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Applied nutritional investigation

Should handgrip strength be considered when choosing the administration mode of oral nutritional supplements in geriatric patients? A secondary analysis of the MEDPass Trial

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ABSTRACT

Objective: It is important to individualize nutrition therapy and to identify whether certain patient groups benefit from a specific intervention such as oral nutritional supplements (ONS). This study investigated whether patients with weak handgrip strength (HGS) benefit better from ONS administration in the Medication Pass Nutritional Supplement Program (MEDPass) mode regarding the individual coverage of energy and protein requirements throughout their hospitalization.

Methods: A secondary analysis of the intention-to-treat data set of the randomized controlled MEDPass trial was conducted. Weak HGS was defined as <27 kg for men and <16 kg for women. Linear mixed-effect models adjusted for the stratification factors energy density of ONS and nutritional risk screening 2002 score were used to address the aim of the study.

Results: We included 188 participants. Energy and protein coverage did not differ between the patients with weak or normal HGS depending on ONS administration mode ($P = 0.084$, $P = 0.108$). Patients with weak HGS and MEDPass administration mode tended to have the lowest energy and protein coverage (estimated mean, 77.2%; 95% confidence interval [CI], 69.3%–85% and estimated mean, 95.1%; 95% CI, 85.3%–105%, respectively). Patients with weak HGS and conventional ONS administration had the highest energy and protein coverage (estimated mean, 90%; 95% CI, 82.8%–97.2% and estimated mean, 110.2%; 95% CI, 101.3%–119%, respectively).

Conclusion: No clear recommendations regarding the mode of ONS administration depending on HGS can be made. In clinical practice, appetite and satiety in patients with weak HGS should be monitored, and the ONS administration mode should be adjusted accordingly.

Introduction

Disease-related malnutrition (DRM) is prevalent in 20% to 60% of geriatric and medical patients at hospital admission [1–3]. Identifying patients at risk for DRM and providing individualized nutrition therapy is crucial to improving patient outcomes [3–7].

Oral nutritional supplements (ONS) as a therapy in patients at risk for DRM have been shown to improve nutritional status and patient outcomes such as mortality, hospital length of stay (LOS), and readmission rate [5,8]. ONS administration in small volumes (50–120 mL) with medication rounds leads to better compliance with ONS prescription [9]. This administration mode is called Medication Pass Nutritional Supplement Program (MEDPass) [9]. A recently published randomized controlled trial (RCT) on the MEDPass versus conventional administration mode of ONS in medical and geriatric inpatients found no difference between the administration modes regarding coverage of individual energy and protein

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requirements as well as handgrip strength (HGS) [10]. Nevertheless, to individualize nutrition therapy, it is relevant to identify whether certain patient groups benefit better from a specific mode of ONS administration, and subgroup analyses can support these therapeutic decisions [11,12].

HGS may be a suitable parameter to predict the benefit of nutrition therapy as the correlation between weak HGS and reduced nutritional and functional status, increased mortality, complication rates, and hospital LOS is well documented [13–19]. Furthermore, it is a simple bedside measurement for muscle strength, which can be used in clinical practice easily [19]. Kaegi-Braun, et al. found a reduction in 30-d mortality in patients with weak HGS versus in patients with higher HGS when receiving nutrition therapy [20]. Whether patients with weak HGS benefit better from ONS administration in the MEDPass mode is currently unknown, and the subject of this study focuses on individual coverage of energy and protein requirements throughout hospitalization.

Materials and method

Design

This is a quantitative secondary analysis of the open-label MEDPass RCT, which was registered on clinicaltrials.gov under NCT03761680. Detailed information on the trial's methods is described elsewhere [10,21].

