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Narrative Review

The nutritional characteristics and experiences of survivors of critical illness after hospital discharge: A multi-method narrative review

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SUMMARY

Background & aims: Many survivors of critical illness experience long-term functional, cognitive, and psychological impairments known as post-intensive care syndrome (PICS). Yet, the nutritional recovery experiences of intensive care unit (ICU) survivors after hospital discharge remain underrecognized and poorly understood. The objective of this review was to characterize nutritional indices and nutrition-related outcomes in survivors of critical illness, and to understand the nutritional recovery experience after hospital discharge.
Methods: Searches were conducted for eligible quantitative and qualitative studies between June and August 2024 using PubMed, CINAHL Complete, and Scopus electronic databases. Abstracts and full texts were screened against predetermined inclusion and exclusion criteria. Primary research analyzing anthropometric, nutritional, and/or experiential data of adult survivors of critical illness after hospital discharge were included in this review.
Results: 21 quantitative (n = 3054) and 7 qualitative (n = 162) studies were included. After hospital discharge, ICU survivors seldom returned to their baseline weight with many having small to modest weight gains in the first months of recovery. Average calorie (18–33.5 calories/kilogram/day) and protein (0.96–1.6 g/kg/day) intakes largely did not meet requirements needed to facilitate recovery, resulting in high rates of malnutrition, ranging from 16.8 to 63 % 3 months after discharge. A multitude of barriers to nutritional recovery were faced in the post-discharge period resulting from persistent physical and functional limitations due to critical illness. Ongoing individualized nutrition monitoring and follow-up from dietetic professionals knowledgeable in post-ICU care has the potential to improve nutrition-related outcomes for survivors yet remains underutilized. Improving the availability and affordability of such services is a key facilitator to improve the nutritional recovery experience for ICU survivors.
Conclusions: After hospital discharge, many survivors of critical illness face numerous barriers to nutritional recovery resulting in long-term nutritional complications. Future research efforts should target nutritional characterization, associations between nutritional variables and PICS, and the identification and development of effective nutrition interventions to improve long-term outcomes for survivors of critical illness after hospital discharge.

Abbreviations: PICS, post-intensive care syndrome; SCCM, Society of Critical Care Medicine; ICU, intensive care unit; ARDS, acute respiratory distress syndrome; BMI, body mass index; COVID-19, Coronavirus Disease 2019; IQR, interquartile range; MNT, medical nutrition therapy; RD, registered dietitian; SD, standard deviation; TBI, traumatic brain injury; CI, confidence interval; Kg, kilograms; m2, meters squared; MUST, Malnutrition Universal Screening Tool; SGA, Subjective Global Assessment; GLIM, Global Leadership Initiative on Malnutrition; ESPEN, European Society for Clinical Nutrition and Metabolism; CKD, chronic kidney disease; G, grams; Kcal, kilocalories; SE, standard error; VAS, visual analogue scale; EN, enteral nutrition; NR, not reported; ONS, oral nutrition supplements; PN, parenteral nutrition.

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1. Introduction

Post-intensive care syndrome (PICS), defined as new or worsening impairments in physical function, cognition, and/or mental health [1,2], is common among adult survivors of critical illness. More than half of survivors experience one or more PICS impairments during the first 12 months following intensive care unit (ICU) hospitalization, often with co-occurrence of impairments [3,4]. These impairments may persist for years after critical illness [5], often resulting in a reduced quality of life and high healthcare costs for survivors [6–8]. Globally, the proportion of individuals at risk for PICS has been increasing [9–12]; the international survival rate for critical illness ranges from 60 to 90 % and, in the United States (U.S.), there has been a 35 % decrease in mortality from critical illness since 1988. Despite the growing prevalence of PICS, literature and practice guidelines on the prevention, identification, and treatment of PICS remains limited in both research and clinical care.

Due to the prolonged hypermetabolism associated with critical illness, survivors require daily energy and protein intakes approximately 1.7 times and 2.5 times greater than healthy controls, respectively, to prevent a starvation-like state. This may last for months to years after ICU discharge [13,14]. Given the correlation between optimal dietary intake and nutritional status, and physical function, cognition and mental health, nutrition should be considered an integral component in critical illness recovery [15–18]. Yet, little attention is given to nutrition in recovery at the Society of Critical Care Medicine (SCCM) multidisciplinary stakeholder meetings focused on improving long-term outcomes after critical illness, and representation from the field of nutrition is largely absent [3,19].

The role of nutrition in critical illness recovery may be underrecognized due to limited characterization of nutritional indicators, such as dietary intake, anthropometric measures, body composition, and factors impacting nutritional recovery, in survivors after hospital discharge. Recent literature reviews have primarily focused on the acute (i.e., in the ICU) and ward-based (i.e., post-ICU discharge but pre-hospital discharge) phases of critical illness [20–22]. However, post-discharge critical illness survivors warrant focused nutritional assessment that accounts for recovery trajectories, inflammatory status, early-onset complications such as ICU-acquired weakness and post-extubation dysphagia, and their access to and utilization of healthcare and social support services. Therefore, the primary objective of this review was to characterize nutritional indices and nutrition-related outcomes in survivors of critical illness after they are discharged from the hospital. The secondary objective was to understand the nutritional recovery experiences, perceptions, and needs of critical illness survivors after hospital discharge.

2. Materials & methods

We conducted a semi-structured literature search using several search strategies. Searches were first conducted between June and August 2024 using PubMed, CINAHL Complete, and Scopus electronic databases for publications containing at least one search term relevant to the research objective, including “nutrition”, “nutritional status”, “nutritional rehabilitation”, and “dietary intake”. These terms were cross-referenced with terms such as “critical illness recovery/rehabilitation”, “post-ICU/recovery/rehabilitation”, and “critical illness/ICU survivor” using advanced search building tools available on electronic databases. Reference lists of included studies and relevant literature reviews were manually screened to identify additional articles relevant for inclusion.

Studies that met inclusion criteria were original quantitative or qualitative research; included populations of adult survivors of acute critical illness (e.g., no prolonged mechanical ventilation) aged ≥18 years; examined nutrition profiles, nutrition-related outcomes, nutritional needs, or nutrition service utilization after hospital discharge; and collected nutrition-related data after hospital discharge. While no studies were excluded based on publication date, those not published or available in English were excluded.

Covidence web-based collaboration software platform was used to screen and review all articles identified from the database and hand searches [23]. Title and abstract screening and full-text review were conducted by an independent reviewer (J.D.), with collaboration by A.D. on quantitative studies and E.B. on qualitative studies. All three authors met to establish consensus as needed in the case of conflict.

Data were extracted using data extraction tables developed for this study adapted from similarly published narrative reviews and specific to study methodology (i.e. quantitative or qualitative) [20,21]. Quantitative study characteristics, including methodology, population and outcomes were extracted into Table 1; while qualitative study characteristics, key themes, and nutrition-related findings were extracted into Table 5. Quantitative data related to anthropometric measurements, dietary intake, nutritional status (i.e. “the result between the nutritional intake received and the nutritional demands that allows for the utilization of nutrients to maintain reserves and compensate for losses”) [50], barriers to dietary intake, and nutrition-related healthcare utilization were extracted and organized by outcome, which were chosen *a-priori*. Qualitative findings related to the nutrition recovery experience after hospital discharge were reviewed by J.D. and E.B. to identify common prominent themes across studies, which were then grouped and reported based on similarities and differences of participant responses. Nutrition-related findings across these studies were condensed into two overarching themes: barriers to dietary intake and nutritional recovery, and facilitators of dietary intake and nutritional recovery after hospital discharge. Primary barriers were separated into “person-related” and “systems-related” barriers.

