ORIGINAL RESEARCH

Nutritional Adequacy of Macro- and Micronutrient Intake in UK Adults Using Glucagon-Like Peptide-1 Receptor Agonists: A Cross-Sectional Questionnaire and Dietary Assessment Study

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Abstract

Background: GLP-1 receptor agonists (GLP-1 RAs) are prescribed for type 2 diabetes, weight management and cardiovascular risk reduction in individuals where a BMI of 27 kg/m² or more is accompanied by comorbidities. The appetite suppressing effect of this class of medications may compromise nutritional adequacy. Evidence on dietary intake in GLP-1 RA users remains limited, with no studies published on UK population to date. This is the first UK focused cross-sectional observational study to assess macro- and micronutrient intake in UK adults using GLP-1 RAs and compare findings against UK DRVs.

Methods: The study was conducted among adult GLP-1 RA users (n=38, mean age 51.6 ± 8.2 years; 86.8% female). The participants completed a questionnaire on anthropometric data and GLP-1 usage. They also recorded 3-day food diaries using INTAKE24, an online tool. Nutrient intakes were analysed against UK DRVs.

Results: Mean daily energy intake was 1,337 ± 475 kcal/day. 89.5% of participants did not meet their estimated average requirement (EAR). All participants (100%) fell below the fibre DRV of 30 g/day, with a mean intake of 14.5 ± 4.9 g/day. Nearly half (44.7%) fell short of the protein EAR of 0.75 g/kg/day. Widespread micronutrient inadequacy was observed. Vitamin D, potassium and selenium showed the most severe deficit, with greater than 90% of participants below the RNI. 81.6% were below the RNI for iron and 78.9% for magnesium. Although 73.7% of participants reported taking supplements, supplementation appeared largely unsupervised, with fewer than 10% under professional nutritional guidance.

Conclusions: UK adults using GLP-1 RAs demonstrate widespread shortfalls across both macro- and micronutrients relative to UK DRVs and energy intake. While supplementation partially addressed some deficits, its use was largely ad hoc. These findings highlight the need for structured, evidence-based nutritional support to be integrated into GLP-1 RA prescribing pathways in the UK.

1. Introduction

1.1 Background. Glucagon-like peptide – 1 (GLP-1) is an incretin hormone secreted by L-cells in the distal ileum and colon (Holst, 2007). It signals the pancreatic β-cells to release insulin when blood glucose levels are high leading to lowering of blood glucose levels without causing hypoglycaemia (Baggio & Drucker, 2007). It also acts on the pancreatic α-cells, suppressing glucagon release at higher blood glucose levels thus inhibiting hepatic glucose output (Hare et al., 2010). GLP-1 slows gastric emptying through a signalling mechanism via the vagal nerve which in turn promotes satiety (Brierley & Lartigue, 2021). Furthermore, it acts to lower cravings for high calorie and high sugar foods by reducing dopamine reward driven eating (Badulescu et al., 2024).

GLP-1 receptor agonists (GLP-1 RAs) are synthetic versions of the GLP-1 hormone and were originally developed to treat Type-2 diabetes (T2D) (Meier, 2012). The advantage of GLP-1 RAs over insulin is that

they lower blood glucose in a glucose dependent manner by stimulating insulin secretion and suppressing glucagon only when blood glucose is elevated thus lowering the risk of hypoglycaemia (Nauck & Meier, 2018). They leverage the body's normal biological incretin system to manage T2D safely (Drucker & Nauck, 2006).

During early clinical trials researchers noticed that people on GLP-1 RAs ate less, had reduced food cravings and naturally moved away from high-fat and high-sugar foods (Blundell et al., 2017, Flint et al., 1998). Many lost significant weight. Overall, clinical trials have shown an average body weight reduction of 15%(Wilding et al., 2021).

This class of drugs has also shown promising results in cardiovascular disease, kidney disease and neurodegenerative diseases (Nauck & Quast, 2021). Given their potential, there has been a rapid increase in their usage and this trend is likely to continue (Chao et al, 2022). UK prescriptions for GLP-1 RAs rose sharply by 88% between 2021 and 2024, reaching approximately 1.7 million (Ibrahim & Orayj, 2024).

1.2 Nutrient adequacy and risk of malnutrition. With growing use, there is growing concern regarding the impact on dietary intake and nutrient adequacy due to GLP-1 RAs' effects at the gastrointestinal level (Mozaffarian et al., 2025). There is a risk of nutritional inadequacy due to reduced food intake resulting from lower appetite and early satiety (Astrup, 2024). This risk is higher for users who experience gastrointestinal side effects common to GLP-RAs such as nausea, vomiting and diarrhoea (Almandoz et al., 2024). Delayed gastric emptying may impact absorption of certain micronutrients such as iron and vitamin B12 that depend on adequate gastric acid exposure and efficient gastrointestinal transit time (Amjad, 2021). The change in food preferences away from fatty foods (Blundell et al., 2017) may lead to lower fat-soluble vitamin absorption (Hofmann & Borgström, 1962). Many GLP-1 RAs users may also move away from higher protein and higher- fibre meals as these feel harder to digest while preferring ultra processed easier to digest food items (Johnson et al., 2025).

In the UK people who qualify for GLP-1 RAs treatment under NHS criteria may already have nutrient deficiencies due to poor diet quality and lifestyle factors like inactivity, stress and irregular eating patterns (Astrup & Bügel, 2019). These people may be more vulnerable to higher risk of worsening deficiencies (O'Kane et al., 2025).

1.3 Lean mass loss and body composition changes. Weight loss achieved through dietary restriction, bariatric surgery or GLP-1 RAs use involves both fat and lean tissue (Heymsfield, 2014; Linge et al., 2024). A systematic review and network meta-analysis on GLP-1 RA users found that approximately 25% of the total weight lost during treatment was attributable to a reduction in lean body mass (Karakasis et al., 2025). This lean mass loss may be exacerbated by the reduced protein intake observed in GLP-1 RA users, given that adequate protein alongside micronutrients such as vitamin D and calcium, which support skeletal muscle function are important considerations during caloric restriction (Roth et al., 2022). Similar patterns have been observed in studies involving bariatric surgery (Voican et al., 2022). STEP1 (Wilding et al., 2022) and SUSTAIN (McCrimmon et al., 2020) trials involving GLP-1 RAs use have shown that two fifths of the weight loss was lean tissue. In summary magnitude of calorie restriction which determines the rapidity of weight loss rather than the method of weight loss is a key determinant of change in body composition (Ashtary-Larky et al., 2020). A high dosage of GLP-1 RAs after the initial titration phase can lead to faster weight loss thus raising concerns on decline in muscle mass, strength and function although Linge et al. (2024) found that muscle loss may hinder long-term weight maintenance, as reduced muscle mass can negatively impact metabolic rate and energy balancet (Turicchi et al., 2020).

1.4 Comprehensive diet and lifestyle support in GLP-1 therapy. To address the above concerns, it is important to have evidence based nutritional guidance for individuals on GLP-1 RAs. Current recommendations are geared towards addressing gastrointestinal side effects rather than nutrient adequacy and supporting body composition. A further concern is the absence of routine monitoring of

micronutrient deficiencies in clinical practice for preventative care for GLP-1 RAs users. The rapid growth in GLP-1 RAs use has outpaced development of evidence-based diet and lifestyle frameworks.

1.5 Research Gap. A pubmed search revealed significant research on weight loss efficacy, glycaemic outcomes as well as emerging therapeutic benefits but evidence on their nutritional implications remains limited. These studies have measured dietary intake via single-day ad libitum test meals rather than validated 3-day food diaries or 24hr-recalls. Multiple studies have analysed food cravings and emotional eating and concluded that GLP-1 RAs reduce cravings for savoury, dairy and starchy foods but these studies did not look at how it affected the nutrient intake (Van der klaauw et al., 2022; Christensen et al., 2024).

Only one study based in the US used a 3-day food diary for data collection and it found that users of GLP-1 RAs fell short of US Dietary Reference Intake (DRI) levels for fibre and key micronutrients including vitamin D, calcium, iron, magnesium, potassium (Johnson et al., 2025) as well as insufficient intake of protein to preserve lean body mass during weight loss (Johnson et al., 2025). Another recent US based observational study using patient-level claims data reported a higher incidence of nutritional deficiencies in adults with T2D using GLP-1 RAs (Butsch et al., 2025). Due to the lack of studies, results from research on patients that underwent bariatric surgery have been used to gain an understanding of potential deficiencies which is not ideal (Mechanick et al., 2017). A recent narrative review by Christensen et al., (2024) has highlighted this research deficit and concluded that more observational studies are needed to develop evidence-based standards of care to prevent nutritional shortfalls.

1.6 Value of research. The study aims to assess the macro- and micronutrient intake of GLP-1 RA users and evaluate adequacy against UK dietary reference values (DRVs). Given cross-sectional design, it can find associations but not causations. (Mann, 2003). Nonetheless, the comparison with UK DRVs can provide a basis for evidence-based protocols for nutrition therapists to support patients using GLP-1 RAs. This could help prevent nutritional deficiencies and improve patient outcomes by identifying nutrients at high risk of insufficiency in a rapidly growing user population. It can also provide a base for further research to explore how nutritional implications may vary by age, gender and comorbidities of patients.

The findings on protein intake could help guide protein content in nutrition plans alongside lifestyle interventions to prevent lean muscle mass loss. To the author's knowledge, protein intake in UK-based GLP-1 RA users has not been previously reported. As modelling estimates a mean daily energy intake of up to 1200 Cal/day (Hall, 2024), the quality of diet becomes more important and insights from this study can help nutritionists in addressing this concern.