Population and recruitment

From November 2018 to November 2022, medical and geriatric inpatients at the Department of General Internal Medicine and the Department of Geriatrics in the Tiefenau facility of the Bern University Hospital were checked for eligibility. Patients >18 y of age with a nutritional risk screening 2002 (NRS 2002) total score of ≥3 points, an expected minimum hospital LOS of 3 d after NRS according to the attending medical doctor, and the ability and willingness to provide informed consent were included. Patients who were initially admitted to the critical care unit, <7 d post-surgery, admitted with or scheduled for supplemental/total enteral or parenteral nutrition, or in a terminal condition were excluded. Further exclusion criteria were dysphagia with the inability to swallow liquids, Mini Mental state <16 points, or patients with cystic fibrosis, short bowel syndrome, gastric bypass, acute pancreatitis, acute liver failure, and anorexia nervosa.

Randomization and intervention

Patients were randomized according to the stratification factors NRS 2002 total score and ONS energy density using the Research Electronic Data Capture version 9.1.15 data management program (Vanderbilt University, Nashville, TN, USA). Randomization for the NRS 2002 total score was defined as NRS 3, NRS 4, or NRS 5–7 to prevent statistical differences regarding the severity of nutritional risk. The NRS 2002 total score includes energy coverage, disease severity, body mass index (BMI), and age as probable confounding factors. Furthermore, the randomization was stratified for the energy density of the prescribed ONS (1.5 or 2 kcal/mL).

In the MEDPass group, patients received 50 mL of ONS four times daily with medication rounds. Medication rounds were timed before breakfast, lunch, dinner, and about 22:00 h.

ONS administration in the control group was conventional, meaning patients received one to four bottles of ONS daily between the main meals or after dinner. ONS from different manufacturers (Abbott Nutrition, Fresenius Kabi, Nestlé Health Science) were prescribed.

Outcomes

The patients' energy and protein requirements were calculated based on actual body weight at study admission. Table 1 lists the formulas for calculating daily energy requirements based on guidelines and dependent on age and BMI [5,7]. Daily individual protein requirements were calculated with 1 g/kg body weight or 0.8 g/kg body weight in case of chronic kidney disease with an estimated glomerular filtration rate of <30 mL/min/1.73 m^2 without renal replacement therapy [22,23]. Registered dietitians did individual calculations on the requirements of other macronutrients.

Table 1
Calculation of daily energy requirements based on actual BW at study admission and depending on age and BMI

Age, y	BMI <18.5 kg/m^2	BMI ≥18.5 kg/m^2
<65	30 kcal/kg BW	27 kcal/kg BW
≥65	32 kcal/kg BW	30 kcal/kg BW

BMI, body mass index; BW, body weight
Adapted from Gomes et al. [5], Volkert et al. [7], Bauer et al. [22], and KDOQI [23].

ONS intake was reported (accuracy 5 mL) in the electronic health record, and food service staff reported the amount consumed of each meal component (0, 25, 50, 75, and 100%) on the menu card. Patients were interviewed about snacks and drinks between main meals to assess intake. Energy and protein intake from food was calculated using the LogiMen version 5.4 electronic menu system (Kretschmer-Keller Leonberg, Germany,) which contains data on the energy and protein content of the hospital's meals and snacks. The nutritional software nut.s version 1.32.74 (dato Denkwerkzeuge, Vienna, Austria) was used for food and beverages not listed in LogiMen. Patients' energy and protein coverage were calculated based on their mean daily energy and protein intake from ONS and food throughout the hospitalization and their energy and protein requirements.

Study visits to assess HGS and appetite were conducted at study admission (day 1) and every 7 d (±2 d) until hospital discharge or up to a maximum of 30 d after admission [21]. Appetite was assessed with a visual analog scale (VAS; 0–10 cm). HGS was measured using a JAMAR Hydraulic Hand Dynamometer (Patterson Medical, Warrenville, IL, USA) [21]. The measurements were conducted according to the American Society of Hand Therapists guideline [24], with a slight adaption of the position of the elbow on a stable surface. The patients were seated with the elbow supported on a stable surface (e.g., a table) and bent at 90 degrees. The measurement was conducted with the dominant hand, if possible. Three measurements were conducted per study visit, with a 30s break between measurements. The highest value was recorded (precision 0.5 kg).

