

Non-Surgical Interventions for Hospitalized Adults with Class II or Class III Obesity: A Scoping Review

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Abstract: Adult inpatients with Class II or III obesity and comorbidities have a high health burden with frequent hospitalizations. Surgical risk and patient choice can be contraindications to bariatric surgery, which is considered the gold standard treatment. The best approach to non-surgical management for this adult inpatient group is currently unknown. The aim of this scoping review was to summarize current research in the inpatient setting. The unpublished literature and six electronic database searches identified 4,582 articles, with 12 articles (reporting on 10 studies) eligible and included. The literature on the interventions and their key components in the non-surgical care of the adult inpatient with Class II or III obesity were mapped identifying service provision successes and gaps. The articles reported on intensive lifestyle interventions, comparison of oxygen administration regimes, total parenteral nutrition regimens, and pre-surgical rapid weight loss. Study designs included evaluation (n=1), before–after intervention studies (n=3), and randomized/non-randomized controlled trials (n=6). The classification of obesity as a chronic disease is not universal resulting in reduced inpatient treatment options. Recommendations for consumers, practitioner practice, health policy-makers and future research priorities are reported. Further research in the development of cost-effective inpatient models of care is indicated.

Keywords: patient care, acute care, obesity, rehabilitation, hospitalized, review

Introduction

The World Health Organization (WHO) defines obesity as a body mass index (BMI) greater than or equal to 30 kilograms per metre squared (kg/m^2).¹ Classes II ($\text{BMI} \geq 35\text{--}39 \text{ kg}/\text{m}^2$) and III ($\text{BMI} \geq 40 \text{ kg}/\text{m}^2$) obesity are considered clinically severe and/or morbid obesity.^{2,3} Obesity is an escalating public health problem. Globally, obesity rates have tripled since 1975, with 13% of adults (over 18 years of age) in 2016 (6.5 million people) considered to have obesity, with the WHO reporting 2.8 million global deaths annually directly attributed to obesity.⁴

In the United States of America (USA) and Australia, 50% of adults have at least one chronic condition and 23–26% have two of more.^{5–7} In Australia, 45% of the arthritis and 53% of the diabetes burden is attributed to patients diagnosed with overweight or obesity, with Indigenous Australian adults 1.6-times more likely to be have obesity than non-Indigenous Australians.⁸ If the obesity trends continue at the current rate, the predicted direct and indirect costs for Australia's healthcare will be \$87.7 billion by 2025.⁹

The most common obesity-related comorbidities are cardiovascular disease, Type II diabetes mellitus (T2DM), insulin resistance, dyslipidemia, hypertension, cholelithiasis, gastroesophageal reflux disease, osteoarthritis, asthma/respiratory disease, and some cancers.^{4,10,11} A Spanish primary care cross-sectional study (n=40,010) demonstrated the degree of obesity increased the risk of co-morbidity, for example there was a 33% increase in the odds of having asthma in Class I obesity [OR (95% CI) =1.33 (1.17–1.50)] and a 75% increase in Class III obesity [OR (95% CI)=1.75 (1.34–2.29)].¹²

Bariatric surgery is a treatment option which is considered the gold standard for the management of patients with Classes II and III obesity.¹³ However, surgical management of adults with obesity and severe co-morbidities is often contraindicated in patients with some medical, intellectual, psychiatric, behavioral, or social conditions if their surgical/anesthetic risk is too high or they are unable to comply with the ongoing follow-up protocol.^{5,14–17} Patients also report a reluctance to undergo surgery. In a mixed-method survey of 105 adults with obesity¹⁸ only 33% of patients were interested in bariatric surgery and 16.2% had “mixed feelings” concerning surgery. The 50.5% not interested cited surgery risks (69.1%) and potential side-effects (57.1%) as barriers.¹⁸ Intensive lifestyle inpatient programs have demonstrated improved quality-of-life^{19,20} and greater weight loss²⁰ at 1¹⁹ to 2²¹ years with age, weight loss at 12 weeks, baseline mental health quality-of-life, and occupational status identified as predictors of weight loss at 1 year.²⁰

Patients with Class II or III obesity experience a higher healthcare burden secondary to higher 30-day hospital readmission rates, nosocomial infection management, and increased risk of clinical failure on discharge.^{22–26} Halilovic et al²² retrospectively evaluated the medical records of 106 hospitalized patients with cellulitis and/or subcutaneous abscess. They identified BMI ≥ 40 kg/m² (OR=4.10, $P=0.002$) as an independent risk factor for readmission.²² In a comparison study²⁵ of two groups (n=2,045) of surgical patients (aged 65–80 years) undergoing hip and knee surgery, colectomy, or thoracotomy surgeries across 47 hospitals, patients with obesity (mean BMI 40 kg/m²) had greater odds of renal dysfunction: OR (odds ratio)=2.05 (95% CI=1.39–3.05), wound infection: OR=1.64 (1.21–2.21), urinary tract infection: OR=1.55 (1.24–1.94), respiratory events: OR=1.44 (1.19–1.75), and hypotension: OR=1.38 (1.07–1.80). Additionally the 30-day readmission risk was greater: OR=1.38 (1.08–1.77), as was length of

stay and costs compared with patients without obesity, (BMI=20–30 kg/m²).²⁵

Patients with obesity report embarrassment associated with hospital admission, describing their experiences as undignified and discriminatory.^{27–29} Poor attitudes of health professionals toward patients with obesity can result in less than optimal care.^{27,30} Reports of negative experiences and poorer outcomes are also supported by others using various methodologies.^{27–29,31}

