An innovative solid oral nutritional supplement to fight weight loss and anorexia: open, randomised controlled trial of efficacy in institutionalised, malnourished older adults

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Abstract

Background and objective: to evaluate the impact of a solid nutritional supplement on the weight gain of institutionalised older adults >70 years with protein-energy malnutrition. The innovation of these high-protein and high-energy cookies was the texture adapted to edentulous patients (Protibis®, Solidages, France).

Design: an open, multicentre, randomised controlled trial.

Setting: seven nursing homes.

Participants: one hundred and seventy-five malnourished older adults, aged 86 ± 8 years.

Intervention: all participants received the standard institutional diet. In addition, Intervention group participants received eight cookies daily (11.5 g protein; 244 kcal) for 6 weeks (w0–w6).

Measurements: five visits (w−4, w0, w6, w10 and w18). Main outcome: percentage of weight gain from w0 to w6 (body mass in kg). Secondary outcomes: appetite, rated using a numerical scale (0: no appetite to 10: extremely good appetite); current episodes of pressure ulcers and diarrhea.

Results: average weight increased in Intervention group (n = 88) compared with Control group (n = 87) without cookies supplementation (+1.6 versus −0.7%, P = 0.038). Weight gain persisted 1 month (+3.0 versus −0.2%, P = 0.025) and 3 months after the end of cookies consumption (+3.9 versus −0.9%, P = 0.003), with diarrhea reduction (P = 0.027). There was a synergistic effect with liquid/creamy dietary supplements. Subgroup analysis confirmed the positive impact of cookies supplementation alone on weight increase (P = 0.024), appetite increase (P = 0.009) and pressure ulcers reduction (P = 0.031).

Conclusion: the trial suggested that, to fight against anorexia, the stimulation of touch (finger food; chewing, even on edentulous gums) and hearing (intra-oral sounds) could be valuable alternatives to sight, smell and taste alterations.

Keywords: anorexia, diarrhea, dietary supplement, pressure ulcer, protein-energy malnutrition, older people
Introduction

Protein-energy malnutrition is common in older people, ranging from 4–10% of community-dwelling seniors, 15–38% of nursing home residents to 30–70% of hospitalised older patients [1]. The main risk factors are alteration of cognitive functions, frequent acute and chronic diseases, poverty and social isolation, the use of >3–4 drugs/day, smell, taste, vision, auditory and motor alterations and increased energetic needs (surgery, roaming patients). Oral problems constitute another risk of malnutrition, including swallowing difficulties, dry mouth, oral pain, periodontitis and teeth mobility, edentulousness and poorly fitted dentures [1–3].

The resulting protein-energy malnutrition has four cardinal symptoms: asthenia, apathy, anorexia and loss of weight, with a modification of the physical body composition, immunodeficiency and subsequent frailty. There is an increased frequency of falls, infections (inhalation pneumonia), pressure ulcers, fatigue, dependence, depression, dementia progression and mortality [1–4]. This disease-to-disease spiral is difficult to reverse, and malnutrition increases the risk of hospital admissions and subsequent resettlement in an institution [5].

Nutritional care must aim to preserve the oral route, and enteral or parenteral route is an ultimate medical option. It is recommended that the number of meals and snacks offered during the day should be increased instead of offering bigger meals, because anorexic patients prefer small-sized portions. It is also recommended to avoid night starvation >12 h, to prefer high-protein and/or high-calorie food adapted to patients’ preferences and to give help if necessary during meals [1, 6]. Dieticians can recommend to enrich food with eggs, cream, grated cheese, powdered milk and in some cases with milk protein powder [1, 2]. However, patients may complain of a monotonous milky taste [7–9]. Besides, homemade enriched dishes generally have a soft texture (soups, béchamel sauces, gratins, puddings, etc.). If necessary, caregivers can prescribe brand dietary supplements, which are generally provided as sweet dairy drinks (sip-feeds) or creams, enriched in protein and/or energy [1]. High-protein cookies are generally not proposed to older adults, because their hard texture is not convenient for edentulous people. However, edentulous patients often complain of the monotony of mixed, mashed and soft food, which is a well-known cause of anorexia [9, 10].