Statistical analysis

The MEDPass Trial was powered at 80% for the primary outcome of individual energy coverage. The intention-to-treat data set from the MEDPass trial was used for this secondary analysis [10]. Patients were included in this secondary analysis if they had an HGS measurement on day 1 according to protocol and if total daily energy and protein intake were measured. Patients without ONS prescriptions were excluded. Weak HGS was defined as <27 kg for men and <16 kg for women [25].

To describe the study population, absolute and relative frequencies for the two groups, weak and normal HGS at day 1, were used for categorical variables, and mean and SDs for normally distributed continuous variables. The median and interquartile range (IQR) were calculated for continuous variables with abnormal distribution [26]. Normal distribution was analyzed visually with histograms. To test for differences in baseline characteristics, the χ^2 test was used for categorical variables when assumptions were met (<20% of the absolute frequencies in the contingency table were under 5); otherwise, Fisher's exact test was used [27]. An unpaired Student's t test was used for normally distributed continuous variables, and the Mann–Whitney U test was used for abnormally distributed continuous variables.

Energy and protein coverage depending on weak and normal HGS at day 1 was investigated with linear regression models adjusted for ONS density and NRS 2002 total score stratification factors. Furthermore, the estimated means for the subgroups were calculated based on these models. To further investigate this potential underlying reason for different energy and protein coverages, the course of appetite between weak and normal HGS within the study group and adjusted for ONS density and NRS 2002 was analyzed with a linear mixed model. The significance level was set at a $P < 0.05$. For the statistical analysis, the software R version 1.4.1106 (RStudio, PBC) [28] and the following R-packages were used: ggpubr [29], stargazer [30], car [31] emmeans [32], lmerTest [33], and modelbased [34].

Ethical considerations

The MEDPass study was conducted according to the principles of the World Medical Association [35], ICH-GCP guidelines [36,37], or ISO 14155 norm [38] and according to the Swiss Federal Act on Research involving Human Beings [39,40]. The Cantonal Ethics Committee Bern, Switzerland, approved the study protocol.

Results

Study population

For the subgroup analysis of HGS at day 1, 188 of 204 participants were included. Sixteen participants were excluded for the following reasons: no ONS prescription (n = 1 control group), no energy and protein intake records (n = 1 MEDPass group), and missing or incorrect HGS measurement at day 1 (n = 7 control

Table 2
Baseline characteristics of patients by weak and normal HGS

Parameters	HGS	
	Weak (n = 96)	Normal (n = 92)
Sociodemographic		
Women, n (%)	50 (52)	44 (48)
Age, y, mean ± SD	84 ± 7	80 ± 6
Geriatric, n (%)	91 (95)	89 (97)
Anthropometrics mean ± SD		
Body weight, kg	65.7 ± 15	70.3 ± 14.6
Body mass index, kg/m^2	23.8 ± 4.5	24.7 ± 4.6
Requirement, mean ± SD		
Energy requirement, kcal	2012 ± 450	2149 ± 440
Protein requirement, g	67 ± 16	71 ± 15
Nutritional risk, n (%)		
NRS 3	26 (27)	35 (38)
NRS 4	46 (48)	36 (39)
NRS 5-7	24 (25)	21 (23)
Nutritional status subscore 0	6 (6)	6 (7)
Nutritional status subscore 1	40 (42)	50 (54)
Nutritional status subscore 2	40 (42)	27 (29)
Nutritional status subscore 3	10 (10)	9 (10)
HGS at day 1, mean ± SD		
Women, kg	12 ± 3	20 ± 3
Men, kg	19 ± 6	33 ± 5
ONS energy density, n (%)		
1.5 kcal/mL	51 (53)	48 (52)
2 kcal/mL	45 (47)	44 (48)
Disease category, n (%)		
Gastrointestinal diseases	10 (10)	8 (9)
Infectious diseases	24 (25)	17 (18)
Cardiovascular diseases	25 (26)	16 (17)
Neurologic diseases	6 (6)	7 (8)
Oncologic diseases	4 (4)	8 (9)
Other diseases	27 (28)	36 (39)

HGS, handgrip strength; NRS, nutritional risk screening 2002; ONS, oral nutritional supplementation.

group and n = 7 MEDPass group). Table 2 presents the baseline characteristics of patients with weak and normal HGS.