3. Results

A total of 563 articles were identified from the initial search and 102 duplicates were removed; 257 articles were excluded during title and abstract screening and 177 articles were excluded during full text review (Fig. 1). There were 27 included studies, 4 of which were identified from hand searches. Studies were classified as quantitative (n = 20) [7,24–42], or qualitative (n = 6) [43–48], with one multi-method intervention study that collected both quantitative and qualitative data [49].

3.1. Quantitative findings

Study characteristics from included quantitative studies (n = 21) are described in Table 1. Study results are described based on their core outcomes of interest: anthropometrics (n = 15), nutritional status (n = 8), dietary intake (n = 7), barriers to dietary intake (n = 8), and nutrition healthcare service or nutrition support utilization (n = 11). All quantitative studies were observational, with the exception of Major et al. (2021), a pilot intervention study [49]. Eight studies recruited participants from or utilized a post-discharge rehabilitation program [29,31,32,37–39,41,42,49]; all but one of which included a nutrition care or consultation component [32]. Of note, Merriweather et al. (2018) was a follow-up observational study but recruited from a cohort of ICU survivors that received a rehabilitation intervention during hospitalization [36].

Table 1
Characteristics of quantitative studies examining nutritional indices during recovery in survivors of critical illness.

Author, year (country)	Study design	Sample size, population	Age (mean [SD] or median [IQR])	% female (n)	Hospital length of stay (mean [SD] or median [IQR])	ICU length of stay (mean [SD] or median [IQR])	Relevant outcome(s)
Alvarez-Hernandez et al., 2023	Observational cohort study 3-, 6-, and 12-month follow-up	n = 199 Adult survivors of COVID-19 admitted to the ICU	60.7 (10.1)	29.6 (59)	–	–	Weight, weight change, BMI, nutritional status, MNT
Beumeler et al., 2024	Descriptive cohort study 3-, 6-, and 12-month follow-up	n = 81 Adult ICU survivors admitted ≥48 h	69 (60–76)	26 (32)	15 (9–25)	5 (4–11)	Dietary intake, barriers to dietary intake, MNT
Chan et al., 2018	Prospective cohort study 6- And 12- month follow-up	n = 120 Survivors of ARDS who were mechanically ventilated	50 (15)	52 (63)	22 (15)	15 (11)	Weight, weight change, BMI
Chapple et al., 2017	Prospective observational study 3-month follow-up	n = 37 Adult ICU survivors with moderate-to-severe TBI admitted for ≥48 h	45.3 (15.8)	13 (5)	37.8 (19.4–52.4)	13.4 (6.4–17.9)	Weight, weight change, BMI
Chapple et al., 2019	Inception cohort study with healthy controls 3-month follow-up	n = 51 Adult ICU survivors **n=25 healthy controls*	69.7 (9.0)	18 (9)	13.9 (8.4–21.9)	3.1 (1.7–5.9)	Dietary intake, appetite, weight, weight change, BMI
Duarte et al., 2017	Retrospective cohort study 3-month follow-up	n = 688 Adult ICU survivors enrolled in a post-ICU outpatient clinic	–	37.1 (255)	–	–	Weight change, MNT
Herridge et al., 2003	Longitudinal study 3-, 6-, and 12-month follow-up	n = 117 Adult survivors of ARDS who were mechanically ventilated	45 (36–58)	44 (51)	48 (22–77)	25 (15–45)	Weight change
Herridge et al., 2011	Prospective longitudinal cohort study 3-, 6-, and 12-month and 2, 3, 4 and 5 year follow-up	n = 83 Adult survivors of ARDS discharged from the ICU	45 (36–56)	45 (37)	47 (26–73)	25 (14–47)	Weight change, BMI
Hoyois et al., 2021	Prospective cohort study 15, 30, and 60 day follow-up	n = 15 Adult survivors of COVID-19 who were mechanically ventilated	60 (55–67)	33.3 (5)	–	33 (26–39)	Nutritional status, dietary intake, appetite, barriers to dietary intake, weight, BMI, weight change, MNT
Jubina et al., 2023	Prospective cohort study 1-month follow-up	n = 41 Adults admitted to the medical ICU with acute respiratory failure requiring mechanical ventilation or high oxygen requirements	48 (38–62)	39 (16)	23 (16–50)	21 (11–44)	Weight, weight change, dietary intake, nutritional status, barriers to dietary intake, appetite
Kitayama et al., 2023	Secondary data analysis of an ambidirectional cohort study 12-month follow-up	n = 468 Adults ICU survivors over 65 years of age living at home for 12 months after discharge	75 (71–80)	30.3 (142)	28.5 (19.5–40.8)	5 (4–7)	Appetite, barriers to dietary intake
Kvale et al., 2003	Prospective cohort study 6-month follow-up	n = 346 Adult ICU survivors	52.5 (17.9)	–	–	6.1 (6.8)	Weight change, MNT
Major et al., 2021	Mixed method, non-randomized, prospective pilot feasibility study 1–2 week, 3- and 6-month follow-up	n = 19 Adult ICU survivors who received mechanical ventilation ≥48 h **n=24 usual care group*	63 (9)	26.4 (5)	23 (21)	10 (16)	Nutritional status, MNT
Mateo Rodriguez et al., 2022	Descriptive prospective study 4–6 week follow-up	n = 29 Adult survivors of COVID-19 admitted to the ICU with severe respiratory failure	63 (10)	44.8 (13)	–	24 (12–36)	Nutritional status
Merriweather et al., 2018	Cohort study 1 week post-ICU discharge and 3-month follow-ups	n = 240 Adult ICU survivors who were mechanically ventilated ≥48 h	62 (52–70)	43 (103)	–	–	Appetite

Table 1 (*continued*)

Author, year (country)	Study design	Sample size, population	Age (mean [SD] or median [IQR])	% female (n)	Hospital length of stay (mean [SD] or median [IQR])	ICU length of stay (mean [SD] or median [IQR])	Relevant outcome(s)
Novak et al., 2022	Prospective observational study 42 ± 16 day follow-up	n = 50 Adult survivors of COVID-19 admitted to the ICU who required mechanical ventilation	62 (10)	28 (14)	67 (28)	–	Weight, weight change,
Rives-Lange et al., 2022	Prospective observational study 1- And 3-month follow-up	n = 38 Adults admitted to the ICU with COVID-19 who were mechanically ventilated	66 (59–72)	24 (9)	–	23 (17–39)	Weight, weight change, BMI, nutritional status, dietary intake, MNT
Rousseau et al., 2022	Observational study 1-, 3-, and 12-month follow-up	n = 97 Adult ICU survivors admitted for ≥7 days	62 (54–70)	39.2 (38)	30 (19–51)	11 (8–20)	Weight, weight change, BMI, nutritional status, dietary intake, appetite, barriers to dietary intake, MNT
Thackeray et al., 2022	Case control study 12-month follow-up	n = 64 Adult ICU survivors who were mechanically ventilated ≥24 h **n=540 healthy controls*	68.8 (60.8–74.6)	47 (30)	16.5 (11–31.5)	6.5 (4–9)	Weight
Whitehead et al., 2022	Prospective observational study 3-month follow-up	n = 26 Adult ICU survivors who were mechanically ventilated ≥24 h and received enteral nutrition **n=10 healthy controls*	62 (2.9)	23 (6)	34.7 (4.8)	17.1 (2.3)	Weight, BMI, nutritional status, dietary intake, MNT
Wierdsma et al., 2021	Prospective observational study 3–5 month follow-up	n = 245 Adults admitted to the ICU with COVID-19 and discharged alive **additional n=162 patients included admitted to a nursing ward only*	62.9 (11.6)	24 (60)	19 (12–32)	–	Weight change, appetite, barriers to dietary intake, MNT

Abbreviations: ARDS: acute respiratory distress syndrome; BMI: body mass index; COVID-19: Coronavirus Disease 2019; ICU: intensive care unit; IQR: interquartile range; MNT: medical nutrition therapy; RD: registered dietitian; SD: standard deviation; TBI: traumatic brain injury.