In 2014–2015 in Hunter New England Area Health Service in Australia, readmission rates within 28 days for patients over 50 years with Class II or III obesity and comorbidities requiring acute care was 37% (unpublished data). Additionally failure of patients to attend follow-up appointments and/or continue with their care plan post-discharge was highlighted by staff. Staff and patients’ expressed dissatisfaction with the system, evidencing the inefficiency and issues in the current practice.

Obesity is classified as a chronic disease by WHO, the European and North American Medical Associations, The Obesity Society, and the UK Royal College of Physicians.^{29,32–36} The Australian Government Department of Health and the Australian Medical Association, however, both consider obesity as a lifestyle condition, with related chronic diseases, rather than as an identified chronic disease.^{7,35,37} Opie et al³⁵ highlight the disadvantage this creates for Australians with obesity, as they are excluded from multidisciplinary structured and funded care plans that are available to patients with a designated chronic disease classification.³⁵

The increasing health burden of Classes II and III obesity is a global phenomenon, which some health services have yet to address. Porter et al.^{38,39} studied obesity within the older population and called for further research in this area.³⁹ The guidelines for the non-surgical assessment and management of patients with Class II or III obesity are designed for the primary care setting. Therefore, the best approach to management for adults admitted to hospital with Class II or III obesity and comorbidities is not known.

Aim

The aim of this scoping review was to therefore map the current literature relating to interventions (and their features and formats) that specifically target the care of the adult inpatient with Class II or III obesity.

Methods

We conducted a scoping review using the framework of Peters et al.⁴⁰ The review protocol is included in the online [supplementary information](#).

Search Strategy

A search of the Cochrane Library, the Johanna Briggs Institute databases, and Medline for systematic reviews of inpatient interventions for the non-surgical management of the adult inpatient with Classes II or III obesity with or without comorbidity was conducted and did not identify any current systematic reviews on this topic. The search strategy aimed to find both published and unpublished studies from 1990–2019 (27 December) written in English. The early date in the range was selected due to the advances in treatment for obesity from this time with advances in pharmacological interventions and the development of national guidelines in several countries.^{41–44}

The databases searched included:

MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily (Ovid); CINAHL (EBSCO); EMBASE (Ovid); PsychInfo (Ovid); Cochrane Library; and Scopus. [Figure 1](#) details the search terms used.

The search for unpublished studies included:

Mednar; Clinical Trials Registry (clinical-trials.gov); Theses from Australian Digital Theses Program and Dissertation and Abstracts and ProQuest; Australian NH&MRC Guidelines, American Guidelines, New Zealand Guidelines, PROSPERO, Australian Policy online and Open Grey. A secondary search of the reference lists of all included studies was undertaken to identify further potentially relevant studies.

Identification of the Research Questions

The Population-Intervention-Comparison-Outcome-Study (PICO)⁴⁵ method was used to identify the following research questions.

What are the non-surgical interventions used in inpatient settings for the care of the adult patient with Class II or III obesity?

What are the features of these interventions?

What is the format of these interventions?

What outcomes are measured within these interventions?

Eligibility

Studies which recruited adults (18 years of age or older) with Class II or III obesity receiving a non-surgical

intervention in an inpatient setting were included. Quantitative, qualitative studies, systematic reviews including meta-analysis, and meta-synthesis were included. Studies with combined inpatient/outpatient settings and or non-surgical/surgical interventions were included if the results of the non-surgical inpatient components of the study were reported separately.

Data Extraction from the Included Studies

Data were extracted using an excel spreadsheet/data extraction tool and included specific details about the publication details, country, year, populations, comorbidities, concept, and context, study design, intervention, features, formats, findings, and outcomes. Initial data were extracted by MR and independently reviewed with further data extracted by NDV. Both authors then confirmed the data extraction. The interventions features and formats included the type of intervention, profession of intervention facilitator, intervention components, key outcomes of interest, and findings. Any disagreements between these two reviewers were resolved through consensus without the need for a third reviewer.

Results

Citation Retrieval

PRISMA flow chart⁴⁶ ([Figure 2](#)) describes the study selection process from identification to inclusion.

Study Country and Dissemination ([Table 1](#))

The included 12 articles^{47–58} reported on 10 studies published between 1997 and 2019 (October) with four articles^{47–49,53} reporting on two studies ([Table 1](#)).