1.7 Research Question. Using a cross-sectional questionnaire design the present study will examine the typical macro and micronutrient intakes of individuals using GLP-1 receptor agonist medications and compare these to UK Dietary Reference Values.

Using the PICO model (Richardson et al., 1995) the population (P) was defined as adults aged 19 to 64 years using GLP-1 RA medications. The intervention (I) was the use of these medications for at least one month. The nutritional intake of each participant was compared (C) against UK DRVs. The outcome (O) was the identification and analysis of macronutrient and micronutrient shortfalls.

2. Methods

2.1 Participants and Sampling. Voluntary response sampling under a purposive framework (Stratton, 2023) was used to recruit participants from online communities predominantly via Facebook and WhatsApp groups. Attempts to recruit participants using various general practitioner (GP) and pharmacy networks in the local area of the researcher were unsuccessful. The Facebook group GLP-1 Nutrition was selected as the main channel as it had approximately 100,000 members and they were already engaged in discussions on nutrition and GLP-1 therapy. This provided a large, accessible pool of potential participants. This pragmatic sampling approach was used in the absence of a central registry of GLP-1 medication users. Although no financial incentives or funding were provided, participants were offered a 15-minute nutrition education session on successful completion of the survey.

To be included in the study, participants had to be UK residents aged 19 to 64 and have at least one month of experience with GLP-1 receptor agonist medications, such as tirzepatide or semaglutide. The study excluded anyone who was pregnant or breastfeeding, as well as those with a history of bariatric surgery or a diagnosed eating disorder. Anybody participating in a structured dietary intervention or prescribed meal plan were also excluded. Pregnancy and lactation can skew the responses due to change in normal eating patterns due to food aversions, cravings or symptoms (Orloff & Hormes, 2014). In individuals who have undergone bariatric surgery, it would be difficult to attribute any dietary changes to GLP-1 RA use (Amouyal & Andreelli, 2016). Given the relatively small sample size, including individuals with eating disorders can introduce significant systematic error (Schebendach et al., 2012).

For this study a minimum of 50 participants was aimed for. Out of the 67 individuals who showed initial interest, 50 participants completed the online questionnaire. Of these, 38 participants completed the 3-day dietary assessment. Attrition between questionnaire completion and dietary assessment completion is common in studies requiring detailed food recording and was anticipated during study design (Shim et al., 2014). A 15-minute nutrition education session was offered to prevent high dropout rates during the demanding 3-day food diary phase, thereby protecting the final sample size.

Only participants with complete dietary intake data were included in the nutrient intake analysis, while questionnaire data from all 50 participants were retained for descriptive analyses relating to demographics, medication use, appetite changes, gastrointestinal (GI) symptoms, and supplement use.

The final dietary analysis sample size was considered sufficient to meet the exploratory aims of the study. While the study fell short of the 50-participant target requested by the Ethics Committee, the 38 respondents exceed the $n \geq 30$ threshold where the Central Limit Theorem typically applies, improving the accuracy of the population mean estimates and the reliability of 95% confidence intervals (Chang et al., 2006).

A power analysis with n=38 assuming a standard significance level α of 0.05 for a one sample two-sided t-test achieved 85% power for medium effect size (d=0.5) and 99% power for large effect size (d= 0.8) (Cohen, 1992). Therefore, the study has sufficient power to detect medium-to-large effects (Norman et al., 2003) and is appropriate for identifying significant nutrient shortfalls which are the primary focus of the research.

2.2 Questionnaire design Participants were asked to fill out an online questionnaire using Microsoft forms. Microsoft Forms was selected due to its accessibility, ease of use, secure data handling, and ability to export anonymised data directly into spreadsheet format for analysis (Mondal et al., 2018). Questions were framed to enable standardised responses wherever possible to reduce respondent burden and facilitate quantitative analysis. Question formats included multiple-choice items, Likert-scale responses, categorical response options and some open-ended questions. It should be noted that no validated questionnaire was identified for this population.

The questionnaire collected information across

- Demographic and anthropometric characteristics
- GLP-1 medication type, dosage, and duration of use
- Changes in appetite, meal frequency, and portion size
- GI symptoms associated with medication use
- Use of dietary supplements
- Access to professional health or nutrition support

A 3-day food diary was chosen over food frequency questionnaire (FFQ) or 24 h recall. FFQ have shown weak associations with dietary biomarkers (Geelen et al., 2015). The 3-day food diary has been found to have better absolute errors as well as lesser proportion of missing foods when compared to single 24 h recall and FFQ (Crawford et al., 1994).

Participants were asked to record a food diary over 2 weekdays and a weekend day to better capture typical dietary variation across the week. Participants used INTAKE24, a validated self-completed online dietary

recall system based on multiple-pass 24-hour recall, to record everything consumed over the previous 24 h (from waking up to when they go to sleep). INTAKE24 has been evaluated against interviewer led recall and found to give very close matches (Bradley et al., 2016). INTAKE24 has much lower participant burden when compared to traditional gold standard dietary assessment methods like weighed food records (Foster et al., 2019). Despite this reduced burden, there was significant attrition of participants from the questionnaire stage to the 3-day food diary stage.

2.3 Data Analysis. The null hypothesis (Gigerenzer, 2004) was that no significant difference exists between the dietary intake of GLP-1 users and the UK DRVs. The alternative hypothesis (Gigerenzer, 2004) was that GLP-1 users have significantly lower intakes of key nutrients relative to recommended levels, suggesting a potential risk of nutritional inadequacy. In this study, the independent variables are the use of GLP-1 RAs, including type, dosage, and duration of use. The dependent variables are the nutrient intake levels (both macro- and micronutrients). A further set of independent variables are dietary behaviours such as appetite, meal frequency, portion size, and reported GI symptoms.

INTAKE24 application was used to calculate macro and micronutrient intake across three days. This data along with all the responses from the questionnaire filled by participants using Microsoft forms was downloaded in a comma-separated values (CSV) format. Excel software was used to calculate the mean, 95% confidence intervals, median and standard deviation for all micro and macronutrients. Percentage of participants below DRV was calculated. Categorical data (e.g. GI symptoms, dosage, duration) was analysed using frequency counts. Data was then further analysed for relationship between the categorical variables and continuous variables (shortfalls/excesses).

2.4 Ethical Considerations and Research Integrity. Ethical approval for the study was granted by the Institute for Optimum Nutrition Research (ION) Ethics Committee prior to data collection. The study adhered to ethical principles outlined by ION, the University of Portsmouth, and the UK Research Integrity Office, including respect for autonomy, beneficence, and data protection.

This research fell under class 1: research involving human participants with minimal risk. Participant risks were considered minimal but included potential psychological discomfort during food recording (Macdiarmid & Blundell, 1998). In accordance with the principles of good research practice, the research was carried out with care, honesty, and transparency, (Resnik, 2020). No conflicts of interest are declared. No funding or incentives were received. The author maintains no affiliation with any pharmaceutical companies or supplement manufacturers.

Participation in this study was voluntary and anonymous. Participants were provided with a digital Participant Information Sheet outlining the purpose of the study, data handling procedures involved, researcher consent details and their rights as participants. Informed consent was obtained electronically during the completion of the questionnaire and before recording of the 3-day food diary. Participants were informed they could withdraw at any point before submitting their responses. Care was taken to avoid any leading language or assumptions in the questions in the questionnaire.

All data was handled in accordance with UK General Data Protection Regulation (GDPR) (Data Protection Act 2018) requirements. Although the questionnaire did not have any fields for personal information, the data collection inadvertently gathered potential identifiable information due to some respondents filling in their names. Data was cleaned, anonymised, securely stored, and used solely for the purposes of this research project. To ensure security, all data was stored on a password-protected, encrypted, secure cloud drive (OneDrive) made available by ION. Email addresses that were used to send the initial email to respondents will be deleted immediately after submission of this report.

3. Results

3.1. Participants. After excluding non-responders, 38 participants who submitted at least one day of dietary recording were included in the final nutrient intake analysis. Data robustness was high; nearly 90% (n = 34) of these successfully completed the full 3-day protocol, with only a small minority (n = 4) completing one or two days. Baseline participant demographic, anthropometric and clinical characteristics of this final cohort are summarised in Table 3.1.

Table 3.1. Participant Characteristics (Dietary Analysis Sample, n = 38)

Variable	Value
Sample size (n)	38
Age (years), mean ± SD	51.6 ± 8.2
Weight (kg), mean ± SD	85.8 ± 22.5
BMI (kg/m²), mean ± SD	30.9 ± 7.4
Duration of GLP-1 use (months), median (IQR) [range]	8.0 (4–12) [1–45]
Sex, n (%)	
Female	33 (86.8%)
Male	5 (13.2%)
Ethnicity, n (%)	
White	32 (84.2%)
Other ethnic backgrounds	6 (15.8%)
Reason for prescription, n (%)	
Weight management / obesity	32 (84.2%)
Weight management and type 2 diabetes	2 (5.3%)
Type 2 diabetes / cardiometabolic	2 (5.3%)
Other medical condition	1 (2.6%)
No data	1 (2.6%)

BMI calculated from self-reported height and weight. IQR = interquartile range (Q1–Q3). Range = minimum–maximum.
White ethnicity includes: White – English, Welsh, Scottish, Northern Irish or British (n = 23); White – Any other White background (n = 8); White – Irish (n = 1). Other ethnic backgrounds include: Asian or Asian British – Indian (n = 5); Asian or Asian British – Any other Asian background (n = 1).
Reason for prescription derived from free-text responses and categorised by the researcher. One participant provided no response (No data). Other medical condition = history of severe thyroid issues (n = 1).