3.1.1. Anthropometrics

3.1.1.1. Body weight. Eleven studies reported on body weight among ICU survivors at more than one time point, including at least one measurement taken after hospital discharge (Table 2; Fig. 2) [24,26–28,31,32,37–41]. Of these, eight studies also reported weight at both admission and discharge from either the hospital or the ICU, all of which observed a decrease in weight during this time period [24,27,31,32,37–39,41]. Participants across these studies failed to return to their hospital or ICU admission body weight at all post-discharge follow-up time points prior to 12 months. At 12 months, most participants had returned to their pre-admission weight [24,39].

Weight at hospital or ICU discharge and at least one post-discharge measure were reported in nine studies [24,27,31,32,37–41]. Weight increased from hospital or ICU discharge to one month [32,37–39]; with the exception of one study that saw a decrease in weight between 1- and 2-month follow-ups [31]. While average weight increased through 3 months in two studies [24,38], three studies observed either weight loss or little to no weight gain from discharge at 3 months [27,39,41]. At 6 and 12 months, weight largely returned to or surpassed discharge weight [24,39,40]. While they did not report admission or discharge weight, Chan et al. (2018) reported an increase in weight from 6 to 12 months post-discharge [26].

3.1.1.2. Weight change. Weight change, either expressed as ± kilograms (kg) or % body weight change, was reported in 13 studies (Table 2; Fig. 2) [7,24,26–32,34,37–39]. Consistent with body weight findings, all eight studies reporting on weight change observed weight loss from hospital or ICU admission to hospital or ICU discharge. There were two studies that tested for statistical significance, both saw significant weight loss in this time frame [27,31]. There were seven studies that reported percentages, average weight loss ranged from 4.9 % to 18 % of admission body weight [24,27,29–31,37,38]. Additionally, six of seven studies reported a weight loss of over 10 % [24,29–31,37,38]. Two studies reported weight loss in kg, with a 4.2–8.9 kg loss from admission to discharge [27,32].

Eight studies reported on weight change from hospital or ICU admission to at least one post-discharge time point [7,27,28,30,31,34,38,39]. Weight loss from admission persisted through 3 months across all studies, averaging 2.9–3.3 kg or 2.5 %–14 %. Two of three studies that tested for statistical significance from admission up to 3 months post-discharge found weight to be significantly lower [27,31,39]. At 6 months post-discharge, the large majority of survivors continued to have a high degree of weight loss though improved from 3 months [30,34]. At 12 months post-discharge, two studies reported a 2 %–3 % weight loss from admission while one reported 12-month weight to be similar to admission weight, although not statistically significant [7,30,39]. Beyond 12 months, one study observed a steady increase in weight ranging 1 %–3 % of admission weight from 2 to 5 years post-discharge [7].

Six studies reported weight change between hospital or ICU discharge and at least one follow-up time point [24,29,31,32,37,38]. The five studies with a 1–3 month follow-up observed a modest average weight gain from discharge weight, but with variation in

Table 2
Anthropometric results.

Author, Year	Time Point	Weight, kg (mean [SD or 95 % CI] or median [IQR])	BMI, kg/m2 (mean [SD or 95 % CI] or median [IQR])	Weight Change, kg or %
Alvarez-Hernandez et al., 2023	Hospital admission Hospital discharge 3 months 6 months 12 months	89.1 (18.5) 74.1 (16.0) 80.1 (17.2) 84.2 (17.9) 86.4 (19.0)	31.6 (5.8) 26.4 (5.4) 28.4 (5.3) 29.8 (5.4) 30.7 (5.9)	**Hospital admission to hospital discharge:** −16.4 % (8.0) **Hospital discharge to 12 months:** +11.6 kg (9.3) (16.5 % [14.0])
Chan et al., 2018	ICU admission 6 months 12 months	– 83.9 (78.3, 89.5) 85.3 (79.7, 90.8)	32.1 (8.1) 30.4 (28.6, 32.3) 30.9 (29.1, 32.8)	**6 to 12 months:** +1.4 kg (0.1, 2.7)a
Chapple et al., 2017	ICU admission Hospital discharge 3 months	81.9 (17.8) 75.4 (14.9) 75.1 (11.4)	26.7 (6.5) 24.9 (5.6) 24.3 (4.0)	**ICU admission to hospital discharge:** -4.2 kg (6.5) (−4.9 % [7.7])[a] **ICU admission to 3 months:** −2.9 kg (6.8) (−2.5 % [8.9])
Chapple et al., 2019	ICU admission 3 months	85.4 (20.7) 83.1 (20.4)	29.4 (6.3) 28.3 (6.1)	**ICU admission to 3 months:** −3.3 kg (3.7)
Duarte et al., 2017	3 months			**ICU admission to hospital discharge:** −11.7 % (51.3 % of patients [n = 278] lost ≥10 % of their body weight) **Hospital discharge to 3 months:** +9.1 % (34.4 % of patients [n = 186] did not gain any or lost weight)
Herridge et al., 2003	12 months	–	–	**Hospital admission to hospital discharge:** −18 % **Hospital admission to 3 months:** −14 % **Hospital admission to 6 months:** −8 % **Hospital admission to 12 months:** −3 %
Herridge et al., 2011	5 years	–	–	**Hospital admission to 12 months:** −2 % **Hospital admission to 2 years:** +1 % **Hospital admission to 3 years:** +2 % **Hospital admission to 4 years:** +2 % **Hospital admission to 5 years:** +3 %
Hoyois et al., 2021	ICU admission ICU discharge 1 month 2 months	87 (71–94) 75.8 (62–90) 78.4 (68–89) 76.5 (69–88)	25.7 (24–31) 22.9 (20.4–31) – –	**ICU admission to ICU discharge:** −11.3 % (7.8–15.5)[a] **ICU admission to 1 month:** −9.1 % (4–12.5)[a] **ICU admission to 2 months:** −6.5 % (3–12)[a] **ICU discharge to 2 months:** +4.3 kg (2.7–6.7)[a]
Jubina et al., 2024	Hospital admission Hospital discharge 1 month	111.4 (92–122) 95.2 (75–112) 99.4 (82–118)	–	**Hospital admission to hospital discharge:** −8.9 kg (−14.9 to −3.0) **Hospital discharge to 1 month:** +0.9 kg (−3.6 to 7.1)
Kvale et al., 2003	ICU admission 6 months	–	–	**ICU admission to 6 months:** *Lost 0*–5 kg*:* 32 % (n = 43) *Lost 5*–10 kg*:* 28 % (n = 38) *Lost 10*–15 kg*:* 19 % (n = 26) *Lost* >15 kg*:* 21 % (n = 29)
Novak et al., 2021	Hospital admission Hospital discharge 1–2 months	– 83.4 (15.7) 86.5 (15.4)	–	**Hospital admission to hospital discharge:** −15.8 % (6.0) **Hospital discharge to 1 month:** +3.1 kg (2.4)[a]
Rives-Lange et al., 2021	ICU admission ICU discharge 1 month 3 months	82.5 (74.8, 90.9) 72.5 (66.3, 82.5) 76.0 (69.0, 80.6) 79.0 (70.0, 86.0)	27.8 (25.5, 30.7) 25.8 (21.7, 27.2) 25.5 (22.7, 26.9) 25.9 (23.8, 28.1)	**ICU admission to ICU discharge:** −11 % (−14.8, −3.4) **ICU admission to 1 month:** −10 % (−15.3, −5.9) **ICU admission to 3 months:** −7 % (−13.8, 0) **ICU discharge to 3 months:** +3 kg (−1, 7.4)
Rousseau et al., 2022	ICU admission ICU discharge 1 month 3 months 12 months	88 (71.2–100.7) 77.7 (64.6–89.7) 81.5 (66.2–93.5) 77 (67.5–90) 90 (76.2–101)	– – 26.6 (22.7–30.9) 26.7 (23.7–31.1) 31.6 (26.8–34.2)	**ICU admission to 1 month:** Weight at 1 month was significantly lower than ICU admission[a] **ICU admission to 3 months:** Weight at 3 months was significantly lower than ICU admission[a] **ICU admission to 12 months:** Weight at 12 months was similar to ICU admission weight **1 month to 3 months:** Patients who attended both visits gained weight[a] **3 months to 12 months:** Patients who attended both visits gained weight[a]
Thackeray et al., 2022	ICU discharge 12 months	77.0 (16.1) kg 81.6 (16.5) kg	–	-
Whitehead et al., 2022	ICU admission ICU discharge 3 months	86.3 (3.9) 84.3 (5.2) 84.9 (8.2)	29.8 (1.2) 29.1 (1.8) 29.1 (2.9)	-

