Embase, Medline, Econlit, PsycINFO, and EBMR.
- Various conferences pertaining to nutrition, digestive diseases, and HEOR were included.



## Discussion

- DRM leads to increased HCRU, through prolonged LOS, higher rates of hospital readmission, increased complication rates, and greater use of post-acute care services.<sup>5,7,9,10, 11–16</sup>
- These factors underscore the preventable nature of the DRM economic burden if early interventions were implemented.<sup>7</sup> There is a strong rationale for identifying interventions that can reduce HCRU and associated costs in paediatric DRM.<sup>7,17</sup>
- Evidence suggests that timely and adequate use of ONS may improve outcomes and reduce costs by decreasing resource use.<sup>18, 19</sup>
- The SLR found no direct comparisons due to heterogeneity in the following: study designs, patient populations, and malnutrition definitions. This highlights the necessity for systematic, multi-country research on paediatric DRM's economic effect across diverse healthcare contexts.

## Conclusion

- DRM places a substantial economic burden on healthcare systems worldwide. Children with chronic conditions are particularly susceptible to both the clinical and economic consequences of DRM.
- Further research is essential to fully understand the magnitude of DRM's impact on healthcare systems and its broader societal implications

Table 2. Aggregated Length of stay (LoS) results from the list of trials by malnutrition level

List of trials	Outcome measured	Degree of malnutrition			
		None	Mild	Moderate	Severe
Diamanti 2019 <sup>6</sup>	N	322	n/r	102	117
	≥15 days LoS	60 (18.6%)	n/r	30 (29.4%) (p=0.005)	47 (40.2%) (p=0.005)
Freijer 2017 <sup>8</sup>	N	1,505	308		
	LoS	n/r	mean of 1.5 day longer LOS than children without DRM		
Hecht 2014 <sup>12</sup>	N	2,243	n/r	120	47
	LoS (vs no malnutrition)	n/r	n/r	+1.3 days (p=0.04)	+1.6 days (p<0.001)
Ladd 2018 <sup>14</sup>	N	349	97	49	21
	Median LoS (SD)	6.0 days (4.0 – 8.0)	6.0 days (4.0 – 13.0)	6.0 days (4.0 – 13.0)	12.0 days (6.0 – 19.0)
Toole 2014 <sup>16</sup>	N	72	30	15	4
	Median LoS (SD)	15.0 days (9.0 – 28.0)	31.0 days (11.0 – 51.0) (p<0.05)	10.0 days (8.0 – 14.8) (p<0.05)	22.5 days (16.5 – 83.5) (p<0.05)
Zhang 2023 <sup>21</sup>	N	774	351		
	Median LoS	8.0 days	12.0 days (p<0.01)		

LoS: Length of stay; n: number of patients; n/r: not reported; SD: standard deviation