The final analytical sample was predominantly female (86.8%, n = 33) and of White ethnicity (84.2%, n = 32), with a mean age of 51.6 ± 8.2 years. Anthropometric data revealed a cohort with high clinical weight status; Mean body weight was 85.8 ± 22.5 kg and mean BMI of 30.9 ± 7.4 kg/m². Notably, despite a median GLP-1 treatment duration of 8.0 months (IQR: 4-12), the average BMI remained within the 'obese' category (≥ 30 kg/m²) at the time of recording. Regarding medication type, Tirzepatide was the most frequently utilised agent (73.7%, n = 28), followed by Semaglutide (23.7%, n = 9) and liraglutide (2.6%, n= 1), with the vast majority of the sample (84.2%) prescribed these medications primarily for weight management.

3.2. Findings

3.2.1 GLP-1 RAs Medication and Symptom Profile. The clinical and pharmacological profile of the study cohort is detailed in Figure 3.1. Tirzepatide was the most frequently used medication (73.7%, n=28), with the remainder of the sample utilising Semaglutide variants or earlier-generation agents like Liraglutide (Figure 3.1 Panel C).

The efficacy of these treatments on appetite suppression was very clear, with 94.8% of participants reporting a decrease in appetite; notably, 71.1% characterised this decrease as "significant" (Figure 3.1,

Panel B). Gastrointestinal (GI) side effects were near-universal within the cohort. Early fullness was the most common symptom, followed closely by constipation (76.3%). More acute GI distress, such as vomiting, was less frequent but still affected 28.9% of the group (Figure 3.1, Panel A).

The data also suggest a high degree of health-conscious behaviour within the group; notably, 73.7% reported using nutritional supplements (Figure 3.1 Panel D). This frequent use of supplements, occurring alongside the high rate of GI symptoms, indicates that many individuals are actively trying to manage both the side effects and the nutritional gaps associated with long-term GLP-1 therapy.

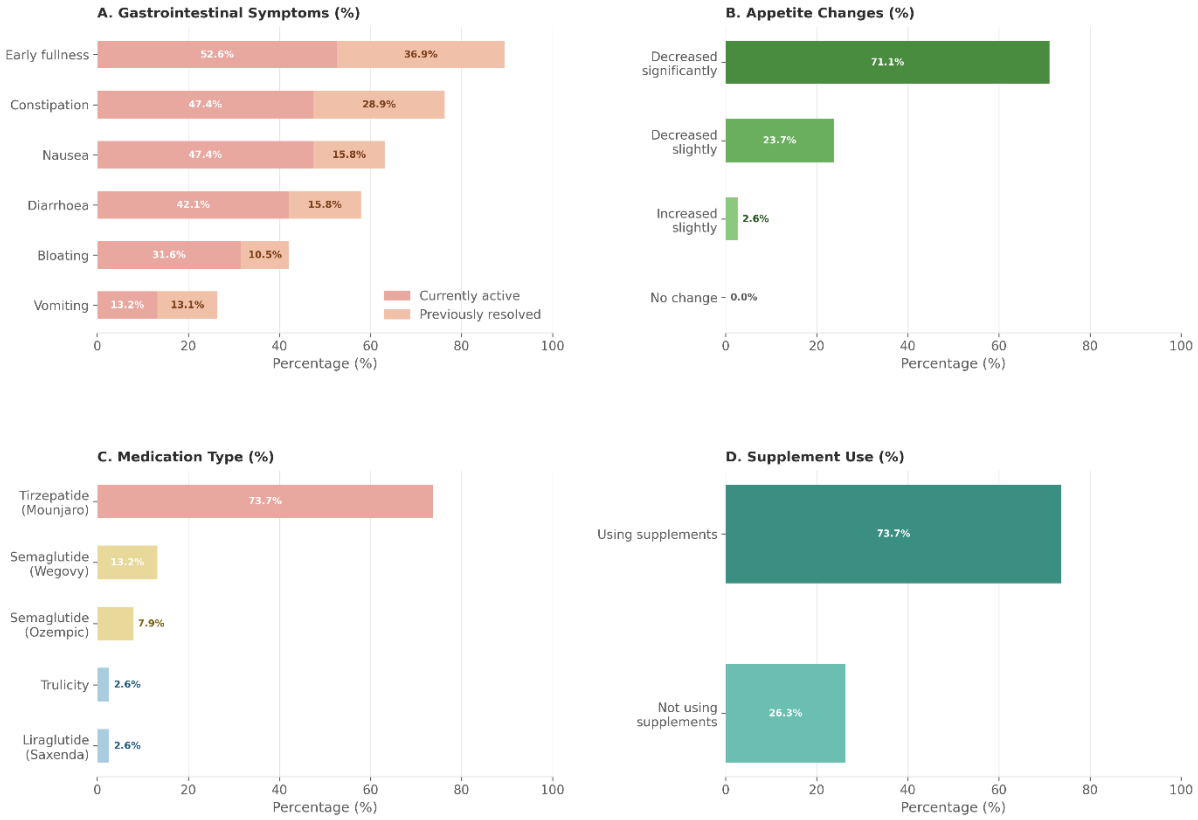


Figure 3.1. Clinical and pharmacological profile of GLP-1 RA users (n = 38). Panel A: gastrointestinal symptom prevalence, categorised as currently active (sometimes, often, or constantly) or previously but resolved. Panel B: reported appetite changes. Panel C: medication type by agonist class. Panel D: nutritional supplement use.

3.2.2. Energy and Macronutrient Intake. Table 3.3 presents energy and macronutrient intake for the study cohort (n=38), with notable deficits observed for key markers, particularly energy and fibre intake, relative to UK DRVs.

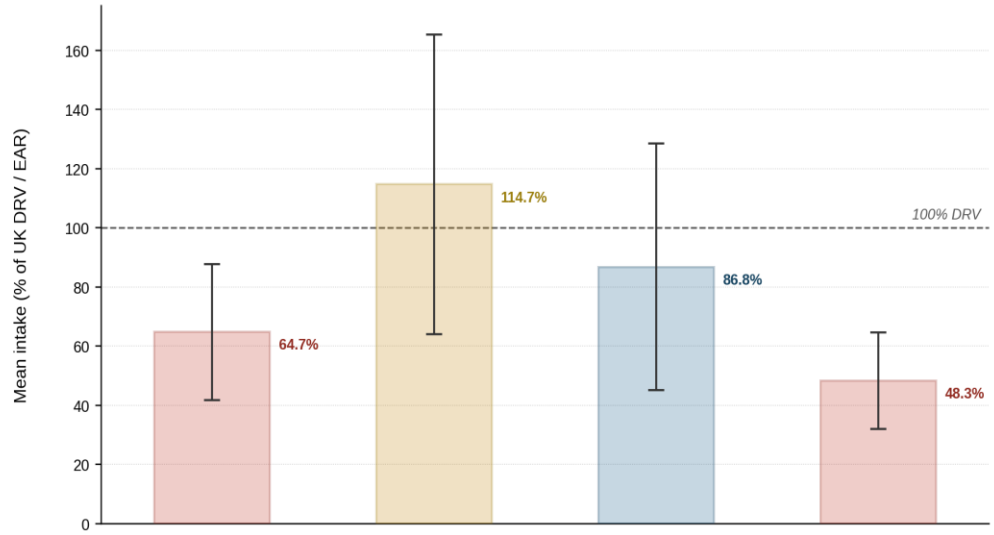
Energy intake showed a profound reduction relative to requirements; mean daily intake was 1,337 ± 475 kcal/day (median: 1,280 kcal; 95% CI: 1,181–1,493). Mean energy intake was 1,473 ± 567 kcal/day for female participants (n=33) and 1,025 ± 523 kcal/day for male participants (n=5), considerably below the Estimated Average Requirement (EAR) of 2,000 kcal/day for women and 2,500 kcal/day for men (SACN, 2011). The low number for male participants should be interpreted with caution due to small sample size. In total, 89.5% of participants did not meet their sex-specific energy EAR (Figure 3.2). This is consistent with the high prevalence of appetite suppression reported in Section 3.2.1, where 94.8% of the cohort reported this as a medication side effect.

While the group mean for protein (0.86 ± 0.38 g/kg/day) exceeded the UK Reference Nutrient Intake (RNI) of 0.75 g/kg/day, nearly half the cohort (44.7%) fell below this threshold (Figure 3.2), reflecting

considerable variability and highlighting the limitations of relying solely on group-level averages to assess dietary adequacy.

Dietary fibre intake, assessed using the AOAC method (Prosky et al., 1985) in line with the UK DRV, was uniformly inadequate across the cohort, with a mean of 14.5 ± 4.9 g/day (median: 13.8; 95% CI: 12.8–16.1), less than half the recommended 30 g/day (SACN, 2015). All participants failed to meet the fibre DRV (Figure 3.2); notably, 76.3% of the cohort reported constipation (Table 3.1 Panel A), a relationship explored further in the Section 4.

As no specific UK DRVs exist for absolute carbohydrate or fat intake, no threshold comparison was made for these macronutrients; however, both values are consistent with the overall pattern of markedly reduced energy intake observed across the sample.