Abbreviations: BMI: Body Mass Index; CI: confidence interval; ICU: Intensive Care Unit; IQR: interquartile range; kg: kilograms; SD: standard deviation.
[a] Indicates statistical significance ($p < 0.05$).

the amount of weight gained both within and across studies [29,31,32,37,38]. Both studies that tested for significance found the weight gain from hospital or ICU discharge through 3 months post-discharge to be statistically significant [31,37]. At 12 months, an average 11.6 (9.3) kg (16.5 % [14.0 %]) weight gain from discharge was observed [24].

Two studies reported on weight change between post-discharge follow-up time points [26,39]. One study found a statistically significant weight gain between both 1 and 3 months as well as between 3 and 12 months post-discharge [39], while the other found a statistically significant weight gain between 6 and 12 months post-discharge [26].

Table 3
Dietary intake results.

Author, Year	Calorie & Protein Targets	Post-Discharge Follow-Up Time Point	Calorie Intake (kcal)	Calorie Intake (kcal/kg/day)	Calorie Target Met (%)	Protein Intake (g)	Protein Intake (g/kg/day)	Protein Target Met (%)
Beumeler et al., 2023[a]ɣ	**Calorie:** 25 kcal/kg/day **Protein:** 1.2 g/kg/day	3 months 6 months 12 months	–	18 (16–25) 22 (18–26) 21 (18–26)	n = 26 % n = 35 % n = 27 %	0.8 (0.6–1.0) 0.9 (0.7–1.1) 0.8 (0.6–1.0)	–	n = 8 % n = 15 % n = 10 %
Chapple et al., 2019[a]	–	3 months	1876 (708)	–	–	88 (37)	–	–
Hoyois et al., 2021	**Calorie:** 30 kcal/kg/day **Protein:** 1.5 g/kg/day	2 months	–	28–33.5	83.3[d]	–	1–1.6	63.3[d]
Rives-Lange et al., 2021[b]	**Calorie:** 30 kcal/kg/day **Protein:** 1.0 g/kg/day	3 months	1800 (1438–2142)	–	80 (72–93)[b]	–	1.05 (0.83, 1.18)	–
Rousseau et al., 2022[b]	**Calorie:** 35 kcal/kg/day **Protein:** 1.5 g/kg/day *(2 g/kg/day if obese or 0.8 g/kg/day if CKD)*	1 month 3 months 12 months	1800 (1530–2250) 2000 (1619–2200) 2100 (1778–2400)	24.5 (21.2–29.3) 26.1 (23–29.7) 27 (23.1–29.1)	n = 8.2 %[c] n = 3 %[c] n = 3.3 %[c]	70 (50–87.4) 80 (60–90) 86.2 (68.9–110)	0.94 (0.7–1.22) 1.07 (0.8–1.2) 1.11 (0.9–1.33)	67.9 (46.5–95.8)[d] 68.5 (48.8–99.3)[d] 71.7 (44.9–95.1)[d]
Whitehead et al., 2022[a]	–	3 months	2360 (396)	32.1 (7.4)	–	114.3 (21.7)	1.53 (0.39)	–

Abbreviations: CKD: Chronic Kidney Disease; g: grams; IQR: interquartile range; kcal: kilocalories; kg: kilograms; SD: standard deviation; SE: standard error.
[a] Intake values expressed as mean (range or SD/SE).
[b] intake values expressed as median (IQR).
[c] % of sample that met intake targets.
[d] % intake target met.

3.1.1.3. Body mass index. Eight studies reported on body mass index (BMI) at more than one time point in a cohort of ICU survivors (Table 2; Fig. 2) [24,26–28,31,38,39,41]. There was a consistent trend across the five studies of BMI being lower at hospital or ICU discharge than hospital or ICU admission [24,27,31,38,41]. Taking into consideration the other two studies reporting BMI at hospital or ICU admission and ≥1 post-discharge visit, all cohorts remained below average admission BMI at the terminal follow-up, ranging from 1 to 12 months post-discharge [24,26–28,31,38,41]. Although studies with more than one post-discharge follow-up saw increases in BMI between visits, they were largely minimal between 1 and 3 months, 3–6 months and 6–12 months, again with none returning to admission BMI [24,26,38].

Four studies reported BMI at hospital or ICU discharge and ≥1 post-discharge visit [24,27,38,41]. Results were mixed across studies, with one study observing a steady increase in BMI at the 3, 6, and 12-month post-discharge follow-up time points, all at which BMI was higher than at discharge [24]. Conversely, average BMI was largely unchanged from discharge at 1 and/or 3 months post-discharge in the remaining three studies with only minor fluctuations, all ±0.6 kg/m^2 or less [27,38,41]. Additionally, BMI was largely unchanged from 1 to 3 months but had a notable increase from 3 to 12 months in the one study reporting on BMI only at the post-discharge visits [39].

3.1.2. Nutritional status

Nutritional status of critical illness survivors after hospital discharge was assessed in eight studies [24,27,31,32,35,38,39,41]. There was heterogeneity in the nutritional status assessment method with many studies using more than one tool, including the Malnutrition Universal Screening Tool (MUST) [24,35,39,51], Subjective Global Assessment (SGA) [27,32,35,41,52], and the Global Leadership Initiative on Malnutrition criteria (GLIM) [38,39,53].

Five studies evaluated nutritional status at ICU or hospital discharge and at least one post-discharge time point [24,27,31,38,41]. At the time of discharge, all studies observed a high rate or risk of malnutrition, with four studies observing a prevalence of ≥79 % [24,31,38,41]. Prevalence of malnutrition decreased after hospital discharge up to 3 months post-discharge yet remained high, ranging from 16.8 to 63.0 % [24,27,38,41]. After 3 months, the prevalence of malnutrition continued to decrease through 12 months post-discharge [31].