Study Designs, Settings, and Interventions ([Tables 1](#) and [2](#))

The study designs included randomized (n=2)/non-randomized controlled trials (n=4)^{47–49,52–54,57,58} (n=6 involving eight articles), evaluation⁵⁶ (n=1), and before–after intervention studies^{50,51,55} (n=3). Settings for six studies^{51,52,54–56,58} were inpatient only, while four studies^{47–50,53,57} combined inpatient and community settings with repeat readmissions to the inpatient setting. Total length of stay for the inpatient setting ranged from 1.3⁵⁷ to 17⁴⁷ weeks for nine of the ten studies.^{47,49–51,53–55,57,58} Intensive lifestyle interventions,^{47–50,53,55,57,58} were used in six studies. The implementation of an inpatient intervention using a very

#	Searches	Results
1	exp Obesity/	205369
2	obes*.tw.	285724
3	1 or 2	334669
4	Inpatients/	20810
5	patient care/ or "episode of care"/ or exp hospitalization/	241343
6	acute care.mp.	20969
7	Rehabilitation/	18027
8	4 or 5 or 6 or 7	289594
9	Bariatrics/	267
10	3 or 9	334716
11	Chronic Disease/	259033
12	exp Diabetes Mellitus/	414528
13	exp apnea/ or hyperventilation/ or alkalosis, respiratory/	47482
14	Heart Diseases/	68391
15	Hypertension/	230624
16	Insulin Resistance/	55292
17	Dyslipidemias/ or Hyperlipidemias/ or Cardiovascular Diseases/ or Coronary Disease/	300155
Unique Identifier	29435811	
Title	Comparative Outcomes of Bariatric Surgery in Patients with Impaired Mobility and Ambulatory Population.	Gastroesophageal Reflux/ 25514
Source	Obesity Surgery. 28(7):2014-2024, 2018 07.	

Figure 1 Medline Search.

low calorie diet (VLCD) for rapid weight loss prior to surgery to reduce the anesthetic/surgical risk,^{51,56} and acute medical interventions (a comparison of high flow and titrated oxygen therapy regimes⁵² and a comparison of isonitrogenic and hypoenergetic total parenteral nutrition (TPN))⁵⁴ were used in two studies each (Table 1). The comparison of oxygen regimen study had an intervention period of 2.5 hours,⁵² while four studies^{47–50,53,57} had follow-up periods from 10

days⁵⁷ to 5 years.^{47,48} Follow-up post-discharge from the inpatient stay was absent in six studies.^{51,–52,–54–56,58}

Sample sizes of the studies ranged from six⁵¹ to 259,⁵⁸ with dropout rates ranging from 0%^{55,56,58} to 46%⁴⁸ at 5-year follow-up. Mean (SD) age of participants ranged from 28.5 (7.2)⁵⁰ to ≥ 60 years.^{56,58} Mean (SD) BMI of the studies ranged from 36 (5)⁵⁴ to 64.3 (2.1).⁵¹ Obesity treatment was the primary reason for admission in eight articles,^{47–51,53,56,57}