	Energy	Protein	Carbohydrate	Dietary fibre
Mean ± SD	1337 ± 475	0.86 ± 0.38	145 ± 70	14.5 ± 4.9
Median (95% CI)	1280 (1181–1493)	0.85 (0.73–0.98)	142.5 (122–168)	13.8 (12.8–16.1)
UK DRV / EAR	2000(F)/ 2500(M)	0.75 g/kg/day	~167 g/day	30 g/day
% participants below DRV	89.5%	44.7%	—	100%

Figure 3.2. Mean energy, protein, carbohydrate, and dietary fibre intake relative to UK Dietary Reference Values (n = 38). Upper panel: bars show mean intake as a percentage of the UK DRV/EAR with values labelled; error bars represent ±1 SD; dashed line indicates 100% of the DRV/EAR. Lower panel: data table with columns aligned directly beneath corresponding bars, showing mean ± SD, median (95% CI), UK DRV/EAR, and percentage of participants below the DRV for each nutrient. EAR for energy is sex-weighted (n = 33 female, n = 5 male; weighted EAR ≈ 2063 kcal/day). † Carbohydrate DRV defined as ~50% daily energy intake (SACN, 2011); ~167 g/day derived from 50% of cohort mean energy intake (1337 kcal ÷ 4 kcal/g); mean intake represents 87% of this derived reference; individual-level % below DRV not calculable from group-level data. ‡ Fibre assessed using AOAC method, consistent with the UK DRV basis (SACN, 2015); 95% CI = mean ± $t_{0.975}(n-1) \times (SD/\sqrt{n})$. EAR = Estimated Average Requirement; DRV = Dietary Reference Value; CI = Confidence Interval; F = female; M = male.

3.2.3. Micronutrient Intake. Relative to UK Dietary Reference Values (DRVs), including the Reference Nutrient Intake (RNI) and Lower Reference Nutrient Intake (LRNI), the cohort demonstrated widespread inadequacy across the vitamins and minerals assessed, with the majority of nutrients showing more than half of participants falling below the RNI. The LRNI represents the level of intake below the deficiency threshold for most individuals (Department of Health, 1991).

This pattern appears primarily driven by the marked reduction in total energy intake documented in Section 3.2.2, though the considerable variation between nutrients — such as iron (81.6% below RNI) versus Vitamin B12 (10.5% below RNI) — suggests that dietary quality and nutrient density are also important factors. As illustrated in Figure 3.3, a large proportion of nutrients showed high rates of inadequacy, with participants falling not only below the RNI but also below the LRNI for several key micronutrients. Iron showed the most pronounced deficit; mean intake was 7.90 ± 2.69 mg/day (95% CI: 7.01–8.78), with 81.6% of participants not meeting their RNI and 18.4% falling below the LRNI — indicating inadequate intake in most individuals

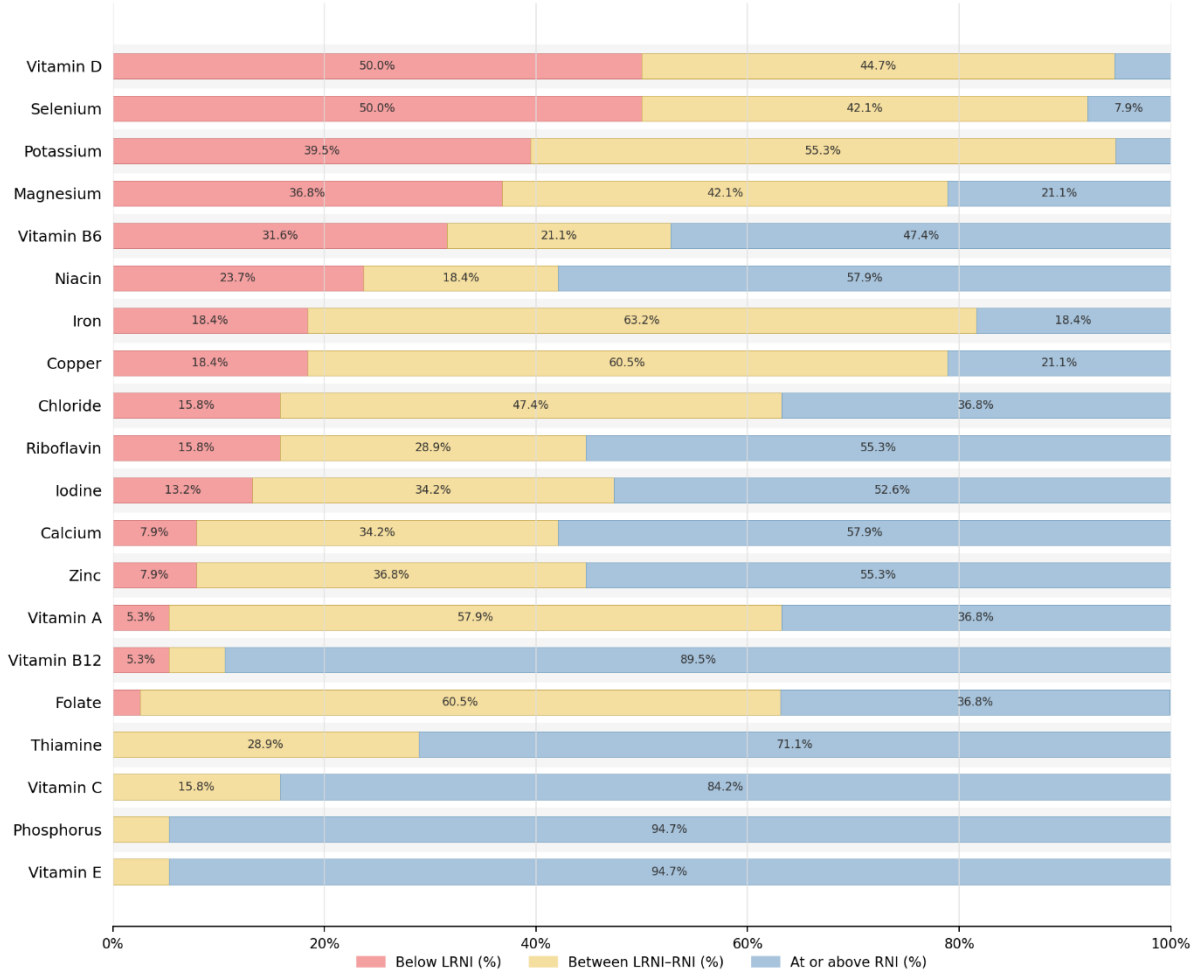


Figure 3.3. Proportion of participants below the LRNI, between the LRNI and RNI, and at or above the RNI for micronutrients with an established LRNI (n = 38). Nutrients ordered by percentage below the LRNI.
LRNI = Lower Reference Nutrient Intake; RNI = Reference Nutrient Intake. Nutrients without an established LRNI (sodium, manganese, biotin, pantothenic acid) are excluded; see Table 3.4 for complete data.

Potassium inadequacy was similarly high, with 94.7% of participants not meeting the RNI and 39.5% falling below the LRNI. Magnesium inadequacy was also marked, with 36.8% falling below the LRNI. In contrast, calcium intake was relatively better preserved, with a mean of 810 ± 357 mg/day (95% CI: 693–928); whilst

Table 3.4. Vitamins and Minerals from Food Only (Supplements Excluded), n=38

Micronutrient	Mean ± SD	Median	95% CI	Male RNI / LRNI	Female RNI / LRNI	% Below RNI	% Below LRNI
Calcium (mg/day)	810 ± 357	742	693 – 928	700 / 400	700 / 400	42.1%	7.9%
Chloride (mg/day)	2352 ± 854	2164	2071 – 2633	2500 / —	2500 / —	68.4%	—
Copper (mg/day)	0.95 ± 0.43	0.88	0.81 – 1.09	1.2 / 0.6	1.2 / 0.6	78.9%	18.4%
Iodine (µg/day)	155 ± 87	145	127 – 184	140 / 70	140 / 70	47.4%	13.2%
Iron (mg/day)	7.90 ± 2.69	7.59	7.01 – 8.78	8.7 / 4.7	‡14.8 / 8.0	81.6%	18.4%
Magnesium (mg/day)	222 ± 65	226	201 – 243	300 / 190	270 / 190	78.9%	36.8%
Manganese (mg/day)	2.38 ± 0.85	2.29	2.10 – 2.66	—	—	—	—
Phosphorus (mg/day)	1102 ± 349	1079	988 – 1217	550 / 400	550 / 400	5.3%	0.0%
Potassium (mg/day)	2282 ± 728	2366	2042 – 2521	3500 / 2000	3500 / 2000	94.7%	39.5%
Selenium (µg/day)	42.2 ± 18.0	41.0	36.2 – 48.1	75 / 40	60 / 40	92.1%	50.0%
Sodium (mg/day)	1422 ± 514	1294	1253 – 1590	1600 / 1600	— / —	65.8%	—
Zinc (mg/day)	7.06 ± 1.97	7.29	6.42 – 7.71	9.5 / 5.5	7.0 / 4.0	44.7%	7.9%
Biotin (µg/day)	34.7 ± 17.0	31.9	29.1 – 40.3	—	—	—	—
Folate (µg/day)	185 ± 66	179	163 – 206	200 / 100	200 / 100	63.2%	2.6%
Niacin (mg/day)	15.1 ± 7.5	15.3	12.6 – 17.5	16.5 / 12.0	13.2 / 8.0	42.1%	23.7%
Pantothenic acid (mg/day)	5.02 ± 1.79	5.12	4.44 – 5.61	—	—	—	—
Riboflavin (mg/day)	1.33 ± 0.54	1.32	1.15 – 1.51	1.3 / 0.8	1.1 / 0.8	44.7%	15.8%
Thiamin (mg/day)	1.07 ± 0.36	1.03	0.96 – 1.19	1.0 / 0.23	0.8 / 0.23	28.9%	0.0%
Vitamin A (µg/day)	592 ± 339	533	480 – 703	700 / 300	600 / 250	63.2%	5.3%
Vitamin B12 (µg/day)	3.76 ± 2.28	3.30	3.02 – 4.51	1.5 / 1.0	1.5 / 1.0	10.5%	5.3%
Vitamin B6 (mg/day)	1.29 ± 0.54	1.26	1.12 – 1.47	1.4 / 1.0	1.2 / 1.0	52.6%	31.6%
Vitamin C (mg/day)	67.7 ± 37.9	65.7	55.2 – 80.1	40 / 40	10 / 10	28.9%	—
Vitamin D (µg/day)	3.42 ± 3.43	2.46	2.29 – 4.54	10 / 2.5	10 / 2.5	94.7%	50.0%
Vitamin E (mg/day)	9.21 ± 3.79	9.49	7.96 – 10.45	4 / 3	3 / 2	5.3%	0.0%

RNI = Reference Nutrient Intake; LRNI = Lower Reference Nutrient Intake. Values are presented as RNI / LRNI. — = no UK Dietary Reference Value established for this nutrient, or no LRNI set.