Three studies evaluated nutritional status at one or more time points after hospital discharge [32,35,39]. All studies observed a high prevalence or risk of malnutrition up to 3 months post-discharge, ranging from 20 to 63 % of the cohort. Rousseau et al. (2022) found a statistically significant decrease in the proportion of malnutrition over time from 1 to 12 months post-discharge ($p < 0.001$) [39].

3.1.3. Dietary intake

Seven studies evaluated dietary intake in critical illness survivors after hospital discharge [25,28,31,32,38,39,41]. Six studies analyzed both calorie and protein intake (Table 3) [25,28,31,38,39,41], and one study only provided narrative results [32]. Four studies compared actual intake to target intake based on nutrient needs for this population [25,31,38,39]. The method used to estimate calorie and protein intake goals varied, as did the targets themselves. Estimation methods commonly used included best practice [25,39]; and the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines for nutritional management of individuals with SARS-CoV-2 infection [31,38,54]. Caloric targets were as follows: 25 kcal/kg/day (n = 1) [25]; 30 kcal/kg/day (n = 2) [31,38]; and 35 kcal/kg/day (n = 1) [39]. Protein targets were as follows: 1.0 g/kg/day (n = 1) [38]; 1.2 g/kg/day (n = 1) [25]; and 1.5 g/kg/day (n = 2) [31,39].

The majority of participants across studies did not meet calorie and protein intake goals through 12 months after critical illness. Calorie intake ranged from 18 to 33.5 kcal/kg/day across studies, with the majority under 30 kcal/kg/day [25,31,39,41]. Few

Table 4
Post-discharge utilization of medical nutrition therapy.

Author, Year	Time Point	Nutrition care provided as part of a standard rehabilitation program? (Y/N)	Nutrition services utilization	Feeding route(s)
Alvarez-Hernandez et al., 2023	12 months	N	NR	**ONS:** 6.4 % (n = 12) **Oral:** 100 % (n = 188)
Beumeler et al., 2024	12 months	N	22.2 % (n = 18) visited an RD at least once 38 % (n = 8) of those who reached the upper quartile of energy and/or protein intake visited an RD at least once	**ONS (3 months):** 15 % (n = 12)[a] **ONS (6 months):** 12 % (n = 10)[a] **ONS (12 months):** 10 % (n = 8)[a,b] **PN (12 months):** 1.2 % (n = 1)
Duarte et al., 2017	3 months	Y	1 30-min nutritionist consultation at the 3 month data collection visit	**Oral:** 94.6 % (n = 513) **EN:** 4.8 % (n = 26) **Oral + EN:** 0.6 % (n = 3)
Hoyois et al., 2021	2 months	Y	30-min nutrition counseling session daily	**Oral:** Median 22 days (IQR, 11–35 days); 53.3 % (n = 8) at end of follow-up **Oral + ONS:** Median 33 days (IQR, 23–42 days) **Oral + EN:** 86.7 % (n = 13) (median 14 days [IQR, 6–23.5 days]) **EN:** 93.3 % (n = 14) (median 7 days [IQR, 4–10 days]); 13.3 % (n = 2) at end of follow-up **PN:** 6.7 % (n = 1) (3 days)
Kvale et al., 2003	6 months	N	No patients received an RD referral	NR
Major et al., 2021	6 months	Y[c]	**0–3 months:** 53.3 % (n = 9) saw an RD (total 27 visits) **3–6 months:** 40 % (n = 6) saw an RD (total 14 visits) Sessions focused on optimizing protein intake	NR
Novak et al., 2021	1–2 months	Y	Individualized nutrition support therapy throughout program	NR
Rives-Lange et al., 2021	3 months	Y	1 RD consultation at the 3 month data collection visit	**ONS or EN:** 30 % (n = 10)
Rousseau et al., 2022	12 months	Y	3 20–30 min RD consultations at 1, 3, and 12 months for general nutrition advice	**Oral:** 100 % (n = 60)
Whitehead et al., 2022	3 months	Y	1 RD consultation at the 3 month data collection visit	**Oral:** 100 % (n = 8)
Wierdsma et al., 2021	3–5 months	Y[c]	71.2 % (n = 126) of patients were referred to an RD after discharge 46.8 % (n = 59) were treated by an RD after discharge	**ONS:** 61 % (n = 59) (0–1 month); 62 % (n = 28) (1–2 months); 52 % (n = 11) (3–5 months) **EN:** 4 % (n = 4) (0–1 month); 1 % (n = 1) (1–2 months)

Abbreviations: EN: enteral nutrition; IQR: interquartile range; MNT: medical nutrition therapy; NR: not reported; ONS: oral nutrition supplements; PN: parenteral nutrition; RD: Registered Dietitian.
[a] Patients using ONS had higher protein intake at 3, 6, and 12 months and higher energy intake at 3 months ($p < 0.05$).
[b] ONS provided an average of 24–36 g of protein (29 %–47 % total protein intake) and 450–775 calories (24 %–35 % total energy intake).
[c] By referral to study RD, consultation not required.

participants met calorie intake targets, with little improvement seen across studies with multiple post-discharge follow-ups [25,39]. Similarly, most participants did not meet protein goals, with intakes ranging from 0.96 to 1.6 g/kg/day [31,38,39,41]. Fewer participants met protein requirements or met a lower percentage of their estimated protein needs compared to energy needs. Jubina et al. (2022) used a subjective interview-based measure of dietary intake, finding that only 52 % of their sample reported the same intake prior to hospitalization [32].

3.1.4. Barriers to dietary intake

Eight studies collected quantitative data on barriers to dietary intake after hospital discharge in survivors of critical illness [25,28,31–33,36,39,42]. The most commonly reported barrier, appetite, was reported in six studies [28,32,33,36,39,42]. There was methodological heterogeneity in how studies collected data on appetite, including: self-report (n = 3) [28,32,39]; visual analogue scale (VAS) (n = 3) [28,36,42]; and simplified nutritional appetite questionnaire (SNAQ) (n = 2) [31,33]. Decreased appetite was prevalent across studies regardless of data collection methodology. One month after hospital discharge, loss of appetite was a common complaint among survivors, reported by up to 38 % of participants [31,32,39,42]. Poor appetite persisted three months after discharge, endorsed by 30 %–79 % of participants across studies [28,36,39,42]. By 12 months post-discharge, the prevalence of poor appetite ranged from 12 % to 26 % of participants [33,39]. Although studies with multiple post-discharge follow-ups observed improvements in appetite during the recovery timeline up to 12 months, appetite loss remained a primary barrier to dietary intake [31,39,42].

Seven studies reported on other barriers to dietary intake experienced during critical illness recovery not related to appetite, however there was high heterogeneity in the type of barriers assessed across studies [25,28,31–33,39,42]. Commonly reported barriers that persisted throughout the recovery trajectory included: chewing and/or swallowing difficulties (n = 4) [25,31,39,42]; taste changes and/or food aversions (n = 3) [25,32,42]; gastrointestinal symptoms (n = 2) [32,42]; changes in satiety (n = 2) [28,42]; depressive symptoms (n = 1) [33]; and food access (n = 1) [32].

3.1.5. Medical nutrition therapy utilization

Utilization of medical nutrition therapy (MNT) by survivors of critical illness after hospital discharge was explored in 11 studies (Table 4) [24,25,29,31,34,37–39,41,42,49]. Six of these studies provided nutrition services or recruited participants from

Table 5
Key findings from qualitative studies evaluating barriers and facilitators to nutritional recovery after critical illness.