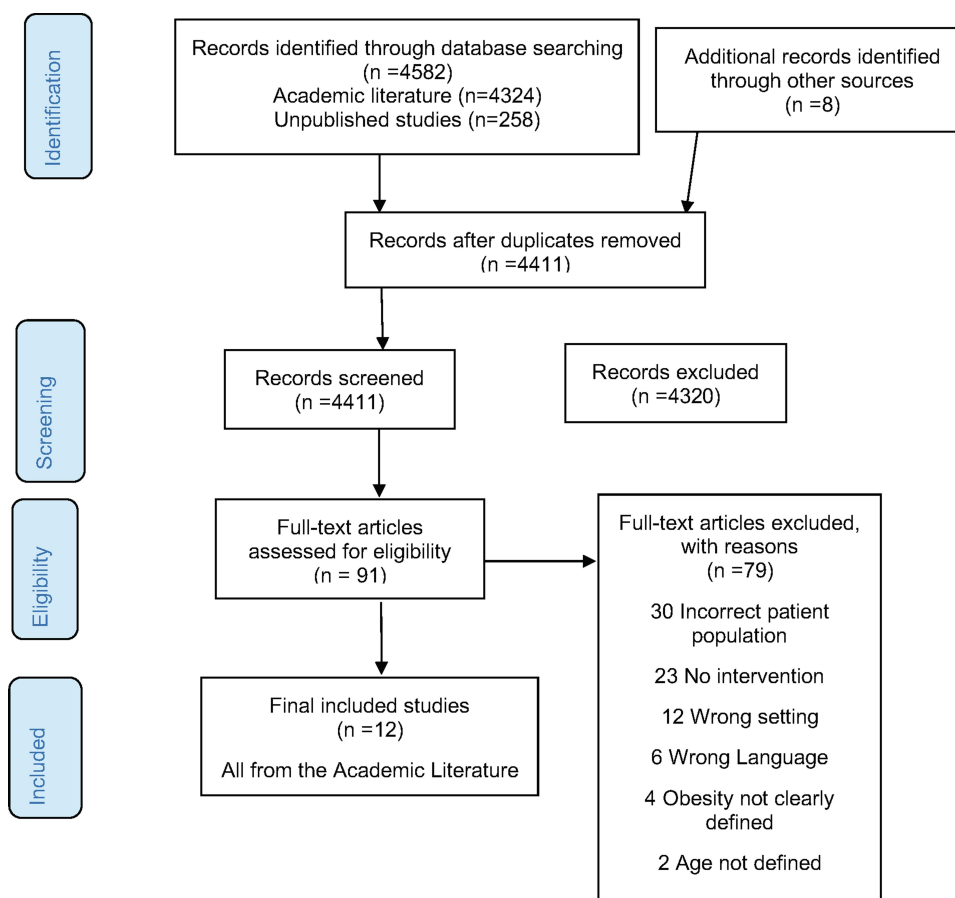


Figure 2 PRISMA flow chart⁴⁶ showing citation process.

Note: PRISMA figure adapted from Moher D, Liberati A, Tetzlaff J, Altman D. Preferred reporting items for systematic reviews and meta analysis: the PRISMA statement. *PLoS Med.* 2009;6(7):e1000097.

rehabilitation for two articles,^{55,58} and acute care for two articles,^{52,54} (including cellulitis,⁵² asthma,⁵² respiratory infection,⁵² cancer,⁵⁴ pancreatic disease,⁵⁴ trauma,⁵⁴ and gastrointestinal disorders⁵⁴) (Table 2).

Profession of the Intervention Facilitator (Table 3)

The clinical profession/professions of the person/s delivering the interventions was clearly defined in five studies,^{47,49,54,55,58} partially reported in two studies^{50,51} and not reported in three studies.^{52,56,57} Medical officers,^{47,49–51,54,55,58} nurses,^{47,49,54} physiotherapists,^{47,49,50,54,55,58} dietitians, or nutritionists,^{47,49–51,53,55,58} and psychologists^{47,49–51,53,55,58} were the disciplines who most frequently delivered interventions. Other disciplines reported were exercise physiologists,^{49,55} a pharmacist,⁵⁴ a chef, and a social worker,⁴⁷ with one study reporting clinical staff.⁵⁷

Description of Intervention Features and Formats

The four studies without an intensive lifestyle intervention^{51,52,54,56} and four of the studies with an intensive lifestyle intervention^{47,48,55,57,58} had structured interventions, while two of the intensive lifestyle intervention studies included elements of patient self-directed flexibility/choice within their interventions.^{49,50,53}

Commonalities within the six intensive inpatient lifestyle intervention studies included combinations and variations of individual and group assessment and education sessions from medical officers, dietitians/nutritionists, physiotherapist/exercise physiologists, and psychologists.^{47–50,53,55,57,58}

Interventions for the Acutely Ill Patient

Only two of the studies aimed to improve management regimens of the acutely ill patient.^{52,54} Pilcher et al⁵²

Table 1 Overview of Eligible Articles

Author	Year	Country	Study Design	Type of Publication	Intervention
Serafim et al ⁵⁶	2019	Brazil	Evaluation	Journal Article	Nutritional Intervention
Budui, et al ⁵⁸	2019	Italy	Non-randomised intervention comparative study	Journal Article	Intensive lifestyle intervention
Giordano, et al ⁵⁵	2017	Italy	Pre and post intervention study	Journal Article	Intensive lifestyle intervention
Pilcher, et al ⁵²	2017	New Zealand	Randomized cross-over trial	Journal Article	Medical Intervention
Danielsen, et al ⁴⁹	2013	Norway	Clinical Control Trial	Journal Article	Intensive lifestyle intervention
Martins, et al ⁴⁷	2010	Norway	Non-randomized intervention comparative study	Journal Article	Intensive lifestyle intervention
Øvrebø, et al ⁴⁸ (Martins, et al study)	2017	Norway	Longitudinal Outcome of	Journal Article	Intensive lifestyle intervention
Mæhlum, et al ⁵³ (Danielsen et al study)	2010	Norway	Clinical controlled trial	Journal Article	Intensive lifestyle intervention
Huerta, et al ⁵¹	2009	USA	Pre and post intervention study	Journal Article	Intensive lifestyle intervention
Saldamacchia, et al ⁵⁷	2008	Italy	Non-randomized controlled trial	Letter to the Editor	Intensive lifestyle intervention
Maffiuletti, et al ⁵⁰	2005	France	Longitudinal clinical pre-post intervention study	Journal Article	Intensive lifestyle intervention
Choban, et al ⁵⁴	1997	USA	Randomized, prospective, double-blind, controlled trial	Journal Article	Medical Intervention

compared high flow oxygen delivery to titrated oxygen in patients without a pre-diagnosed obesity hypoventilation diagnosis, while Choban et al⁵⁴ (in 1997) trialed hypoe-nergetic TPN compared to isonitrogenic TPN in acutely ill patients in the intensive care unit with the rationale that hypoe-nergetic TPN would prevent overfeeding and reduce the rate of nosocomial infection.