Source: Department of Health (1991). Dietary Reference Values for Food Energy and Nutrients for the United Kingdom. HMSO. % Below RNI and % Below LRNI calculated using sex-specific thresholds where male and female values differ. 95% CI = 95% confidence interval, calculated as mean ± t(0.975, n−1) × (SD/√n). Fibre intake assessed using AOAC method, consistent with UK DRV basis. ‡Iron RNI/LRNI for age ≤ 50 years; for age > 50 same as male RNI/LRNI

42.1% fell below the RNI of 700 mg/day, only 7.9% fell below the LRNI, suggesting that dairy or fortified plant-based foods remained a consistent component of participants' reduced dietary intake.

Vitamin D intake from food alone was critically low, with a mean of 3.42 ± 3.43 µg/day (95% CI: 2.29–4.54), with 94.7% of participants not meeting the RNI of 10 µg/day and 50.0% falling below the LRNI. Notably, 76.3% of participants reported taking vitamin D supplements, contextualising the extent to which dietary sources alone were insufficient. Folate and vitamin A were below RNI in 63.2% of participants each, whilst vitamin B6 was inadequate in 52.6%. In contrast, vitamin B12 and vitamin E were relatively well met, with only 10.5% and 5.3% of participants respectively falling below their RNIs, and no participant falling below the LRNI for vitamin E.

In summary, the cohort demonstrated a broad pattern of nutritional inadequacy, with markedly reduced energy intake, universal failure to meet the fibre DRV, and widespread deficits across the majority of micronutrients assessed. The high prevalence of GI symptoms, specifically constipation (76.3%), occurred alongside these dietary deficits. Whilst certain nutrients, notably vitamin B12 and vitamin E, were relatively well maintained, iron and vitamin D showed the most severe inadequacy.

4. Discussion

The results of this study showed widespread shortfalls relative to UK DRVs for a number of nutrients as shown in Figure 3.3. The central question in interpreting these findings is whether the shortfall is due to lower food intake or change in preference for certain foods compounded by the lower occurrence of certain food groups in UK dietary patterns. To help answer this, a comparison of results to the nutrient intake in the wider UK population not restricted to GLP-1RA users would be useful. To this end, in this section the shortfalls in the nutrient intake in this cohort are compared against UK population level data from the National Diet and Nutrition Survey (NDNS) 2019 – 2023 as well as the only comparable study by Johnson et al. (2025), though latter was based on a US population.

4.1. Key Findings and the Wider Literature

4.1.1. Energy Intake. The mean daily energy intake of 1,337 ± 475 kcal/day observed fell far short of sex-specific EARs. 89.5% of participants did not meet their sex-specific EARs. Compared to the NDNS adults aged 19–64 reference mean of 1,682 kcal/day (OHID, 2025), the cohort consumed approximately 345 kcal/day less (−20.5%), with a proportional shift in macronutrient composition: protein contributed a greater share of energy (20.6% vs 16.7%), while carbohydrate intake was markedly reduced in absolute terms (145 g/day vs 199 g/day) (Figure 4.1).

This supports the likely appetite suppressing effects of GLP-1 RAs observed in previous studies (Aldawsari et al., 2023). A comparable US study (n=69) by Johnson et al. (2025), using similar 3-day food diary methodology, found a mean intake of 1,748 kcal/day, which is 400 kcal/day higher than in the present study conducted in the UK population. A larger proportion of participants in the present study used tirzepatide, 73.7% versus 33.3% in Johnson et al. (2025). Tirzepatide, a dual Glucose-Dependent Insulinotropic Polypeptide (GIP)/GLP-1 RA, has demonstrated greater appetite suppression and weight loss than GLP-1 mono-agonists in clinical trials (Jodoin et al., 2025). The extent to which the severity of caloric restriction explains the shortfalls in DRVs is explored in the subsequent sections.

4.1.2. Dietary Fibre and Gastrointestinal Symptoms. As illustrated in Figure 4.2, all 38 participants (100%) had a large shortfall in dietary fibre intake versus UK fibre DRV of 30 g/day. Mean intake was 14.5 ± 4.9 g/day — less than half the recommended amount. This finding is consistent with Johnson et al. (2025), who also reported an identical mean fibre intake of 14.5 g/day in their US cohort. Interestingly, findings from a large UK-wide national diet and nutrition survey show a mean fibre intake of 16.4g/day for adults aged 19-64 (OHID, 2025). Similarly, Hoy & Goldman (2014) reported a daily fibre intake of 16g/day for the US

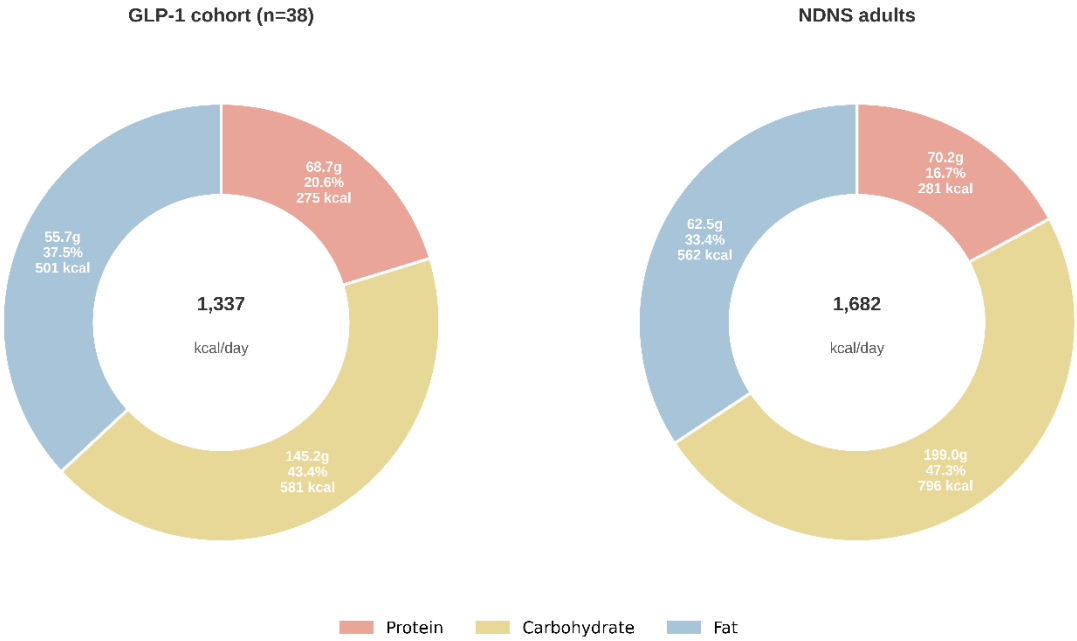


Figure 4.1. Macronutrient energy composition (% energy) of the GLP-1 cohort (n=38) vs NDNS adults aged 19–64 (2019–2023). Values in segments denote mean daily intake in grams.