Author, year	Primary objective	Sample size and population	Data collection methodology	Key themes	Nutrition-related findings
Bench et al., 2021	To explore experiences of fatigue after ICU discharge and identify potential management strategies	n = 17 Adult survivors of critical illness	Semi-structured interview	- Survivors have unique and different experiences with fatigue - Report complex interrelating interactions between fatigue and their physical, social, cognitive, and emotional states - Report a range of strategies in which to manage their fatigue	- Fatigue negatively affects ability to function properly, participate in physical activity and prepare meals, contributes to weight changes and leads to poor attention to physical appearance - Bodily changes may worsen fatigue - Exercise and good nutrition are common strategies survivors use to manage fatigue
da Silva et al., 2024	To explore critical illness recovery from the experiences, perspectives, and beliefs of ICU survivors, their caregivers, and multidisciplinary clinicians	n = 15 adult ICU survivors n = 2 Caregivers n = 23 Clinicians	Experience-based codesign workshops	- Survivors report returning home was a key time point for change, acceptance, and adjustment and when physical and mental limitations became apparent - PICS was poorly understood in the community - There was a lack of support to aid recovery - An intervention prototype and resource toolkit was developed to improve care after hospital discharge	- Participants reported a strong desire for screening during hospitalization and after discharge to assess nutritional needs - Nutrition advice and support is essential for recovery - Participants expressed desire for nutritional support and education
Major et al., 2021	To investigate the feasibility of an interdisciplinary home-based intervention for patients with new or worsened PICS impairments, initiated immediately after hospital discharge and targeting physical recovery and self-management in comparison to patients receiving usual care	n = 11 Physical therapists delivering the intervention	Focus group (at the end of the intervention)	- Providing health facilitated patient-centered care resulted in increased patient satisfaction - 'Being part of the state-of-the-art': Continuous interdisciplinary professional development increased awareness towards problems outside one's scope and suggested the need for an expanded interdisciplinary network for PICS - 'Balancing patients' needs with professional practice requirements': Further validation is needed for optimal recovery interventions for PICS patients - Many participants experience financial constraints limiting their ability to participate in rehabilitation	- An interdisciplinary approach to recovery, inclusive of dietitians, can improve patient satisfaction and recovery outcomes - Interdisciplinary team members should engage in professional development outside their scope of practice to increase their understanding of PICS and critical illness recovery - Further investigation is needed into optimal recovery intervention parameters and financial resources for patients
Merriweather et al., 2016	To explore factors influencing nutritional recovery in patients after critical illness and to develop a model of care to improve current nutrition management for this patient group	n = 17 Adult ICU survivors who were mechanically ventilated ≥48 h	Semi-structured interviews	- 'Experiencing a dysfunctional body': Patients faced physiological changes impacting nutritional intake, psychological changes, changes to body, self and identity - 'Experiencing socio-cultural changes in relation to eating': Patients experienced social isolation causing reduced nutritional intake, struggled to adapt to an unfamiliar culture, and recognized the importance of food habits and routine at home - 'Encountering organizational nutritional care delivery failures': participants reported system-centered failures, communication failures between healthcare professionals, nutritional care not being a priority, and a lack of nutritional knowledge for post-ICU needs	- 'Inter-related system breakdowns during the nutritional recovery process' was the primary influencer of patients' eating experiences after critical illness - Patients experienced numerous barriers to achieving nutritional recovery after discharge - Patients were unaware of the importance of nutrition in recovery - Patients were unaware of their increased calorie and protein needs and/or strategies to meet these needs - Patients reported a lack of nutritional care and patient-centered follow-up during recovery - There is a lack of nutrition knowledge for ICU survivors among healthcare professionals which negatively impacted nutritional care
Merriweather et al., 2014	To compare and contrast current nutritional rehabilitation practices against recommendations from national Institute for health and excellence guideline rehabilitation after critical illness	n = 17 Adult ICU survivors who were mechanically ventilated >2 days	Mealtime observations on the acute ward Semi-structured interviews	- Lack of nutrition knowledge among healthcare providers and a system-centered approach to care adversely affected the efficacy of nutrition care throughout hospitalization - Many patients received no nutritional advice on discharge or organized follow-up from outpatient dietitians - Patients were not following nutrition recommendations from hospital dietitians after discharge - No patients saw a dietitian after discharge despite referrals to community services	- Patients did not receive appropriate nutritional advice at hospital discharge - At the 3 month interview, there was a desire for additional nutrition information and advice - Patients experienced a lack of continuity of nutrition care both on the hospital ward and after discharge

(continued on next page)

Table 5 (*continued*)

Author, year	Primary objective	Sample size and population	Data collection methodology	Key themes	Nutrition-related findings
Scheunemann et al., 2022	To identify critical illness survivors perceived barriers and facilitators to resuming performance of meaningful activities when transitioning from hospital to home	n = 39 Adult ICU survivors	Semi-structured interviews	- Participants experienced person-related, task-related, and environment related barriers to resuming meaningful activities - Participants experienced person-related, task-related and environment related facilitators to resuming meaningful activities - Primary barrier/facilitator domains included mood/motivation, setbacks/progress, fatigability/strength, mis/communication, lack/community support, and lack/health services and policies - Barriers decreased and facilitators increased over time	- Barriers included inadequate nutrition or hydration (49 % of sample) and non-supportive health services or policies (97 %) - Inadequate nutrition or hydration included weight loss, digestive problems, altered taste, reduced appetite, struggling to meet nutritional intake targets, and weight management - Facilitators included supportive health services and community resources (82 %), and supportive healthcare personnel (100 %) - Participants felt supported during admission by dietitians, but did not report seeing a dietitian at home
Zhang et al., 2024	To explore and describe the barriers and facilitators of post-ICU follow-up services from the perspective of critical care professionals	n = 21 Healthcare workers whose units had offered ICU survivors different forms of follow-up services	Semi-structured interviews	- Barriers to the follow-up of ICU survivors include the restriction of decision-making rights and scope of practice, and indifferent attitudes towards survivors and repeated work. - Facilitators to the follow-up of ICU survivors include admitted significance, the needs of ICU survivors, the conscientiousness of professionals and the pioneers and leadership support - Barriers to implementing a follow-up service model include lack of confidence, lack of cooperation in medical consortium, distrusted relationships, restrictions of medical insurance, aging problems, and insufficient human resources - Facilitators to implementing a follow-up service model include lessons learned, positive feedback, and digital support	- Respondents reported a gap in post-ICU nutritional rehabilitation tracking and care - ICU professionals emphasized the need for a multidisciplinary member structure of follow-up or interdisciplinary methods for recovery to provide tailored interventions to combat PICS - Respondents believe building a follow-up service model with target-specific rehabilitation strategies and interventions can effectively improve long-term outcomes - ICU survivors face numerous barriers in seeking rehabilitation services, including financial and insurance constraints

Abbreviations: ICU: intensive care unit; PICS: Post-Intensive Care Syndrome.

rehabilitation programs inclusive of nutrition professionals [29,31,37–39,41]. Two other studies offered nutrition consultation referrals to all eligible participants but utilization of this service was not required as a condition of participation [42,49]. Data on nutrition services utilization was reported by all but Alvarez-Hernandez et al. (2023), while data on feeding route(s) including use of oral nutrition supplements (ONS) was reported in eight studies [24,25,29,31,38,39,41,42].