Physical Activity Interventions

A physical activity intervention component was included in five of the ten studies,^{47–49,53,55,57,58} with frequency of sessions ranging from once weekly,^{49,53,57} twice weekly,^{47,55,58} to more than twice weekly.⁵³ The duration of each session was from 30 minutes,⁵¹ to 45 minutes,⁴⁹ and 60 minutes.^{47,53,55} Activities included walking,⁴⁹ aquatic,⁵¹ aerobic and gym exercises, including cycling and weights.^{50,55,58} Activity and education sessions were held face-to-face^{47,55,58} and included practical sessions.^{47,49,51,55,58} The aim of the physical activity inter-vention was to improve the inpatient's knowledge, skills in physical activity, and function, resulting in the individual continuing this behavioral change on discharge.^{47,49,53,55,57,58}

Dietary/Nutritional Interventions

A dietary intervention component was included within nine of the ten studies.^{47,49–51,53–58} The content of the diet in Martins et al⁴⁷ study was not described. Saldamacchia et al⁵⁷ reported limited dietary details (800 kcal/day for 3 months, 1,100 kcal/day for 3 months, and then 1,400 kcal/day for 6 months). Maffiuletti et al⁵⁰ reported the most detail related to the dietary intervention, including kcal/day intake, salt, macronutrient, and fluid intake. Low calorie (below 1,900 kcal/day) and very low calorie diets (between 600–900 kcal/day were used in seven of the studies,^{49–51,53,55,57,58} with one using a very low calorie diet⁵¹ as a liquid meal replacement. Very low calorie diets (VLCD) were used in five studies.^{51,55–58} Diets between 1,200–1,900 kcal/day^{49,50,53,55} were reported in three studies. The macronutrient composition of the diets was described in five studies, ranging from 20–21% protein, 50–60% carbo-hydrate, and 20–30% fat.^{49,50,53,55,56,58} Diets individualized to the patient by calculating individual basal metabolic rates and tailoring total daily energy targets accordingly were used in four studies.^{50,53,55,58} Huerta et al⁵¹ used a VLCD (liquid) providing 891 kcal/day using a nutritional supplement,

Table 2 Characteristics of Eligible Articles

Author	Sample Size Enrolled	Sample Size Completed (Drop-out)	Mean Age (SD)	Mean BMI (SD)	Inpatient Setting only	Inpatient/ Outpatient Setting	Reason for Admission	Inpatient LOS (Weeks)	Follow up (Years)
Serafim, et al ⁵⁶	120	0	92% ≤60years	53.7 (0.39)	Yes	No	Obesity treatment	1	0
Budui, et al ⁵⁸	259	0	48.2 (11.5) 69.3 (3.5)	43.9 (4.2)	Yes	No	Rehabilitation program	3	0
Giordano, et al ⁵⁵	136	136	52.7 (13.3)	43.2	Yes	No	Rehabilitation program	3	0
Pilcher, et al ⁵²	24	22 (8%)	53.5 (16.1)	50.4	Yes	No	Acute care- Cellulitis (6) Asthma (7) Respiratory Infection (2) Other (7)	0 ^g	0
Danielsen, et al ⁴⁹	139	104 (25%)	45.2 (9.5) ^a 38.4 (9.8) ^b	42.6 (5.2)	No	Yes	Obesity treatment	12	1
Martins, et al ⁴⁷	94	83 (12%)	42 (9.8) ^c 38.4 (10.1) ^d	45.4 (5.6)	No	Yes	Obesity treatment	15-17	5
Øvrebø, et al ⁴⁸ (Martins, et al study)	95	44 (46%)	42 (9.8) ^c 38.4 (10.1) ^d	45.3 (5.5) 45.5 (5.7) ^c	No	Yes	Obesity treatment	15-17	5
Mæhlum, et al ⁵³ (Danielsen et al study)	166	108 (36%)	42.1 (10.6)	45.7 (8.6)	No	Yes	Obesity treatment	16	1
Huerta, et al ⁵¹	6	5 (17%)	54.7 (2.6) ^a 51.2 (0.9) ^b	64.3 (2.1)	Yes	No	Obesity treatment	10	0
Saldamacchia, et al ⁵⁷	7	7	49 (9)	-	No	Yes	Obesity treatment	1.3	.027 ^h
Maffioletti, et al ⁵⁰	70	64 (9%)	30.9 (7.1) ^e 28.5 (7.2) ^f	41.3 (4.3)	No	Yes	Obesity treatment	3	1
Choban, et al ⁵⁴	30	30	52 (19) 52 (15)	36 (5)	Yes	No	Acute Care -Cancer (11) Pancreatic disease (10) Trauma (1) Gastrointestinal issue (5)	2	0

Notes: ^aIntervention; ^bControl/comparator; ^cResidential intermittent program; ^dWeight loss camp; ^eFemale; ^fMale; ^gIntervention 2.5 hours; ^hFollow-up 10 days.