To help to prevent and fight against malnutrition in older adults, a solid dietary supplement designed for people with chewing difficulties has been developed. This supplement was in the form of a high-protein and high-energy cookie. The innovation relied on the texture of the cookie, specifically designed for patients who regained the pleasure to crunch and chew, despite a poor dental health or edentulousness [11]. A preliminary study has shown that 30 institutionalised older people enjoyed the taste and texture of these butter cookies (Protibis®, Solidages, France) [12]. In a second preliminary test involving 15 institutionalised older adults with weight loss, patients were given an average number of 4.5 ± 0.5 cookies daily (range: 3.9–5.3) for 2 months. The average intake was 6.4 g of protein and 137 kcal daily. Weight remained stable (±1.5% weight variation) or increased for 60% of the subjects (4 and 5 subjects, respectively) after this 2-month period of cookies consumption (unpublished data).

In this study, we hypothesised that a 6-week consumption period of this innovative oral nutritional supplement (ONS) would enhance the percentage of weight gain in institutionalised, malnourished older adults. We also wanted to investigate the impact of cookies consumption on other parameters such as appetite, meal consumption, calories intake, current episodes of pressure ulcers and diarrhea, number of falls, fractures, infection episodes, antibiotic days and death.

Methods

Participants

This study was an open, multicentre, randomised controlled trial in seven nursing homes [13–15]. Main inclusion criteria were age over 70 and malnutrition (Figure 1). Prescription of home-made sweets enriched with milk proteins and/or liquid or creamy ONSs (‘dairy supplements’) was not an exclusion criteria. The protocol was approved by the local Ethics Committee (Espace Ethique Azuréen, Nice University Hospital) (Supplementary data, Appendix 1 available in Age and Ageing online).

Nutritional intervention

All participants received the usual food regimen of the institution. Patients who were prescribed dairy dietary supplements continue to take them. Participants in the Intervention group additionally received eight Protibis cookies daily for 6 weeks. There was no commercial sponsorship. Each cookie weighed 6.5 g and contained 1.44 g of protein and 30.5 kcal. It contained 22% of weight in proteins. Total energy content in proteins was 19% with an animal/vegetable protein ratio of 3.5 and a glycaemic index of 46.1. Ingredients were wheat flour, fresh butter, milk protein (casein), sugar, vanilla aroma, baking powder and salt. There was no palm oil or other vegetable oil. Eight cookies were distributed in the breakfast and/or in the snack (total 52 g of cookies: 11.5 g of protein and 244 kcal as daily supplementation).

Study design and measures

The study was designed with five visits (w−4, w0, w6, w10 and w18). There was an initial period of 4 weeks to observe weight evolution, without intervention (w−4 to w0). Participants in the Intervention group received Protibis cookies for 6 weeks (w0–w6). There was then a follow-up period in both groups with two visits (w10 and w18), respectively, 1 and 3 months after the end of cookies consumption. At w−4 routine, medical data were collected from patients’ medical files.
The main outcome assessment was the percentage of weight gain from w0 to w6 (body mass in kg). Secondary outcome was appetite, rated by the participant or by the nursing staff using a numerical scale ranging from 0 (absolutely no appetite) to 10 (extremely good appetite) [16].

To compare the calorie supplement actually consumed from w0 to w6 between the two groups, dietary intakes were measured during 5 days (d0, d3, d6, d40 and d42). Food and beverage consumption was scored as the percentage of each serving actually consumed (score 0, 1/3, 2/3 and 1). In one nursing home (Tiers Temps, Le Cannet), calorie count was done by the dietician in charge of the menus. We recorded current episodes of pressure ulcers and diarrhea at baseline (w−4), and current episode or previous episode of pressure ulcer and diarrhea since the last visit (w0, w6, w10 and w18). The number of falls, fractures after falls, infection episodes, antibiotic days and deaths from w0 to w18 was also recorded at w18. Data analysis methodology is detailed in Supplementary data, Appendix 1 available in Age and Ageing online.

Results

The study was performed from January 2010 until May 2013. A total of 216 patients were randomised, but only 175 patients fulfilled the inclusion visit at w−4 and 154 could be analysed for the main outcome (Figure 1; Table 1). There was full adherence to the protocol (cookies consumption). No harm or side effect attributed to Protibis cookies was reported.