Figure 1. Impact of malnutrition on complication rate<sup>14</sup>

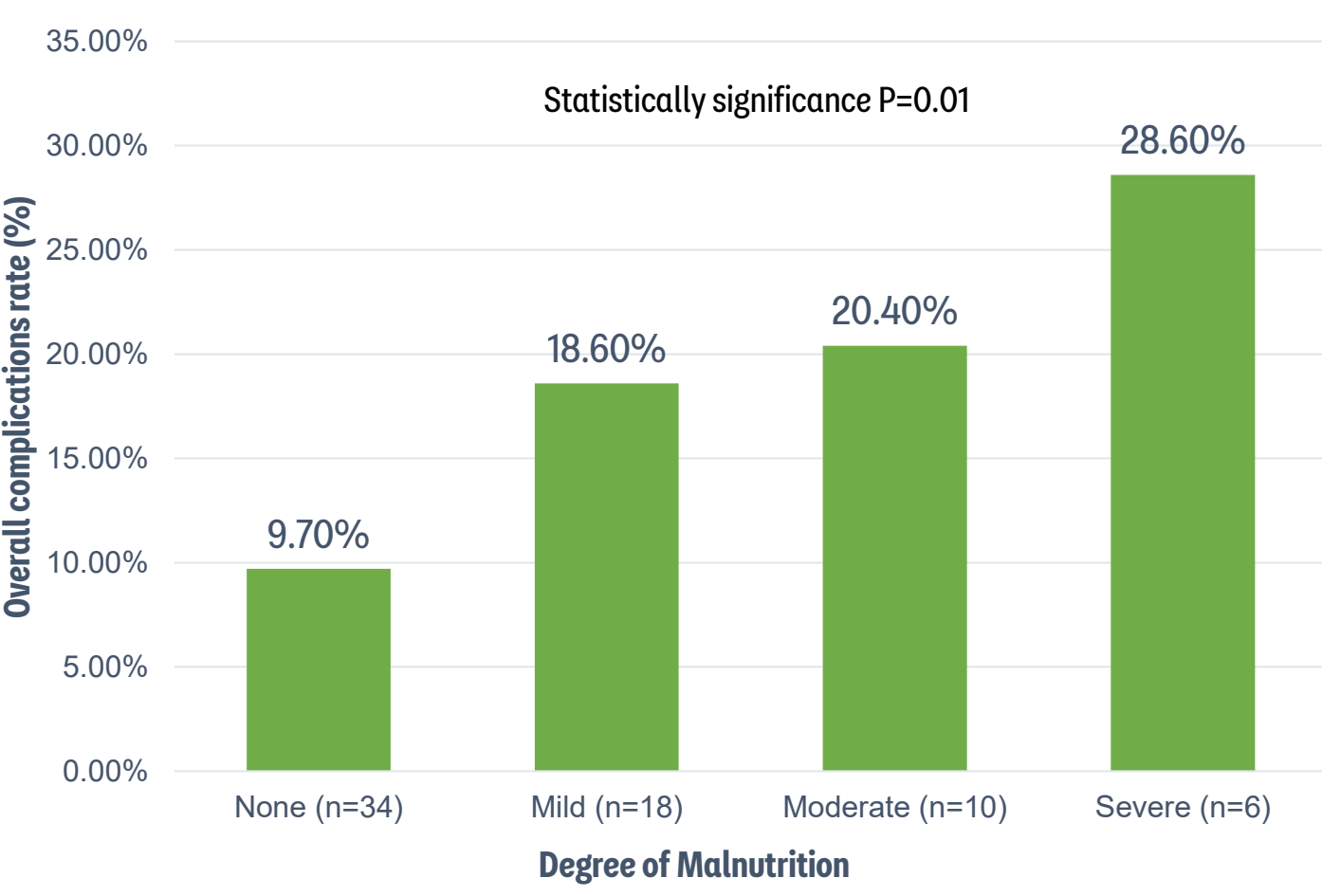
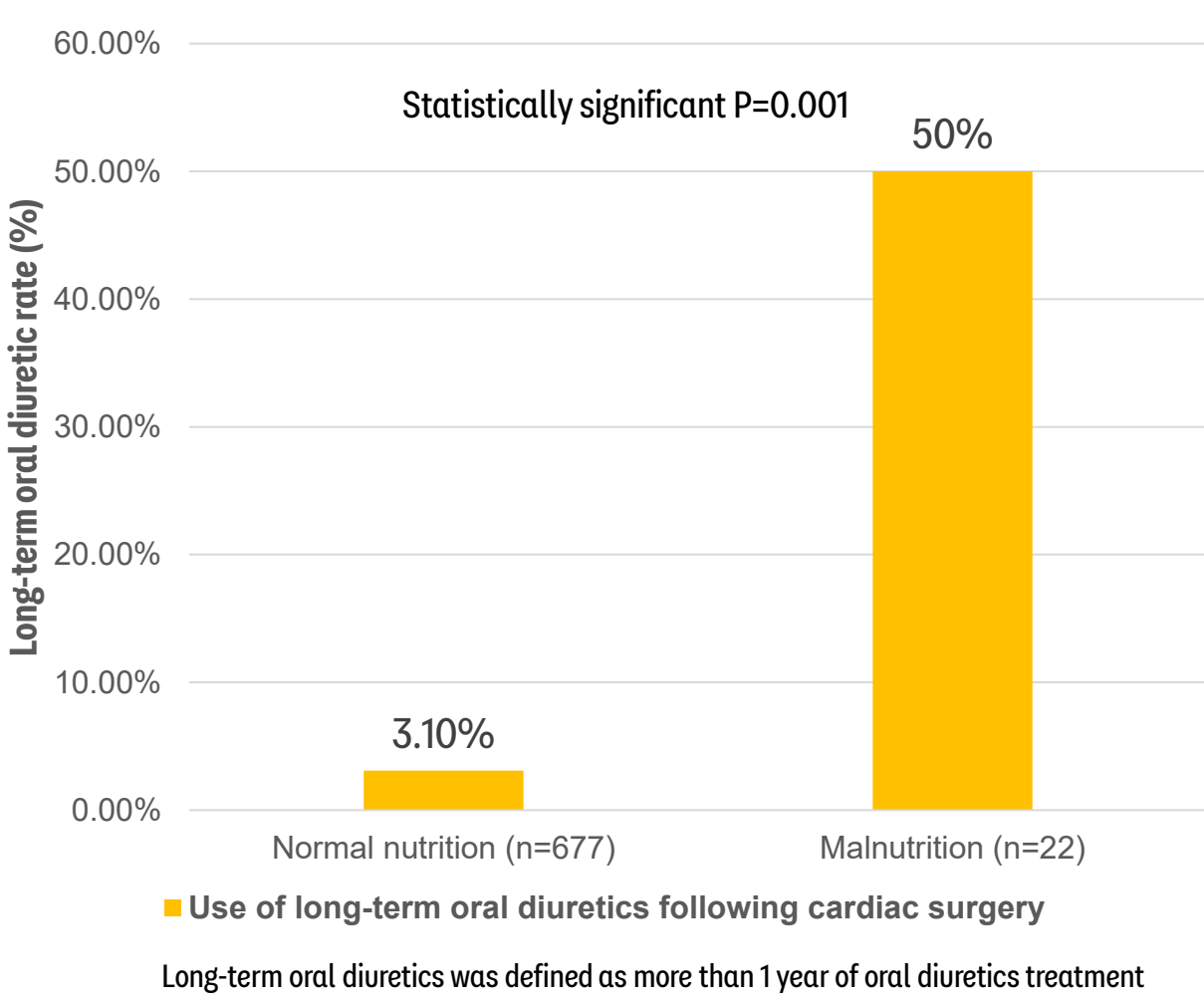