Abbreviations: SD, standard deviation; LOS, length of stay.

additional protein powder (83.7 gm/day) and multivitamin supplements. Serafim et al⁵⁶ reported use of a 600 kcal/day VLCD with a similar macronutrient composition. Both studies^{51,56} aimed for rapid weight loss to reduce anesthetic/surgery risks prior to the patient undergoing bariatric surgery. The aims of the other seven studies were to educate and upskill patients, enabling them to make healthier food choices following discharge.^{47,49,50,53,55,57,58} Choban et al⁵⁴ used a hypoenergetic TPN formula providing 5,416±1,250 kilojoules/day, to isonitrogenic TPN 8,107±828² kilojoules/

day, with non-protein energy 3,407±944 kilojoules/day, to isonitrogenic TPN 6,308±685² kilojoules/day, and 120±27 grams protein/day, compared to 108±14 grams protein/day.

Interventions were delivered in a group only format in four studies,^{47,53,54,56} an individual patient format in one study,⁵⁷ while four studies used a combination of group and individual intervention delivery.^{49-51,55,58} Frequency of intervention delivery was daily in five studies.^{50,53,55,57,58} In six studies nutrition interventions were provided in a structured format with only the

Table 3 Profession/Discipline Intervention Delivered by

Authors	Medical Officer	Nurse	Physiotherapist	Exercise Physiologist	Dietitian / Nutritionist	Psychologist	Other
Serafim, et al ⁵⁶	-	-	-	-	-	-	-
Budui, et al ⁵⁸	Yes	No	Yes	Yes	Yes	Yes	No
Giordano, et al ⁵⁵	Yes	No	Yes	Yes	Yes	Yes	No
Pilcher, et al ⁵²	-	-	-	-	-	-	-
Danielsen, et al ⁴⁹	Yes	Yes	Yes	Yes	Yes	Yes	No
Martins, et al ⁴⁷	Yes	Yes	Yes	No	Yes	Yes	Yes ^a
Mæhlum, et al ⁵³ (Danielsen et al study)	-	-	-	-	Yes	Yes	No
Huerta, et al ⁵¹	Yes	-	-	-	Yes	Yes	No ^b
Saldamacchia, et al ⁵⁷	-	-	-	-	-	-	-
Maffioletti, et al ⁵⁰	Yes	-	Yes	No	Yes	Yes	No
Choban, et al ⁵⁴	Yes	Yes	No	No	No	No	Yes ^c
Øvrebø, et al ⁴⁸ (Martins, et al study)	Yes	Yes	Yes	No	Yes	Yes	Yes ^a

Notes: –, Not Reported; ^aSocial Worker and Chef; ^bCalled Staff; ^cPharmacist.

Danielsen et al⁴⁹ study having a patient choice component with patients selecting a buffet breakfast and lunch and snacks as part of provision of the diet. Interventions were delivered face-to-face with a theoretical education component in six studies^{47,49,50,53,55,57,58} and a practical skills component in four studies.^{47,49,50,53}

Psychological Interventions

A psychological intervention was included in five studies.^{47,49,50,53,55,58} A combined format of group and individual sessions were identified in four of these studies,^{47,53,55,58} while the Danielsen et al⁴⁹ study used an individualized inpatient format. Patients were screened for psychiatric and eating disorders prior to enrolment in four studies.^{47–49,53,55,58} Frequency of the delivery of the patient intervention varied with individual sessions ranging from, twice to three times per week,⁵⁰ to weekly,^{55,58} second weekly,⁴⁷ and in one study on an ad hoc basis.^{49,53} The group sessions were held twice weekly,^{55,58} weekly,⁴⁷ and second weekly.⁴⁹ Duration of the sessions was poorly reported by most studies.^{47,48,53,55,58} However, Maffioletti et al⁵⁰ reported sessions to be 60 minutes in their study. All sessions

were structured and face-to-face, with Martins et al⁴⁷ the only study to report a practical component to the psychology sessions. The aim of the psychological interventions were to increase the patient's awareness of their eating behavior, increasing their ability to identify and manage their eating behavior, equipping them with an understanding of their needs for a lasting behavioral change required to ensure weight loss maintenance.^{47,49,53,55,58} The most commonly reported theoretical framework utilized for these interventions was Cognitive Behavioral Therapy,^{47,50,55,58} while two studies^{55,58} also utilized Prochaska and Clemente's trans-theoretical model and wheel of change.

Key Study Outcomes of Interest (Table 4)

Weight was the most common outcome measure and was included in eight of the 10 studies.^{47–51,53,55–58} Measurement of cardiovascular risk factors,^{47–50,55,58} symptoms of type II diabetes mellitus,^{47–49,51,55,58} physical activity change^{47–50,55,58} and psychological factors^{47,49,51,55,58} were included in five studies, with body composition^{47–49,51,53,55,56,58} recorded in six. Nutrition-related outcomes from comparison of TPN,⁵⁴ education on eating behaviors, food selection, and portion