Primary outcome

In this population of malnourished older people, there was a mean loss of weight the month before intervention, both in the Intervention and in the Control group (−0.7 versus −0.1%, respectively). At the end of supplementation with Protibis cookies, patients in the Intervention group had a significant and persistent weight gain compared with the Control group. The average percentage of weight variation was as follows: from w0 to w6 (+1.6 versus −0.7%), from w0 to w10 (+3.0 versus −0.2%) and from w0 to w18
A total of 216 subjects were assessed for eligibility and randomised to the Intervention group or to the Control group (108 patients in each group). However, the participants participating in the study were frail elderly people suffering from malnutrition. Besides, many of them suffered from cognitive impairment too and we could not obtain family’s or tutor’s informed written consent. For these reasons, 41 participants were randomised following a pre-inclusion visit but could not perform the inclusion visit 4 weeks before intervention (Intervention group: 20 subjects; Control group: 21 subjects). Case report form was completed and baseline characteristics were obtained at w–4 for the 88 remaining patients in the Intervention group and the 87 remaining patients in the Control group. Groupe Iso Ressource (GIR), disability index of French Health Authorities ranging from 6 (complete autonomy) to 1 (sick bedridden); ID, identification card; ONS, oral nutritional supplement.

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### Table 1. Comparison of baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Intervention group (n = 88)</th>
<th>Control group (n = 87)</th>
<th>T-test P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male [% (%)]</td>
<td>23.9 (21)</td>
<td>16.1 (14)</td>
<td>0.537</td>
</tr>
<tr>
<td>Age, year [mean (SD)]</td>
<td>85.4 ± 7.1</td>
<td>86.8 ± 7.1</td>
<td>0.751</td>
</tr>
<tr>
<td>Groupe Iso Ressource (GIR) [mean (SD)]</td>
<td>2.7 ± 1.4</td>
<td>2.8 ± 1.1</td>
<td>0.325</td>
</tr>
<tr>
<td>Mini Mental Score [mean (SD)]</td>
<td>18.1 ± 8.4</td>
<td>18.1 ± 8.3</td>
<td>0.976</td>
</tr>
<tr>
<td>Weight, kg [mean (SD)]</td>
<td>51.7 ± 1.5</td>
<td>50.9 ± 9.9</td>
<td>0.711</td>
</tr>
<tr>
<td>Weight loss &gt;10% in 6 months [% (%)]</td>
<td>23.9 (21)</td>
<td>29.9 (26)</td>
<td>0.626</td>
</tr>
<tr>
<td>Weight loss &gt;5% in 1 month [% (%)]</td>
<td>34.1 (30)</td>
<td>36.8 (32)</td>
<td>0.865</td>
</tr>
<tr>
<td>Body mass index, kg/m² (size from ID card) [mean (SD)]</td>
<td>19.2 ± 2.9</td>
<td>19.2 ± 2.9</td>
<td>0.709</td>
</tr>
<tr>
<td>Mini Nutritional Assessment (MNA) [mean (SD)]</td>
<td>14.5 ± 3.9</td>
<td>14.7 ± 5.0</td>
<td>0.995</td>
</tr>
<tr>
<td>Albuminaemia, g/l [mean (SD)]</td>
<td>34.3 ± 4.6</td>
<td>35.4 ± 4.4</td>
<td>0.938</td>
</tr>
<tr>
<td>Appetite, score 0–10 [mean (SD)]</td>
<td>4.27 ± 2.01</td>
<td>5.26 ± 2.22</td>
<td>0.770</td>
</tr>
<tr>
<td>Pressure ulcer, current episode [% (%)]</td>
<td>20.5 (18)</td>
<td>9.2 (8)</td>
<td>0.055</td>
</tr>
<tr>
<td>Diarrhea, current episode [% (%)]</td>
<td>15.9 (14)</td>
<td>12.6 (11)</td>
<td>0.667</td>
</tr>
<tr>
<td>Masticatory ability, % [mean (SD)]</td>
<td>32.5 ± 36.8</td>
<td>35.6 ± 37.0</td>
<td>0.810</td>
</tr>
<tr>
<td>Prescription of dairy ONS [% (%)]</td>
<td>44.3 (39)</td>
<td>32.2 (26)</td>
<td>0.040</td>
</tr>
<tr>
<td>Oral pain complaint [% (%)]</td>
<td>10.2 (9)</td>
<td>9.2 (8)</td>
<td>0.592</td>
</tr>
<tr>
<td>Dry mouth complaint [% (%)]</td>
<td>36.4 (32)</td>
<td>37.9 (33)</td>
<td>0.597</td>
</tr>
<tr>
<td>Edentulousness with chewing difficulties [% (%)]</td>
<td>23.9 (21)</td>
<td>19.5 (17)</td>
<td>0.347</td>
</tr>
<tr>
<td>Maxillary removable denture [% (%)]</td>
<td>25.0 (22)</td>
<td>19.5 (17)</td>
<td>0.546</td>
</tr>
<tr>
<td>Mandible removable denture [% (%)]</td>
<td>21.6 (19)</td>
<td>17.2 (15)</td>
<td>0.704</td>
</tr>
</tbody>
</table>