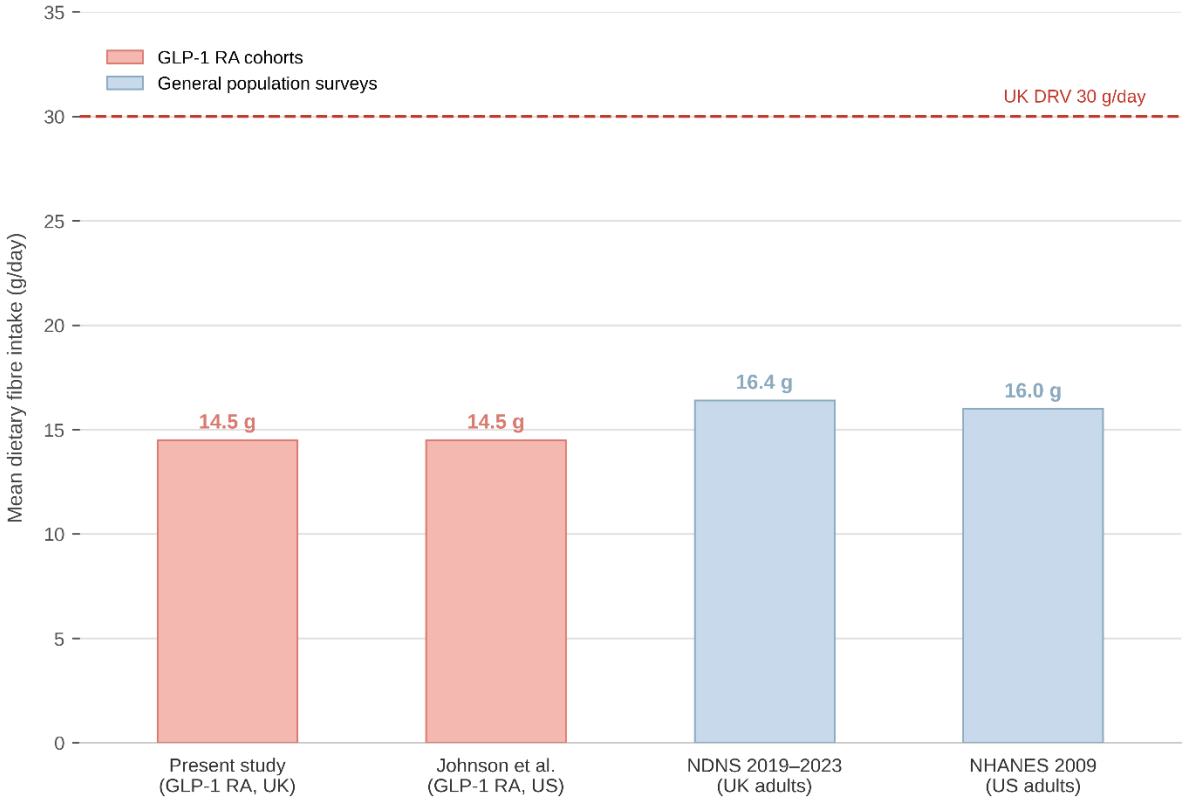


Figure 4.2. Mean dietary fibre intake compared across GLP-1 RA cohorts and national dietary surveys. Dashed line indicates the UK DRV of 30 g/day. Data sources: present study (n=38); Johnson et al. (2025) (n=69); NDNS 2019–2023 (Office for Health Improvement and Disparities, 2025), adults aged 19–64 years; Hoy & Goldman (2014), NHANES 2009. NDNS = National Diet and Nutrition Survey (OHID, 2025). NHANES = National Health and Nutrition Examination Survey. DRV = Dietary Reference Value

population based on National Health and Nutrition Examination Survey (NHANES) 2009. The fibre intake of the GLP-1 cohorts is close to the population mean intake which itself is well short of the DRV of 30g/day. The SD of 4.9 g/day for the present study implies that GLP-1 RA use does not decrease fibre intake. Moreover, the closeness of observations (see Figure 4.2) across the two countries makes it more likely that there is a shortfall at the population level and not specific to GLP-1 RA use.

High prevalence of constipation (76.3%) in this sample may be linked to reduced gut motility from GLP-1 RAs (Brierley & Lartigue, 2021). Inadequate fibre further compounds constipation risk as fibre is a stimulus for peristalsis (van der Schoot et al., 2022). Thus, constipation may have less to do with caloric restriction and more to do with the interaction between the specific pharmacological effect of GLP-1 RAs and an existing dietary pattern in the UK population that is low in fibre. Constipation management was identified as one of the key challenges by dietitians working with adults on GLP-1 RAs (Christensen et al., 2024) and increasing dietary fibre intake is an actionable finding from this study that could help.

4.1.3. Protein Intake and Lean Mass Preservation

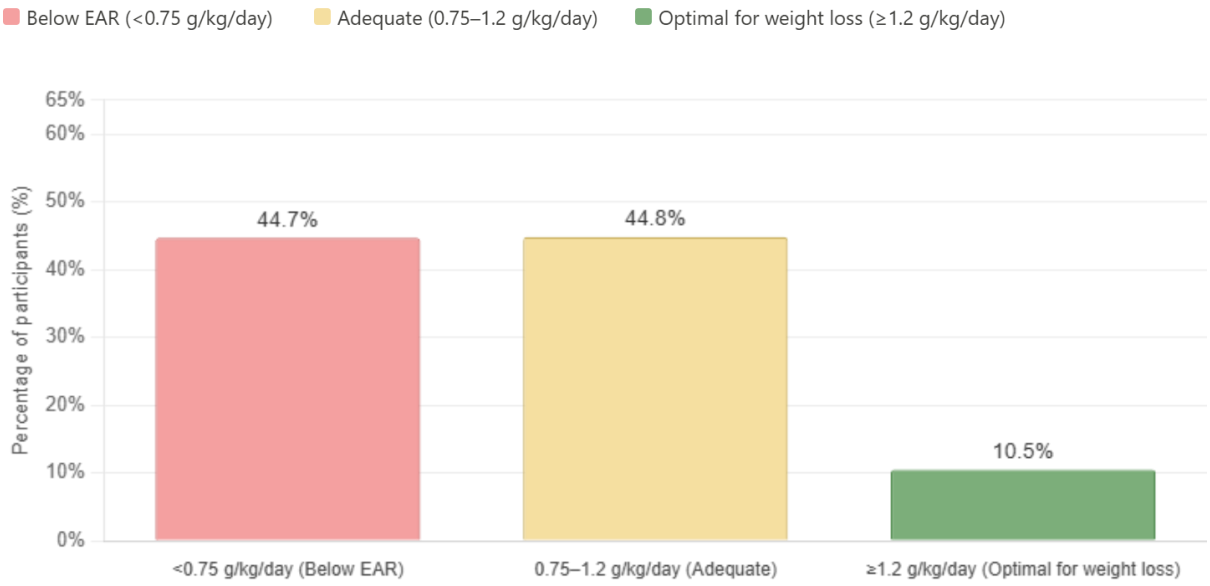


Figure 4.3. Distribution of protein intake relative to the UK EAR and optimal weight-loss targets (n = 38). Categories defined as: below UK EAR (<0.75 g/kg/day); adequate per UK EAR (0.75–1.2 g/kg/day); optimal for lean mass preservation during weight loss (≥1.2 g/kg/day). EAR = Estimated Average Requirement.

Although the group mean protein intake of 0.86 ± 0.38 g/kg/day exceeded the UK EAR of 0.75 g/kg/day, it does not differ significantly from the general UK population (0.92 g/kg/day) (OHID, 2025) especially given the large standard deviation of the present study. More importantly, from the perspective of lean mass preservation, nearly half of participants (44.7%) fell below the 0.75 g/kg/day threshold and only 10.5% achieved intakes ≥1.2 g/kg/day (See Figure 4.3). The 1.2–1.5 g/kg/day range is recommended to preserve lean mass during weight loss (Christensen et al., 2024; Kerlikowsky et al., 2025) but is not a requirement for the wider population. Johnson et al. (2025) reported a larger (~43%) proportion met ≥1.2 g/kg/day. This could be related to the higher proportion of tirzepatide users in the present study (73.7% vs 33.3% in Johnson et al. (2025)) given its greater appetite suppression (Bernardi et al., 2026).

Nevertheless, the finding that only 10.5% achieved the 1.2–1.5 g/kg/day preservation threshold, combined with near-universal vitamin D inadequacy, represents a compounded risk for lean mass loss in this cohort with an older age profile (mean 51.6 years) (Wilding et al., 2021; Roth et al., 2022; Kerlikowsky et al., 2025).

These findings provide evidence to nutrition therapists regarding importance of protein when designing nutrition plans for GLP-1 RA users.

4.1.4. Vitamin D. Among the micronutrients, highest prevalence of inadequate intake was seen for Vitamin D, with 94.7% of participants reporting intake below the RNI of 10 µg/day and 50.0% below the LRNI. The mean dietary intake of 3.42 ± 3.43 µg/day is consistent with previous studies that highlight the low Vitamin D intake in the wider UK general population (Lin et al., 2021; Webb et al., 2011). For e.g. Jodoin et al. (2025) evaluated the nutritional status of a pre-operative surgical cohort and similarly reported lower vitamin D levels among GLP-1 RA users compared to non-users. Butsch et al. (2025) identified vitamin D deficiency as the most commonly diagnosed nutritional deficiency in GLP-1 RA users, affecting 13.6% within 12 months of therapy initiation. However, these estimates from claims data likely underestimate the true prevalence due to under diagnosis (Butsch et al., 2025).

Nevertheless, data from 2019 – 2023 NDNS (OHID, 2025) found a lower mean intake of 2.6 µg/day in the wider UK population. This implies that GLP-1RA use does not seem to affect vitamin D intake. Interestingly Holt et al., (2025) found that weight loss resulted in significant increase in vitamin D levels (≈ 12 nmol/L approximately) likely due to the release of sequestered vitamin during fat loss. Insufficient vitamin D intake is already common in the UK population.

47.4% of participants (n=38) in this study reported using vitamin D supplements. When the supplement intake was included, the mean total vitamin D intake increased to 16.98 µg/day but the median remained low (5.83 µg/day). This discrepancy was due to 3 participants reporting intake of extremely high dosage of vitamin D supplements which inflated the mean value. Despite supplementation 63% of participants still failed to meet the RNI and 29% remained below the LRNI.