Table 4 Key Outcomes of Interest

Author	CVR Factors	Physical Activity	Nutrition	Psychological	Medical ^a	DM 2	Weight	Body Composition	Other
Serafim, et al ⁵⁶	No	No	No	No	Yes	No	Yes	Yes	Yes ^b
Budui, et al ⁵⁸	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Giordano, et al ⁵⁵	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Pilcher, et al ⁵²	No	No	No	No	Yes	No	No	No	No
Danielsen, et al ⁴⁹	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Martins, et al ⁴⁷	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Mæhlum, et al ⁵³ (Danielsen et al study)	No	Yes	Yes	Yes	No	No	No	No	No
Huerta, et al ⁵¹	No	No	No	No	Yes	Yes	Yes	Yes	Yes ^b
Saldamacchia, et al ⁵⁷	No	No	No	No	No	No	Yes	No	No
Maffioletti, et al ⁵⁰	Yes	Yes	Yes	No	No	No	Yes	No	No
Choban, et al ⁵⁴	No	No	Yes	No	No	No	No	No	No
Øvrebø, et al ⁴⁸ (Martins, et al study)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Notes: ^aMedical – Includes outcome from medical intervention of acute or chronic illness, eg, medication management/titration; ^bReduction in anesthetic/surgical risk.

sizes were included in five studies,^{49,50,53,55,58} while diet related outcomes of resultant weight change were reported in eight studies.^{47–51,53,55–58} The efficacy of high flow oxygen administration (determined by P_{tcO₂} at 60 minutes) comparison to titrated oxygen was the outcome of interest in the Pilcher et al⁵² study. Improvement in patients' overall chronic diseases evidenced by reduced medication dosages were reported in four studies.^{47–49,51,52}

Funding Sources

Sources of funding were reported in five studies.^{47,50,52,54,58} Public health organizations funded two studies,^{47,54} a private research institute funded two,^{50,58} and one was funded by a public research council.⁵² Patient payments or reimbursements were not reported in any studies, one study reported the requirement for patients to take leave from work to attend the program.^{49,53}

Discussion

This scoping review highlights significant knowledge gaps regarding effective approaches for the management of adults hospitalized with Classes II or III obesity, with or without comorbidities who are unsuitable for surgery. The small number of studies, and very limited number of RCTs

identified emphasized the paucity of literature related to non-surgical interventions studies targeting improved identification and holistic management of this inpatient group.

In contrast there has been a strong focus in the literature on surgical interventions and strategies, including pre- and post-surgical care,^{60,61} management of complications,⁶¹ and reducing surgical risk; with 10 studies identified (only two were eligible for inclusion) targeting pre-surgical rapid weight loss.^{51,56}

Of the studies that included structured intensive lifestyle inpatient programs, two studies^{49,50,53} incorporated some patient choice aimed at improving decision-making related to healthy choices to improve sustainability at home. In a mixed methods study within a community setting, Stead et al⁶² explored why some patients were better at making lifestyle change than others. Of the 148 participants in their study,⁶² a subgroup of 24 completed qualitative interviews. These interviews highlighted that lower levels of patient engagement due to physical and mental health problems resulted in lower weight loss. They suggest that in order to achieve successful patient outcomes vital program components must include holistic patient centered interventions that addressed patients' individual physical and mental health barriers to engagement.

Our review suggests this is not the case and should be considered in the design of future interventions.

Semlitsch et al's⁶³ 2019 review of evidence-based practice guidelines for the management of obesity within high income countries identified key recommendations including; obesity being managed as a chronic disease, BMI recorded as a standard measurement, intensive lifestyle program duration of at least 6–12 months with interventions addressing behavioral changes, reduced total energy intake, and increased physical activity. They proposed that optimal follow-up of outcomes should be between 1–5 years and may need to continue indefinitely.⁶³ Of the six intensive lifestyle studies included in this review^{47–50,53,55,57,58} only one met all the above recommendations,^{47,48} while two studies met six out of the seven recommendations,^{49,50,53} one study met five recommendations,⁵⁷ and two studies met three.^{55,58} Weimann et al 2019⁵⁹ emphasized the importance of psychological support (for patients seeking the non-surgical approach) including 57 hours of cognitive-behavioral therapy (3.5 hours more than their exercise intervention and 13.5 more hours than their nutritional intervention) within a non-surgical intensive lifestyle community intervention. None of the intensive lifestyle interventions^{47–50,53,55,57,58} or the rapid weight loss intervention prior to surgery^{51,56} included pharmacological interventions. The absence of studies including pharmacological interventions suggest a gap in treatment options within the inpatient setting. These results highlight that whilst recommendations are available they have not been universally tested in intervention studies. RCTs testing these approaches are needed to ascertain their efficacy and cost-effectiveness both for the patient and health services.