A total of 216 subjects were assessed for eligibility and randomised to the Intervention group or to the Control group (108 patients in each group). However, the participants participating in the study were frail elderly people suffering from malnutrition. Besides, many of them suffered from cognitive impairment too and we could not obtain family’s or tutor’s informed written consent. For these reasons, 41 participants were randomised following a pre-inclusion visit but could not perform the inclusion visit 4 weeks before intervention (Intervention group: 20 subjects; Control group: 21 subjects). Case report form was completed and baseline characteristics were obtained at w–4 for the 88 remaining patients in the Intervention group and the 87 remaining patients in the Control group. Groupe Iso Ressource (GIR), disability index of French Health Authorities ranging from 6 (complete autonomy) to 1 (sick bedridden); ID, identification card; ONS, oral nutritional supplement.

Masticatory ability ranges from 0% (no antagonistic teeth) to 100% (16 pairs of antagonistic teeth); masticatory ability is impaired under 70% [11].

Exploratory analysis in four subgroups

Baseline characteristics of participants showed a higher prescription rate of dairy dietary supplements in the Intervention group (Table 1). In this group, patients who were prescribed dairy supplements were given a mean number of 1.9 ± 1.2 units daily, ranging from 1 to 6. In the Control group, they received 1.8 ± 1.5 units daily, ranging from 1 to 5.

We thus realised an exploratory analysis of four subgroups, ‘No supplementation’, ‘Dairy ONSs’, ‘Protibis cookies’ and ‘Dairy ONSs and Protibis cookies’, with 48, 27, 46 and 37 subjects, respectively. There was a synergistic effect between cookies and other oral dietary supplements (Figure 2). However, subgroup analysis confirmed the positive impact of cookies supplementation alone on weight increase (P = 0.024), appetite increase (P = 0.009) and pressure ulcers reduction (P = 0.031) (Supplementary data, Appendix 2 available in Age and Ageing online).

Discussion

To our knowledge, this is the first trial investigating a solid ONS adapted to people with masticatory impairment. The percentage change in body weight during a 6-week trial
period is a reference outcome for studies assaying nutritional supplements. The meta-analysis involving older people at risk of malnutrition was updated in 2009 [17]. It showed that liquid ONSs (sip-feeds) during a 6-week period allowed an average increase of 2.2% weight gain. Additional protein doses ranged from 10 to 36 g daily. In the present study involving older people suffering from true malnutrition, we observed a weight gain at the end of the 6-week cookies consumption period (+1.6%), followed by a persistent weight increase lasting for 1 month (+3.0%) and 3 months after the end of cookies consumption (+3.6%).

The supplement of proteins brought about by eight Protibis cookies was limited to 11.5 g of protein and 244 kcal daily. This significant and persistent weight gain and appetite increase, despite this rather limited protein and calorie supplementation, could have several explanations. First, there was a good compliance with eight cookies a day, while with sip-feeds in particular, the nursing staff cannot easily control the quantities actually consumed and wasted. Another explanation could be related to the solid texture of cookies. Smeets et al. [18] reviewed stimuli involved in salivation and appetite, and how taste, texture and sight of food trigger a cascade of pre-absorptive physiological responses, called cephalic phase responses. In the present series, most of participants had dental alterations (Table 1) and they were given a soft diet. Cookies’ specific texture allowed easy crumbling between edentulous jaws. Chewing could have stimulated saliva and other digestive secretions, facilitated the processing of ingested food, the assimilation of all food supplies and contributed to weight increase [9, 18]. Finally, weight gain could result from the fight against anorexia, based on the pleasure to eat a butter cookie with a non-medical aspect [19]. Actually, butter taste is uncommon among conventional ONSs. But in patients over 75 years, restrictive diets such as low-cholesterol diet avoiding butter consumption are not recommended, because they increase the risk of under-nutrition [20].