Of the 10 studies reporting on nutrition services utilization, four provided consultations with a registered dietitian (RD) or nutritionist only at the data collection visit(s) [29,38,39,41]. These consultations focused primarily on nutrition-focused data collection (i.e. 24-hour dietary recall, malnutrition assessment) and general nutrition advice, but lacked in individualized care. Regular individualized nutrition counseling as part of a rehabilitation program was offered less frequently (n = 2) [31,37]. Data on the number of RD visits after hospital discharge outside of study offerings was collected in four studies, of which two used a multidisciplinary services referral model inclusive of nutrition [25,34,42,49]. A higher percentage of participants that received a referral saw an RD after discharge, ranging from 40 to 53.3 % compared to 22.2 % of participants who did not receive a referral [25,42,49]. Despite a high referral rate, far fewer participants were treated by an RD after discharge than were referred [42]. Such findings indicate that having a referral model in place does not guarantee high rates of RD referrals or utilization [34]. Furthermore, a higher frequency of RD visits was observed in the first 3 months of recovery compared to later in the recovery trajectory [49]. Notably, 38 % of participants in Beumeler et al. (2024) who reached the upper quartile of energy and/or protein intake visited an RD at least once during recovery [25].

The majority of participants across studies were consuming an exclusively oral diet by the end of follow-up, with very few continuing to receive enteral or parenteral nutrition support exclusively or in conjunction with an oral diet [24,25,29,31,38,39,41,42]. The frequency of participants using ONS was low, yet generally higher in studies with more RD or nutritionist consultations outside of those occurring at data collection visits [31,42]. Use of ONS decreased over time during recovery [25,42]. Only Beumeler et al. (2024) reported on ONS effectiveness, finding that patients using ONS had higher protein intake at 3, 6, and 12 months and higher energy intake at 3 months ($p < 0.05$) and ONS provided an average of 24–36 g of protein (29 %–47 % total protein intake) and 450–775 calories (24 %–35 % total energy intake) [25].

3.2. Qualitative findings

In total, seven qualitative studies exploring the recovery experience of critical illness survivors following hospital discharge met the eligibility criteria for inclusion in this review [43–49]. Study characteristics, key themes, and nutrition-related findings from included studies are described in Table 5.

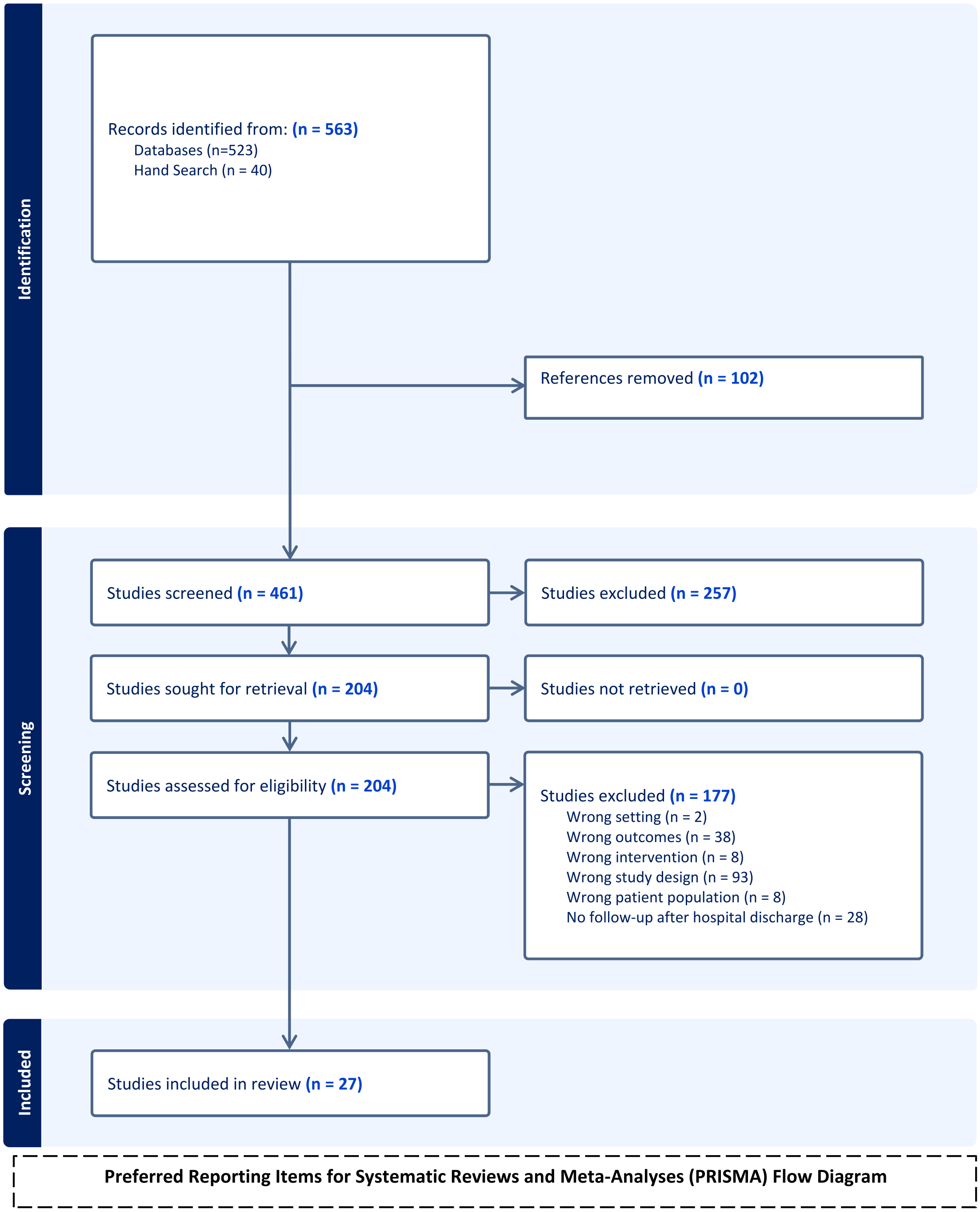

Fig. 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram.

3.2.1. *Barriers to dietary intake and nutritional recovery*

3.2.1.1. Person-related barriers. Prevalent person-related barriers to dietary intake and nutritional recovery were primarily functional and physiological, with many participants reporting a bidirectional relationship between eating and recovery in which both can be inhibited by the other. Survivors felt that persistent fatigue following hospital discharge had a negative impact on their ability to prepare meals and meet nutritional targets during recovery, worsened by changes in body weight and body composition [43,45,47]. A wide array of physiological barriers to nutritional recovery were reported including digestive issues, taste changes and reduced appetite, all of which resulted in difficulty meeting nutritional intake targets, mitigating weight loss, and facilitating weight management [45,47].

3.2.1.2. Systems-related barriers. Systems-related barriers to dietary intake and nutritional recovery were widely reported across studies, largely due to a lack of continuity of nutrition care or nutrition education during the recovery period. Such barriers resulted from a lack of availability and/or accessibility to multidisciplinary rehabilitative and supportive health services in either the healthcare system or community after hospital discharge, in

Study	Measurement			Data Collection									
				Admission		Discharge		Follow-up (months)					
	Weight	BMI	Weight Change	Hospital	ICU	Hospital	ICU	1	2	3	6	12	>12
Alvarez-Hernandez et al., 2023	✓	✓	✓	✓		✓				✓	✓	✓	
Chan et al., 2018	✓	✓	✓		✓						✓	✓	
Chapple et al., 2017	✓	✓	✓		✓	✓				✓			
Chapple et al., 2019	✓	✓	✓		✓					✓			
Duarte et al., 2017			✓		✓	✓				✓			
Herridge et al., 2003			✓	✓		✓				✓	✓	✓	
Herridge et al., 2011			✓	✓								✓	✓
Hoyois et al., 2021	✓	✓	✓		✓		✓	✓	✓				
Jubina et al., 2024	✓		✓	✓		✓		✓					
Kvale et al., 2003			✓		✓						✓		
Novak et al., 2021	✓		✓	✓		✓		✓					
Rives-Lange et al., 2021	✓	✓	✓		✓		✓	✓		✓			
Rousseau et al., 2022	✓	✓	✓		✓		✓	✓		✓		✓	
Thackeray et al., 2022	✓						✓					✓	
Whitehead et al., 2022	✓	✓			✓		✓			✓			

Abbreviations: BMI: body mass index (kg/m^2); ICU: intensive care unit.