The complexity of care for this population group may require recognition of Classes II and III obesity as a chronic disease and patient diagnosis, assessment, and management of obesity performed within the same framework as other chronic diseases such as respiratory, cardiovascular disease, or diabetes. Caterson et al²⁹ conducted an online survey across 11 countries (including Australia) of patients with obesity (n=14,502) and healthcare professionals (n=2,785), and reported that 68% of patients and 88% of healthcare professionals identified obesity as a chronic disease. However a significant barrier for the patient accessing care is the lack of communication and a disconnect between patients with obesity and their healthcare professionals, with neither group initiating discussion of obesity as a health issue within the same

context as they would for other chronic diseases.^{29,64,65}

When compared with outpatient groups, the inpatient groups and inpatient intermittent readmission studies, conducted within countries where Class II and III obesity are recognized as a chronic disease, achieved statistically significant improvements in health outcomes.^{47–49} Sarcopenic obesity is a challenge for the older adult with Class II or III obesity however, Budui et al⁵⁸ reported weight loss in this older age group participants (>65 years) with a reduction of frailty. Further research into the economic and health impacts of a models of care with combinations of age appropriate inpatient interventions followed by the intermittent residential lifestyle modification interventions with long-term follow-up for patients on the non-surgical pathway is indicated by the studies in this review.^{47–51,53,55–58}

The majority of studies included in this review were from countries where obesity is considered a chronic disease (Norway, Italy, France, and the USA)^{47–51,53,55,57,58} There appears to be a disparity in the approaches to assessment and management of the patients with Class II or III obesity in these countries compared to countries that consider it a lifestyle condition. Norway, for example, offers obesity inpatient and outpatient clinics within its four health regions, and regional hospitals offer non-surgical and surgical interventions.⁵³ This is in contrast to Australia, where obesity is considered a lifestyle condition, and the majority of services for adult patients with Class II or III obesity are in the primary healthcare and private sector at a cost to the patient.⁴³ Government funding is available in Australia for management of the common comorbidities that are associated with this level of obesity including cardiovascular disease, T2DM, and respiratory disease, but not for obesity assessment and management itself.⁶⁶

The literature reports inadequate identification, diagnosis and treatment of overweight and obesity,⁶⁷ unclear safe medication dosages,⁶⁸ including disagreement on kidney function estimates for dosages and ongoing challenges to effective obesity care⁶⁹ for this acute inpatient group. On admission to a hospital a patient's weight is considered as part of medication management and malnutrition screening and assessment. Within this review weight was a key outcome measure in six studies (reported in seven articles).^{47–49,51,55,56,58} However, these aspects of medical evaluation are commonly missed in the patient with Class II or III obesity.^{70,71} Unless a patient's weight immediately affects the management of their acute illness it is often not

considered an important factor within their management care plan.^{71,72} Smoking and alcohol⁷³ usage are routinely assessed on admission and interventions implemented; however, weight is not considered in the context of the same behaviours.⁷¹ Given the consequences of obesity rivaling health issues such as smoking and excessive alcohol usage the health professionals' holistic assessment of the patients care needs is incomplete without nutrition and weight related health assessments. A valuable opportunity to engage patients in education and self-management of obesity is missed.⁷¹ With studies showing patients with BMI >40 kg/m² or a history of weight loss surgery have lower quality diets⁷⁴ and nutrition knowledge gaps⁷⁵ it is of concern that inpatient nutrition programs, healthy weight education, and appropriate interventions for achieving this are not always part of the inpatients' program.⁷¹ Simple inpatient interventions such as increased flexibility within the range and availability of foods, menus, and patient choices could assist with healthy eating interventions.⁷⁶ A systematic review of barriers to the identification, assessment, and holistic treatment of the acute and subacute inpatient with Class II or III obesity is indicated.

For sustained health benefits patients with Class II or III obesity require engagement in accessible programs with skilled multidisciplinary teams multifactorial intensive and long-term management and monitoring in a similar manner to other chronic diseases.⁶³ The limited number of studies identified for this review highlight that there is currently a gap in non-surgical inpatient options for these patients outside Norway^{47–49,53} and Italy^{50,55,57,58} and demonstrates an under-researched area, particularly when contrasted with the prevalence of inpatients with Class II or III obesity. With adult inpatients with Class II or III obesity and their associated chronicity increasing in numbers a longer term view of their care within a chronic disease model is required. To overcome the evidence gaps clinicians need to partner with others and their patients locally, nationally and internationally to develop and test chronic disease interventions and models of care for this patient group for economic and healthcare efficacy.

Strengths and Limitations

A major strength of the current review is that it highlights the international variation in assessment, treatments, and outcomes for this patient group and the paucity of high quality research in this area. We also note some limitations, including the small number of studies identified for inclusion, the small sample sizes within these studies, and the lack of longitudinal

data which limits definitive conclusions being drawn from the data. However, that was not the aim of this scoping review. As a scoping review, the quality of the studies is also not assessed, limiting generalization of results. This review also has additional strengths, as it represents studies conducted globally and importantly identifies research gaps that should be addressed for this vulnerable population.

Conclusions

Considering the global health impact of living with Class II or III obesity, including hospital admission/readmission rates, and evidence that not all patients with Class II or III obesity are eligible or willing to undertake a surgical treatment pathway, it is surprising there are so few studies published related to clinical care and treatment in this population group to date. This scoping review highlights that research, clinical practice, health service funding, and support are mainly focused around the surgical and primary healthcare interventions. Future research evaluating person centered models of care are required for this vulnerable population.

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