Patients included were between 67 and 98 y of age. Patients with weak HGS were significantly older (84 ± 7 y) than patients with normal HGS (80 ± 6 y; $P < 0.001$). Sex was balanced with 52% women in the weak and 48% in the normal HGS groups. Most patients were hospitalized in the geriatric clinic in the weak and normal HGS groups (95% and 97%, respectively).

Study procedures

The mean (SD) duration of ONS prescription for patients with weak and normal HGS was 8.9 (4.5) and 8.3 (3.6) d, respectively. The median (IQR) ONS intake was 180 mL/d (34 mL/d) in patients with weak HGS and 175 mL/d (30 mL/d) in patients with normal HGS. Mean (SD) duration of food intake monitoring was 9.4 (4.4) d in patients with weak HGS and 8.5 (3.5) d in patients with normal HGS. There was no significant difference in study procedures between patients with weak and normal HGS regarding the above-mentioned parameters ($P > 0.05$). The number of not assessed meals was higher in patients with weak HGS (n = 33) compared with patients with normal HGS (n = 10; $P < 0.01$). Additional data on study procedures are shown in Supplementary Table 1.

Energy and protein coverage

Table 3 shows the estimated energy and protein coverage means per the linear regression model. Patients with weak HGS and the MEDPass administration mode had the lowest estimated means for energy and protein coverage at 77.2% (95% confidence interval [CI], 69.3%–85%) and 95.1% (95% CI, 85.3%–105%), respectively. Patients with weak HGS and conventional ONS administration had the highest energy and protein coverage at 90% (95% CI, 82.8%–97.2%) and 110.2% (95% CI, 101.3%–119%). These differences were not significant for energy coverage ($P = 0.084$) or protein coverage ($P = 0.108$).

Course of appetite

There was no difference in the appetite course in patients with weak and normal HGS regarding the ONS administration mode ($P = 0.397$). Overall, the appetite improved over 2 wk ($P = 0.046$). Independent of the ONS administration mode, patients with normal HGS had a higher appetite than those with weak HGS, but the difference was not significant ($P = 0.068$) (Fig. 1).

Discussion

Patients with weak HGS and conventional ONS administration tended to have higher energy and protein coverage than those with weak HGS and the MEDPass administration mode. However, there were no significant differences in energy and protein coverage in patients with weak versus normal HGS with MEDPass and conventional ONS administration. Overall, the energy and protein coverage in the main study was high in both ONS administration modes, and an effect of unblinded patients could influence the energy and protein intake during the study [10].

As a possible reason for the tendency of lower energy and protein coverage in patients with weak HGS, the effect on the appetite of the MEDPass mode, resulting in a lower intake of energy and protein at main meals, should be considered. The possible influence of ONS in general and depending on the administration mode on satiety and appetite has been discussed in previous studies [41–43]. Patients generally classified ONS as a food rather than medicine, and they felt saturated after ONS intake [42]. Nursing staff perceived ONS administrated in the MEDPass mode was consumed more easily by patients because of the smaller volume and the patients' perception that ONS is a medicine [41]. However, medication rounds usually happen before meals, so patients may feel satiated from the ONS and exhibit lower appetite [41].

Table 3
Estimated means and 95% CI for energy and protein coverage (% of individual requirement) as per linear regression model adjusted for ONS energy density and NRS 2002.