4.1.5. Iron. Iron inadequacy was highly prevalent. The mean intake of 7.90 ± 2.69 mg/day fell below the male and post-menopausal female RNI of 8.7 mg/day and substantially below the pre-menopausal female RNI of 14.8 mg/day. 81.6% of participants did not meet their RNI and 18.4% had an intake below the LRNI. These findings are broadly comparable to the national level NDNS 2019-2023 (OHID, 2025) data which reported 18.7% of adults below the iron LRNI. Therefore, iron intake levels measured in the present study seem to reflect a pre-existing population level dietary pattern rather than related to GLP-1 RA use. But comparisons to LRNI of the present study as well as the national study should be treated with caution due to absence of information of actual menopausal status of female respondents. Instead, an age cut-off of 50 years is used as proxy for menopause onset, with much higher LRNI for menstruating women. Interestingly the relative preservation of vitamin B12 intake which is found in the same food groups as iron, may point to more demanding RNIs for iron due to low absorption efficiency versus B12 (Hurrell & Egli, 2010; Watanabe, 2007).

The breadth of inadequacy is nevertheless concerning particularly given the pre-existing vulnerability of the study population (mean BMI 30.7 kg/m² ± 7.9 kg/m²). Individuals with obesity have elevated baseline rates of iron deficiency due to chronic low-grade inflammation impairing iron absorption (Cepeda-Lopez et al., 2010). Chronic low-grade inflammation upregulates hepcidin and iron regulatory hormone which in turn triggers degradation of ferroportin (Nemeth & Ganz, 2023). Ferroportin is the sole exporter of iron into the blood and degradation of ferroportin sequesters iron within the gut lining thus blocking systemic absorption (Nemeth & Ganz, 2023). Delayed gastric emptying may further compound this and measuring dietary iron intake may underestimate the true clinical risk of inadequacy (Amjad, 2021).

The clinical consequences of iron deficiency may include fatigue, impaired immune function, and nutritional anaemia (Kumar et al., 2022). Butsch et al. (2025), using insurance claims data from over 460,000 GLP-1 RA users, identified nutritional anaemia as the most common deficiency-related complication within 12 months of therapy initiation. Whilst not a direct measure of dietary iron, this clinical data provides corroborating evidence that the iron inadequacy observed in dietary assessments may

translate into real-world health consequences. Taken together, these findings suggest that routine iron monitoring should form part of nutrition care for GLP-1 RA users.

4.1.6. Potassium, Magnesium, and Selenium. Potassium inadequacy (39.5% below LRNI) was high (see Figure 3.3 and Table 3.4). This is consistent with the low fruit, vegetable, and legume intakes that were prevalent in the group.

NDNS (2019-2023) (OHID, 2025) found that 28% of the population had an intake below LRNI. GLP-1 RA use worsens the intake as seen in Figure 4.4. This is consistent with studies involving hypocaloric diets (De Amicis et al., 2025). Potassium deficiency has implications for cardiovascular health, muscle function, and fluid balance (Weaver, 2013).

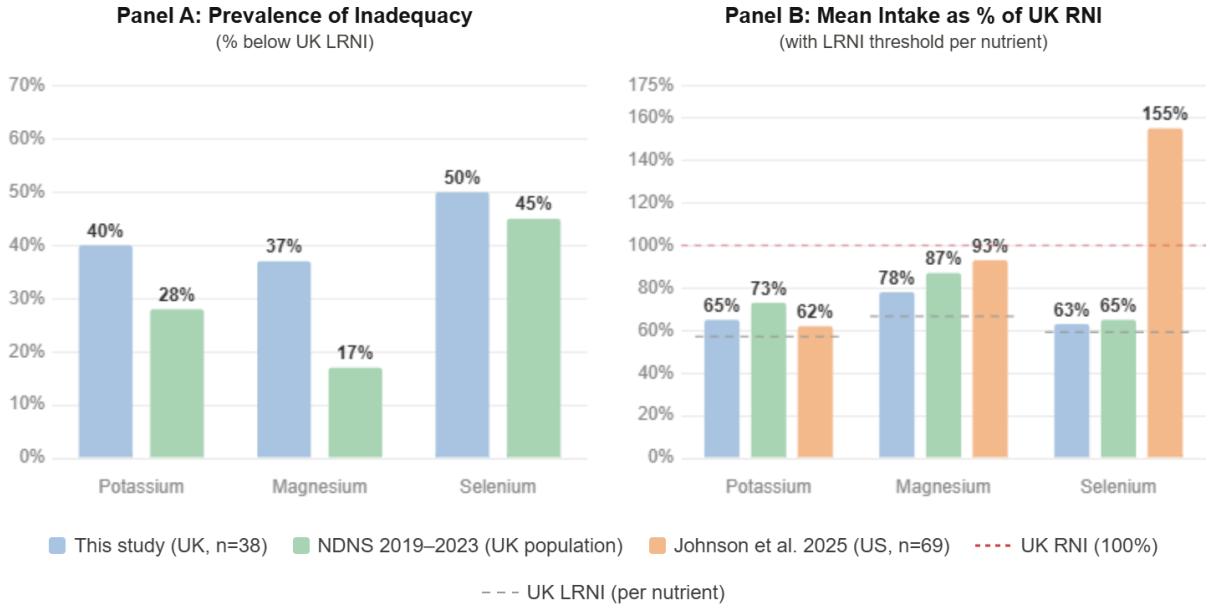


Figure 4.4. Comparison of potassium, magnesium, and selenium intake across cohorts (adults 19–64 years). Panel A: Percentage of participants below the UK Lower Reference Nutrient Intake (LRNI); this study (n=38) vs NDNS 2019–2023. Panel B: Mean intake expressed as a percentage of the UK Reference Nutrient Intake (RNI); dashed lines indicate the UK LRNI for each nutrient. UK RNIs used: Potassium 3,500 mg/day; Magnesium 285 mg/day (mean of male and female RNIs); Selenium 67.5 µg/day (mean of male and female RNIs). Johnson et al. (2025) mean intakes converted to % UK RNI for comparability; note US Dietary Reference Intake thresholds differ from UK Dietary Reference Values. NDNS = National Diet and Nutrition Survey (OHID, 2025)

Magnesium (Mg) inadequacy was also notable, with 36.8% below LRNI vs 17% nationally (OHID, 2025). This indicated lower intake of Mg within the GLP-1 RA cohort as relative to the wider UK population (Figure 4.4). Severe Mg depletion has been reported as an adverse event in GLP-1 RA users in published case reports (Fallows, 2025).

Selenium inadequacy, however, was comparable with the wider UK population (Figure 4.4). In the present study, 50.0% of participants had intakes below the LRNI versus 45% nationally (OHID, 2025)). Johnson et al. (2025) similarly reported adequate Selenium intake in their US cohort in contrast to the present study. Selenium deficiency can impair thyroid and immune function (Rayman, 2012) and may need further attention in this population.

4.1.7. Relative Preservation of Vitamin B12 and Vitamin E. Not all micronutrients were affected to the same extent. Vitamin B12 intake was good, with only 10.5% of participants reporting below the RNI and 5.3% below the LRNI. This likely reflects the continued consumption of protein-rich foods such as meat and dairy, which are key dietary sources of vitamin B12.

Vitamin E intake was also relatively well-preserved, with only 5.3% of participants consuming below the RNI. This finding is consistent with the high fat intake observed in this cohort (mean 55.7 g/day vs 62.5g

nationally (OHID, 2025)), given that vitamin E is found in dietary fats and oils (Traber, 2014). These exceptions imply that GLP-1 RA users under significant caloric restriction adopt specific dietary patterns that favour certain foods over others.

4.1.8. Supplement Use and Its Implications

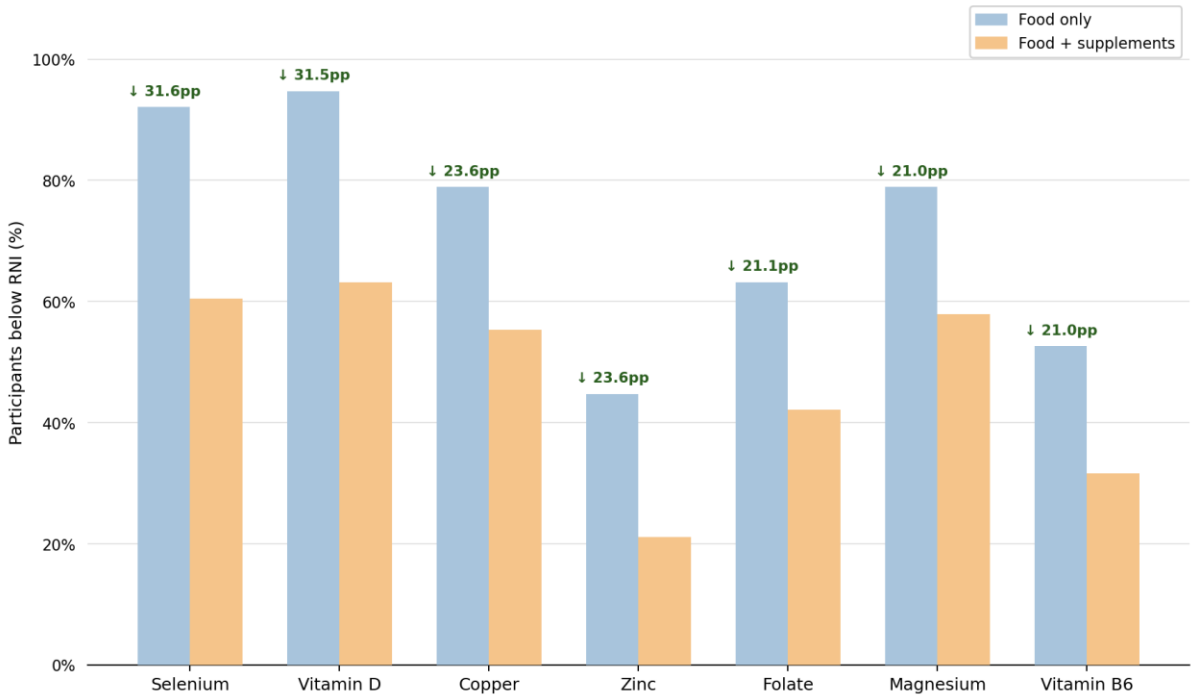


Figure 4.5. Percentage of participants (n = 38) falling below the Reference Nutrient Intake (RNI) for the seven micronutrients most improved by supplementation, comparing food-only intake with food and supplement intake combined. Figures in green indicate the reduction in percentage points (pp) attributable to supplementation. RNI thresholds are sex-specific where applicable (DH, 1991).