Figure 2. Impact of malnutrition on use of long-term oral diuretic following surgery<sup>20</sup>



## REFERENCES

- World Health Organization. Accessed April 29th, 2025. <https://iris.who.int/bitstream/handle/10665/375033/WHO-EURO-2023-8931-48703-72392-eng.pdf?sequence=5&isAllowed=y>
- Katsagoni CN, Cheirakaki O, Hatzoglou A, et al. *Nutrients*. 2021;13(4):1279.
- Baldwin C, Spiro A, Ahern R, Emery PW. *J Natl Cancer Inst*. Mar 7 2012; 104(5):371–85. doi:10.1093/jnci/djr556
- British Association for Parenteral and Enteral Nutrition. Accessed 30th April, 2025. <https://www.bapen.org.uk/education/nutrition-support/nutrition-by-mouth/oral-nutritional-supplements-ons/>
- Diakatou V, Vassilakou T. *Children*. 2020;7(11):218.
- Diamanti A, Cereda E, Capriati T, et al. *Clinical Nutrition*. 2019;38(4):1877–1882.
- Dipasquale V, Catena MA, Cardile S, Romano C. *Nutrients*. May 28 2018;10(6)doi:10.3390/nu10060684
- Freijer K, van Puffelen E, Joosten KF, Hulst JM, Koopmanschap MA. *Clin Nutr ESPEN*. Feb 2017;23:228–233. doi:10.1016/j.clnesp.2017.09.009
- Joosten KF, Hulst JM. *Nutrition*. 2011;27(2):133–137.
- Ismail SR, Mehmood A, Rabiah N, Abu-sulaiman RM, Kabbani MS. *Egyptian Pediatric Association Gazette*. 2021;69:1–8.
- Zhang Y, Lu L, Yang L, et al. *BMC pediatrics*. 2023;23(1):126.
- Hecht C, Weber M, Grote V, et al. *Clinical nutrition*. 2015;34(1):53–59.
- Pradelli L, Zaniolo O, Sanfilippo A, Lezo A, Riso S, Zanetti M. *Nutrition*. 2023;108:111943.
- Ladd MR, Garcia AV, Leeds IL, et al. *Journal of pediatric surgery*. 2018;53(11):2336–2345.
- Troege C, Colombaro DV, Rao PC, et al. *The Lancet Global Health*. 2018;6(3):e255–e269. doi:10.1016/S2214-109X(18)30045-7
- Toole BJ, Toole LE, Kyle UG, Cabrera AG, Orellana RA, Coss-Bu JA. *Congenit Heart Dis*. 2014;9(1):15–25.
- Khlevner J, Naranzo K, Hoyer C, et al. *Nutrients*. 2023; 15(13)
- Lakdawalla DN, Mascarenhas M, Jena AB, et al. *Journal of Parenteral and Enteral Nutrition*. 2014;38:42S–49S.
- Lezo A, Povero M, Pradelli L, Nigro E, Plazzotta C, Lagazio C. *Journal of Parenteral and Enteral Nutrition*. 2021;45(7):1400–1407.
- Zhang M, Wang L, Huang R, Sun C, Bao N, Xu Z. *BMC Pediatrics*. 2020; 20:213. <https://doi.org/10.1186/s12887-020-02124-7>
- Zhang Y, Lu L, Yang L, Yan W, Yu Q, Sheng J, Mao X, Feng Y, Tang Q, Cai W, Wang Y. *BMC Pediatrics*. 2023; 21:126. <https://doi.org/10.1186/s12887-023-03899-1>

Abbreviations:

**BMI:** Body mass index; **DRM:** Disease related malnutrition; **EBMR:** Evidence-Based medicine reviews; **Econlit:** specialised database for comprehensive literature relevant to an economic topic; **ENHA:** European Nutrition Society for Health Alliance; **ESPEN:** European Society for Clinical Nutrition and Growth; **ESPGHAN:** European Society for Paediatric Gastroenterology Hepatology and Nutrition; **FSMP:** food for special medical purposes; **HRU:** Healthcare-resource utilisation **ICGGD:** International Conference on Gastroenterology and Digestive Disorders; **ISPOR:** International Society for Pharmacoeconomics and Outcomes Research; **LoS:** Length of stay; **MEDLINE:** National Library of Medicine's (NLM) bibliographic database; **N&G:** International Conference on Nutrition and Growth; **ONS:** oral nutritional supplements; **PsycINFO:** Interdisciplinary bibliographic database in psychology and related fields; **SLR:** Systematic literature review