	HGS			
	Weak		Normal	
	MEDPass (n = 43)	Control (n = 53)	MEDPass (n = 49)	Control (n = 43)
Coverage, %, mean (95% CI)				
Energy	77.2 (69.3–85)	90 (82.8–97.2)	87.3 (79.9–94.8)	82.4 (74.6–90.3)
Protein	95.1 (85.3–105)	110.2 (101.3–119)	105.7 (96.5–115)	99.5 (89.8–109)

HGS, handgrip strength; NRS, nutritional risk screening 2002; ONS, oral nutritional supplementation

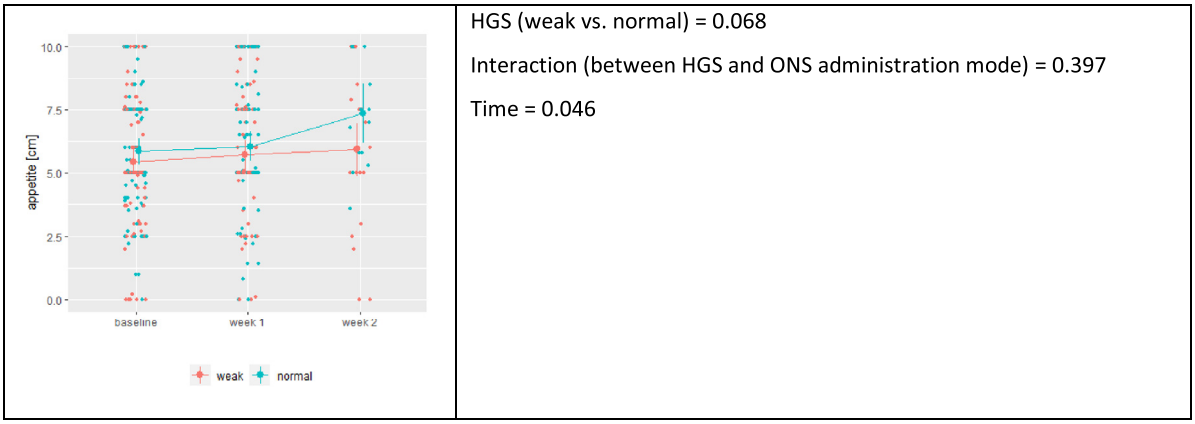

Fig. 1. Course of appetite in patients with weak and normal handgrip strength regarding oral nutritional supplement administration mode, adjusted for nutritional risk screening 2002 and oral nutritional supplement energy density.
HGS, handgrip strength, ONS, oral nutritional supplement.

Conventional ONS administration allows for an individualized administration of ONS in terms of time and volume.

To our knowledge, the effect of ONS administration in MEDPass mode on appetite is scarcely investigated. The course of appetite was assessed in the MEDPass trial, and no difference between patients in the MEDPass and control group was observed [10]. Furthermore, the course of appetite did not differ between the subgroups in our analysis; only patients with normal HGS showed a tendency to have a higher appetite than patients with weak HGS independent of ONS administration mode. No significant difference in energy intake from food between the MEDPass group and the control group was found in two studies [44,45]. A before–after study reported a significantly higher percentage of intake at main meals (mean +7.3%; SD 13.4%) after introducing the MEDPass mode [46]. A second before–after study reported higher energy and protein intake (19%) from food after 4 wk of ONS administration in the MEDPass mode but lower total energy intake (food + ONS) of −17% and no change in total protein intake compared with before [47]. These studies, as well as our analysis, suggest that appetite is not negatively affected by ONS administration in the MEDPass mode. However, the before–after studies have a risk of bias, and our analysis was not sufficiently powered for our outcomes. Therefore, it remains unclear if ONS administration in the MEDPass mode has a negative effect on appetite in patients with weak HGS.