Fig. 2. Anthropometric data collection timepoints.

addition to financial and insurance constraints preventing survivors from seeking rehabilitation services after hospital discharge [44–48].

Lack of education on the role of nutrition in critical illness recovery, both during and after hospitalization, served as a major systems-related barrier to nutritional recovery. Participants reported a significant gap in post-discharge nutrition monitoring, follow-up, and care in addition to nutritional rehabilitation strategies being largely absent from recovery plans [45–48]. Survivors felt they received inadequate nutritional advice at and after hospital discharge, resulting in a lack of awareness of the importance of nutrition in critical illness recovery, their increased calorie and protein needs, or strategies to meet these needs [45,46]. Merriweather et al. (2016) reported that these “inter-related system breakdowns during the nutritional recovery process” were the primary influencers of patients’ eating experiences after critical illness [45]. Infact, a large majority of respondents did not see a dietitian after hospital discharge [46,47], and felt that other multidisciplinary healthcare professionals had a lack of nutrition knowledge specific to ICU survivors which negatively impacted their nutritional recovery experience [45,46].

3.2.2. Facilitators of dietary intake and nutritional recovery

Availability and expansion of nutrition support and services after hospital discharge were identified as a primary facilitator of dietary intake and nutritional recovery among survivors of critical illness. Survivors reported nutrition screening, counseling, and support after hospital discharge to be essential for recovery, and expressed a desire to receive these services along with appropriate community resources and access to supportive healthcare personnel [43,44,47].

There was consensus among critical illness survivors and post-ICU healthcare personnel on the need for an interdisciplinary approach to recovery, inclusive of RDs, with tailored interventions to combat PICS [48,49]. Respondents believed that a more comprehensive, patient-centered follow-up service model with target-specific rehabilitative strategies and interventions has the potential to improve long-term recovery outcomes and patient satisfaction [48,49]. There was also an identified need for rehabilitation healthcare team members to engage in professional development outside their immediate scope of practice to increase the understanding of interdisciplinary strategies to target PICS and critical illness recovery [44,48,49]. Furthermore, survivors felt more investigation was needed into optimal post-ICU recovery interventions and financial resources for patients [48,49].

4. Discussion

This review adds to a growing body of literature emphasizing the need for the prioritization of nutrition care after hospital discharge for survivors of critical illness. ICU survivors experience a multitude of nutritional changes during recovery, including changes in body composition, increased energy and protein requirements and poor nutritional status. These individuals struggle to regain the weight lost during critical illness and meet the heightened nutritional needs required to facilitate recovery after hospital discharge, resulting in prolonged high rates of malnutrition. In addition, they face numerous barriers to nutritional recovery including the persistent functional and physiological effects of critical illness, as well as a lack of nutrition education, support, and services following discharge.

A 1999 landmark clinical review was among the first publications to provide a comprehensive exploration into critical illness recovery [55]. Dr. Richard Griffiths, a pioneer in the field of post-ICU rehabilitation, described numerous long-term effects of critical illness that may persist for years throughout the recovery trajectory, including both what the healthcare field now recognizes as PICS as well as nutrition-specific impairments such as weight loss and poor nutritional status. A key element in his recommended care guide was a minimum of 6 months of follow-up after hospital discharge by medical, dietetic, psychological, and rehabilitation health professionals. Despite these findings, standardized multidisciplinary monitoring and follow-up care structures for ICU survivors are largely absent in global healthcare systems 25 years later.

There is consensus among experts in the fields of critical care, rehabilitation, and dietetics that nutrition care is an underrecognized rehabilitative strategy with the potential to reduce the risk and severity of PICS and improve long-term health outcomes for survivors of critical illness due to the bidirectional relationships between various elements of nutrition (e.g. dietary intake adequacy, nutritional status, body composition) and PICS impairments (i.e. functional, cognitive, and psychological status) [13,20,21,56,57]. However, prior reviews of the literature largely include nutrition research both in the ICU and on the acute ward, preventing the adequate characterization of nutritional indices and barriers to nutritional recovery unique to the post-hospitalization period. This knowledge is crucial for the identification and development of feasible and efficacious nutrition interventions during critical illness recovery.

The present review highlights future opportunities for research and clinical care that can aid in the facilitation of nutritional recovery for critical illness survivors. Current evidence on increased energy and/or protein intake in critically ill patients both during and after an ICU stay is weak and scrutinized by emerging prospective data [58,59]. This however does not detract from the poor nutritional intake following hospital discharge which requires further characterization and investigation into the impact on long-term recovery outcomes. At this time, no known clinical trials have been conducted leveraging nutrition interventions with PICS as the primary outcome. Post-ICU clinical trials to date utilizing nutrition interventions were predominantly delivered on the acute ward and discontinued at hospital discharge [60–62]. The identification of feasible and preferred nutrition intervention characteristics must be a research priority, followed by high-quality, adequately powered randomized controlled trials testing the effectiveness of such interventions after hospital discharge. Standardized nutrition-related outcome measures should be prioritized, including indicators of PICS and quality of life. Researchers can refer to recent outcomes-centered literature for recommended subjective and objective outcome measures to include [3,19,63,64].

The expansion of nutrition support and services availability and affordability is a key area for attention in clinical care. A patient-centered rehabilitative services model should be utilized to provide standardized referral pathways with individualized interdisciplinary care targeting the prevention and treatment of PICS. Nutrition care and MNT as a recovery strategy cannot be maximally effective against PICS when delivered in solidarity, thus should be combined with close monitoring and follow-up from a variety of medical, rehabilitative, and allied health professionals.

This review has several strengths. A large number of studies were included with a variety of outcomes, expanding the understanding of the nutritional characteristics and experiences of adult ICU survivors. Many studies had large sample sizes and diverse populations, enhancing generalizability of findings to a wider range of critical illness survivors. Additionally, both quantitative and qualitative studies were included, offering a comprehensive and dynamic perspective into the nutritional recovery period. Such multi-method results can be considered in conjunction with one another, which is crucial given the interplay between many aspects of nutrition and recovery.

Like all narrative reviews, there were limitations in the methodology and results. The heterogeneity of outcome measures reported and data collection methods across studies prevented a systematic analysis of data. The lack of timing standardization for data collection, including at admission and/or discharge and at various post-discharge time points, made it difficult to tell a clear story of the nutritional recovery timeline. Several studies had small sample sizes, reflective of recruitment and retention challenges commonly experienced in post-ICU research. Additionally, reporting bias was observed in that multiple studies did not report all relevant data collected. There was also significant geographic variability, which may impact availability and affordability of post-discharge nutrition services in global healthcare systems.

5. Conclusion

Adult survivors of critical illness face a long and complex road to recovery. After hospital discharge, survivors struggle to return to their base line nutritional status, seldom meet their calorie and protein needs, and face numerous barriers to achieving nutritional recovery which can persist for years after their illness. Future research efforts should target the comprehensive characterization of the nutritional recovery experience, explore the associations between nutritional variables and PICS, and identify and develop effective nutrition interventions to improve long-term outcomes for survivors of critical illness after hospital discharge.

Author statement

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