A high proportion of participants used supplements (73.7%). And their inclusion improved the proportion of participants meeting the RNI and reduced the proportion falling below the LRNI for the majority of micronutrients (Figure 4.5). But these improvements were not uniform across the micronutrients with the highest shortfall, still leaving significant proportion of respondents with inadequate intake. However, only 7% of supplement users were supervised by a nutritionist. Butsch et al. (2025) found that nutrient deficiencies are significantly more likely to be diagnosed in GLP-1 RA patients having access to a dietitian, yet their large cohort study found that nearly 92% of GLP-1 RA users had not seen a dietitian in the six months prior to prescription. Despain and Hoffman (2024), in a qualitative study with registered dietitians managing GLP-1 RA patients, highlighted a lack of guidance on nutrition accompanying GLP-1 RA prescribing, similar to the inadequate nutritional support in the early bariatric surgery era (Mechanick et al., 2017).

4.2. Risk of Malnutrition. The findings of the present study highlight the risk of malnutrition associated with GLP-1 RA use. Additionally, there already exists a baseline risk of low intake in many nutrients like fibre, iron, vitamin D, selenium, potassium and magnesium in the wider UK population (OHID, 2025). The present findings suggest that structured nutrition support may be needed to actively manage these inadequacies. The findings on supplementation did lead to improvements in nutritional intake but seemed ad hoc and not evidence based. Without professional oversight supplementation may not be dosed or targeted appropriately (Pokushalov, 2024).

These findings are consistent with emerging clinical evidence. Fallows (2025) noted that UK patients qualifying for these medications under NHS criteria often come from deprived backgrounds with already poor diets. Jodoin et al. (2025), assessing preoperative nutritional status in 165 patients undergoing total joint arthroplasty, found that GLP-1 RA users had six-fold greater odds of malnutrition (38% vs 8.8%) and seven-fold greater odds of severe malnutrition (17.2% vs 2.9%) compared to non-users. However, this may be due to the cohort being comprised of older adults with a comorbidity burden awaiting joint surgery and may not represent the general GLP-1 user population.

4.3. Limitations. Several methodological limitations of this study must be acknowledged. First, the voluntary response sampling strategy may introduce selection bias (Cheung et al., 2017). Recruiting predominantly from a Facebook group of GLP-1 nutrition enthusiasts, may over-represent health-conscious, motivated individuals who pay particular attention to their nutritional intake (Young et al., 2020; Althubaiti, 2016). Relying on volunteers can lead to self-selection bias where individuals with strong opinions or unique experiences with the medication are more likely to participate than those with typical experiences (Pannucci & Wilkins, 2010). If anything, this would be expected to produce better dietary intakes than the broader GLP-1 RA user population, suggesting the true extent of nutritional inadequacy may be greater than observed here.

Second, dietary assessment relied entirely on self-reported 3-day food diary data collected via INTAKE24, an online recall system. Whilst INTAKE24 has been validated against interviewer-led recall (Bradley et al., 2016), self-reported dietary data are susceptible to recall bias and under-reporting, particularly in individuals with obesity — a group known to systematically underestimate energy intake (Macdiarmid & Blundell, 1998). Under-reporting would result in artificially low apparent nutrient intakes, though the extent of any bias is unknown in this population.

Thirdly, although n=38 participants achieved 84% power for medium effect sizes and 99% for large effects (as described in Section 2), the sample size has low statistical power for subgroup analyses by medication type, duration of use, and demographic variables. The sample was predominantly female (86.8%), White (84.2%) and middle-aged. In comparison to the nationally representative data from the 2019-23 NDNS (OHID, 2025), this sample significantly over-represents women (86.8% vs. 54.3% in the national survey) and fails to capture users from ethnic minority backgrounds. The cohort limits generalisability to male users, younger adults, older adults, and ethnic minority populations, who may have distinct dietary patterns, cultural food practices, and nutritional risk profiles.

Fourthly, the cross-sectional design precludes any causal inference. It is not possible to determine whether the nutritional inadequacies preceded GLP-1 RA initiation, represent an acute effect of appetite suppression or have evolved progressively over the treatment period. A prospective longitudinal design with pre-treatment dietary assessment would be necessary to address this question. Similarly, the absence of biochemical nutritional markers (e.g., serum ferritin and 25-hydroxyvitamin D) means that it is not possible to confirm whether dietary shortfalls have translated into clinically significant deficiencies in this specific sample.

Finally, potential researcher interpretive bias should be acknowledged (Kaptchuk, 2003). As a nutrition therapist with a professional interest in optimising GLP-1 RA patient care, the researcher may be predisposed to interpret findings in a direction that supports the value of nutritional intervention, as discussed in the Methods earlier.

4.4. Strengths. Notwithstanding these limitations, this study has several notable strengths. It is, to the author's knowledge, the first UK study to assess nutritional adequacy in UK GLP-1 RA users, providing country-specific relevance that cannot be inferred from a US-based study (Johnson et al., 2025). As the potential participants are members of a Facebook Group open to users of any GLP1 medications, there is limited sampling bias towards any particular label (Patino & Ferreira, 2018).

The use of INTAKE24, a validated multiple-pass 24-hour recall system, across three days including weekdays and a weekend day represents a more robust dietary assessment than single-day ad libitum test meal designs used in many prior nutrition intake studies (Christensen et al., 2024). The inclusion of a broad range of both macro- and micronutrients gives a complete nutritional profile when compared to previous studies that looked at energy intake only. The collection of data on GI symptoms, medication type, duration, and supplement provides a fuller context to the findings.

4.5. Directions for Future Research. This study identifies several important directions for future investigation. Larger, prospective cohort studies that record dietary information and biochemical markers before and during the course of treatment can help understand the nutritional status over the course of GLP-1 RA therapy. This present study provides a foundation for future research and larger studies are warranted to explore differences across age, sex, ethnicity and socioeconomic status.

Research is needed to determine whether nutritional deficiencies observed in GLP-1 RA users differ by medication type (semaglutide versus tirzepatide versus liraglutide). These have different pharmacological profiles. Tirzepatide works through a dual-agonist mechanism by targeting both GLP-1 and GIP receptors (Chavda et al., 2022). It may affect appetite and nutrient absorption differently than mono-agonists like semaglutide (used in Johnson et al, (2025) a US based study) or liraglutide (Liu, 2024). Given that nearly three-quarters of the present study participants were on tirzepatide, a future study that has large enough sample sizes for each of the medication types would be useful in understanding the difference in risk of nutrient inadequacy for each medication type.

Use of GLP-1 RAs is growing rapidly in the UK and worldwide. A few nutrition and lifestyle support care guidelines have recently been published. Butsch et al. (2025) and Despain and Hoffman (2024) both emphasise the critical role of dietitian involvement in GLP-1 RA management. An expert consensus statement outlining key considerations for supportive care has highlighted the need for personalised nutritional support (Sievenpiper et al.,2025). This statement is based on opinion of experts. Nevertheless, no randomised controlled trials on nutritional interventions involving GLP-1 users were found to back these conclusions. Further studies on this topic are needed for evidence-based nutrition guidelines. In the UK, rollout of GLP-1 RAs without adequate nutritional guidelines may exacerbate health inequalities as the population eligible for these medicines are disproportionately from lower socioeconomic backgrounds.

4.6 Conclusions. This study found significant shortfalls in dietary intake of many nutrients in GLP-1 RA users in the UK. Mean daily energy intake at 1337 kcal/day was lower when compared to the UK population (1682 kcal/day) and much lower than sex specific daily requirements. Macronutrient shortfalls of concern were fibre and protein. Fibre shortfall was universal while only 10% of the cohort had a protein intake greater than 1.2g/kg/day, a minimum level important for lean mass preservation during weight loss. There were large inadequacies in micronutrients like iron, vitamin D, potassium, and selenium.

Comparison with the UK population data from 2019-23 NDNS (OHID, 2025) found shortfalls in fibre, iron, vitamin D and selenium as pre-existing dietary patterns rather than large changes influenced by GLP-1 RA use. However, nutrients such as magnesium and potassium had higher inadequacies than the national population, indicating that GLP-1 RA use may worsen these.

The study also found that although supplementation addressed these shortfalls to some extent, the dosage and supplements targeted were ad hoc with only a minority under professional nutritional support.

These findings have clinical relevance for nutrition therapists. The existence of shortfalls in nutrient intake and the large variations underscore the importance of testing for biochemical markers along with recording dietary intake. This would help nutrition therapists support GLP-1 RA users with appropriately targeted nutrition plans. Future longitudinal research measuring biochemical markers in GLP-1 RA users is needed to help devise more specific nutrition support guidelines.

Key limitations of the present study include the small, predominantly female, self-selected sample recruited from a health-conscious online community and the reliance on self-reported dietary data which may underestimate true intake.

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