To include HGS in nutrition assessment and follow-up, the suggested time between the measurements is ≥ 1 wk [48]. HGS is a valuable assessment tool for geriatric inpatients as LOS is often longer in geriatric patients than in the general population. In Switzerland, 11% of mainly geriatric patients made up for half of hospitalization days from 2017 to 2019 [49]. In our trial, the mean (SD) duration of food intake monitoring was 9.4 (4.4) d in patients with weak HGS and 8.5 (3.5) d in those with normal HGS. However, according to the Organization for Economic Cooperation and Development, the mean hospital LOS in Switzerland was 6.8 d in 2021, rendering the usefulness of a second HGS measurement during hospitalization questionable [50].

To our knowledge, few studies have been conducted on the ability of HGS to identify patients who would benefit better from nutrition therapy or a specific ONS administration mode. Kaegi-Braun et al., found a reduction in 30-d mortality in patients with weak HGS when receiving nutrition therapy compared with those with normal HGS [20]. To make therapeutic decisions based on HGS measurements in nutrition therapy, more research is needed investigating the ability of HGS to identify patients who will benefit better from nutrition therapy or a specific ONS administration mode. Based on the results of this subgroup analysis, no clear recommendations on ONS administration mode can be made for patients concerning their HGS. However, a possible negative effect on the appetite of ONS administration in the MEDPass mode in patients with weak HGS should be evaluated in individualized nutrition therapy, and the ONS administration mode should be chosen accordingly.

Strengths and limitations

The MEDPass trial demonstrates good quality in study design and data collection and adequate power. Patients' energy and protein intake were assessed daily, and hospital food was prepared according to recipes, which were also used to calculate energy and protein intake from hospital food [21].

Energy and protein requirements were calculated using pragmatic formulae according to international guidelines. These formulae do not foresee calculations according to adjusted body weight in overweight or obese patients or adjustments for mobility. Furthermore, adjustments were not made in patients with edema. Therefore, requirements may have been over- or underestimated in part of the trial population. The definition of the weak and normal HGS cutoffs was based on the current literature. For the definition of the HGS cutoff values according to Dodds et al., ethnicity and age distribution of the MEDPass data set were considered, and a study with a large sample was chosen [25]. However, the adequacy and, therefore, the influence of these cutoffs on the results remain unknown. Furthermore, medications were not recorded in the MEDPass trial and could potentially influence appetite or gastrointestinal function. The statistical analysis was adjusted for the stratification factors used in randomization. However, even if stratification for NRS 2002 total score minimizes bias, the statistical model did not consider specific differences in sociodemographic and anthropometric data. They might have had some influence on the results.

Conclusion

This study found a tendency for lower energy and protein coverage in patients with weak HGS in patients receiving ONS in the MEDPass mode compared with patients with weak HGS who received it conventionally.

Based on these results, no clear recommendations on ONS administration mode can be made for patients with regard to their HGS in clinical practice. Furthermore, additional research is needed to investigate the ability of HGS to identify patients who may benefit more from nutrition therapy or specific nutrition interventions, such as the timing of ONS administration. In clinical practice, appetite and satiety in patients with weak HGS should be monitored, and the ONS administration mode should be adjusted accordingly.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: KU: KU has no competing interests to declare. ER: has no competing interests to declare. KAS: KAS has no competing interests to declare. ZS: The institution of ZS received speaking honorariums and research support from Nestlé Health Science, Abbott Nutrition, and Fresenius Kabi. SK: SK has received honorariums from Abbott Nutrition and Fresenius Kabi and consulting fees from Omanda Medical Nutrition

CRediT authorship contribution statement

Katja Uhlmann: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Visualization. **Emilie Reber:** Conceptualization, Methodology, Validation, Supervision, Writing – review & editing. **Katja A. Schonenberger:** Methodology, Validation, Writing – review & editing. **Zeno Stanga:** Conceptualization, Methodology, Validation, Writing – review & editing. **Silvia Kurmann:** Conceptualization, Methodology, Validation, Writing – review & editing, Project administration, Supervision.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.nut.2024.112429.

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