However, outcome determination and analysis was not possible in a high proportion of patients, and the approach taken (on-treatment analysis) could have led to bias in the results. Another limitation of this study was the lack of placebo, which introduces possible bias over some of the assessments, particularly those which have a subjective element such as appetite, percentage of normal diet and fluids remaining after a meal and pressure sores. As the impact of this new solid ONS on pressure sores and diarrhea was unanticipated, the questions in case report forms had been limited to ‘Current episode of pressure sore: yes/no’ and ‘Current episode of pressure diarrhea: yes/no’. In the absence of precise scoring, the present results should be considered as a preliminary screening. Besides, the main outcome, weight gain, is presumed to be objective, but it can be affected by the observer knowing which group a patient is allocated to.

Another limitation of this study was the use of enriched sweets and/or sip-feeds by 37.7% of the participants, without randomisation. This was deliberate in the study design, because we wanted to diversify the offer of protein supplementation, without disturbing this frail population composed of anorexic older people. Thus, we did not wish
to substitute a dairy dietary supplement by a solid dietary supplement. For this reason, we realised instead a subgroup analysis which suggested that weight gain, appetite increase and pressure ulcer reduction could be attributed to cookies alone (Figure 2). We realised a sensitivity analysis, adjusting percentage weight change at W18 and other parameters for the use of ONS. We had to remove all observations with a missing value for the percentage weight change from the analysis, and the lack of power did not allow us to eliminate ONS as a potential confounder. Thus, due to the limited size of the sample, the study results must be interpreted with caution. However, unexpectedly, this trial suggested a synergistic effect between liquid/creamy and solid oral supplements. This outcome deserves further investigations, with a precise scoring of the severity grade of pressure ulcer and diarrhea episodes [21, 22].

Literature data showed that immobilisation, moisture and incontinence as well as malnutrition were high-risk factors of pressure ulcer [23–27]. This trial involved older adults living in nursing homes, frail but not bedridden. The reduction of pressure ulcers could be related to higher protein intake or to increased mobility, but we did not measure muscular tissue gain, muscular strength or gait speed. However, these results are in line with the meta-analysis of Milne et al. [17], who concluded that oral dietary supplements had benefits on weight gain and pressure ulcer reduction.

Milne et al. [17] also reported that conventional liquid/creamy dietary supplements could have adverse effects, such as nausea and diarrhea. Conversely, the present study suggested that regimen diversification with texture-adapted cookies could reverse diarrhea episodes in some patients who were prescribed dairy dietary supplements (Figure 2). We observed appetite increase, but no case of nausea. The adjunction of fibres and probiotics has been proposed to combat diarrhea induced by enteral nutrition [27]. In malnourished older people with oral route feeding, a solid food could also contribute to the reduction of diarrhea episodes. An explanation could be that, when chewing a solid food, the stimulation of digestive secretions could regulate the balance of the luminal ecosystem.

The present results suggested that a solid diversification to mixed and mashed food could help to fight anorexia. The cookie form could facilitate finger food, dose repetition through the day (no cold storage), autonomy during snacks, better compliance and compliance control by the nursing staff.

**Conclusion**

In conclusion, this innovative solid oral dietary supplement allowed to diversify and to enrich in protein and calories the diet of institutionalised older adults. The main outcomes were a positive impact on weight and appetite, and a reduction of pressure ulcer and diarrhea episodes. This trial also suggested that to fight against anorexia, the stimulation of touch (finger food; chewing, even on edentulous gums) and hearing (intra-oral sounds) could be valuable alternatives to sight, smell and taste alterations.

**Key points**

- A solid oral nutritional supplement with a specifically adapted texture can be chewed by edentulous older adults.
- An oral nutritional supplement with a solid texture allows to enrich diet with protein and calories under a small volume.
- The pleasure to crunch and chew is a way to fight anorexia in older adults used to soft food.

**Conflicts of interest**

None declared.

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**Supplementary data**

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

**References**


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