Evaluate the Effect of Implant-Supported Prostheses on the Bioavailability of Nutrients: A Systematic Review and Meta-Analysis

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Abstract

Background and aim: The aim of this study was to evaluate the Effect of Implant-Supported Prostheses on the Bioavailability of Nutrients by Systematic Review and Meta-Analysis.

Method: Databases of PubMed, Scopus, Web of Science, EBSCO and Embase were searched for systematic literature between 2010 to August 2021. For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included.95% confidence interval for mean differences with fixed effect model and Inverse-variancemethod were calculated. To deal with potential heterogeneity, random effects were used and I^2 showed heterogeneity. Meta-analysis was performed using Stata/MP v.16 software (The fastest version of Stata).

Result: In the initial review, duplicate studies were eliminated and abstracts of 326 studies were reviewed, the full text of 121 studies was reviewed by two authors, finally, nine studies were selected. Meta-analysis showed that serum folate concentration was not different after 12 months in the intervention and control groups. No significant differences were observed between groups for nutrient residues after 12 months. Significant differences were observed for albumin in the control and intervention groups; similarly, vitamin B12 levels also increased.

Conclusion: Based on the findings of the present meta-analysis, the use of dental implant-supported prostheses has no significant effect on the bioavailability of several nutrients in patients with complete or partiallyedentulous.

Key words:implant-Supported Prostheses, Bioavailability of Nutrients, implantOverdentures

Introduction

One of the most important and controversial topics is the study and evaluation of the relationship between food intake and chewing.In people who lose their teeth for any reason, poor chewing performance is observed; these patients consume less fiber, vegetables(1, 2). Tooth loss is very common in the elderly, which according to studies, malnutrition is very common in the elderly(3). Dental rehabilitation can improve the chewing capacity of toothless people and eliminate nutritional problems(4). Inverted dental implants can facilitate

chewing and reduce swallowing time(5). Based on the available evidence, improvement in diet quality after oral rehabilitation is not normally observed, and it is highly debatable whether or not there is a significant relationship between improved chewing and improved diet quality(6, 7). Community culture, religion, economic situation, individual habits can influence how you choose the type of food(8). On the other hand, studies have shown that people also tend to adapt their diet to tooth loss(9, 10). In people who receive implant overdentures, eating solid foods is much easier than in people who receive conventional complete dentures(11).Implant overdenture systems have two separate parts. One part is connected to the prosthesis, while the other is connected to the implant or implant bar(12).
Previous studies have shown that implant overdentures can improve chewing(13, 14). Given the bioavailability of nutrients and nutritional risks, there is also debate about how improved chewing can increase blood nutrient levels and thus reduce the risk of malnutrition(15). The commonly accepted definition of bioavailability is the proportion of the nutrient that is digested, absorbed and metabolized through normal pathways(16). Due to the importance of the subject and the lack of studies in this field and updates in the existing literature, the researcher decided to evaluate and compare the nutritional and chewing performance in patients with complete and partial edentulousness who have used implant-supported prostheses versus conventional perform rehabilitations. The aim of this study was to evaluate the Effect of Implant-Supported Prostheses on the Bioavailability of Nutrients by Systematic Review and Meta-Analysis.

Method

Databases of PubMed, Scopus, Web of Science, EBSCO and Embase were searched for systematic literature between 2010 to February 2022.Use the MeSH Database, to build searches in PubMed:
("Denture, Complete"[Mesh]) AND "Denture, Partial, Removable"[Mesh]) AND "Jaw, Edentulous"[Mesh])) OR "Mouth, Edentulous"[Mesh]) AND "Dental Prosthesis, Implant-Supported"[Mesh]) AND "Activator Appliances"[Mesh]) AND "Diet, Food, and Nutrition"[Mesh]) AND ("Nutritional Status"[Mesh] OR "Nutrition Assessment"[Mesh])) AND "Biological Availability"[Mesh]) AND "Nutrients"[Mesh].
Key considerations PRISMA was the basis of the present study(17) and PIECO strategy to answer theresearch questions showed in Table1.

Selection criteria

*Inclusion criteria: criteria:*mastication and nutritional outcomes, partially or completely edentulous patients,implant-supported prostheses, Clinical controlled trials, randomized controlled trials, and cohort studies, observational studies , English language. Case studies, case reports, and reviews were excluded from the study.

Table1. PICO strategy

PICO strategy	Description
P	Population: partially or completely edentulous patients
I	interventions: implant-supported prostheses prosthetic rehabilitation
C	Comparison: conventional dental prosthetic rehabilitation
O	Outcome: masticatory function and nutrition parameters

Study selection, Data Extraction and method of analysis

Studies data were reported by study, years, study design, age, and number of patients.

Newcastle-Ottawa Scale (NOS) (18) used to assessed quality of the cohort studies and case-control studies, This scale measures three dimensions (selection, comparability of cohorts and outcome) with a total of 9 items. In the analysis, any studies with NOS scores of 1- 3, 4- 6 and 7- 9 were defined as low, medium and high quality, respectively. The quality of the randomized control trial studies included was assessed using the Cochrane Collaboration's tool(19). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality. The quality of studies reporting prevalence data was assessed using Joanna Briggs Institute Critical Appraisal Checklist (20). To answer the questions of this tool, yes, no, or unclear is used. A study should have a positive answer in all areas, and if the answer is "no" (negative) in each area, the study will be of lower quality.

For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included.Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.

95% confidence interval for mean differences with fixed effect model and Inverse-variancemethod were calculated. To deal with potential heterogeneity, random effects were used and I^2 showed heterogeneity. I^2 values less than 50% indicate low heterogeneity and above 50% indicate moderate to high heterogeneity. Meta-analysis was performed using Stata/MP v.16 software (The fastest version of Stata).

Result

The review of the existing literature using the studied keywords, 326 studies were found. In the initial review, duplicate studies were eliminated and abstracts of 316 studies were reviewed. At this stage, 195 studies did not meet the inclusion criteria, so they were excluded, and in the second stage, the full text of 121 studies was reviewed by two authors. At this stage, 112 studies were excluded from the study due to incomplete data, inconsistency of results in a study, poor studies, lack of access to full text, inconsistent data with the purpose of the study. Finally, nine studies were selected (Figure1).

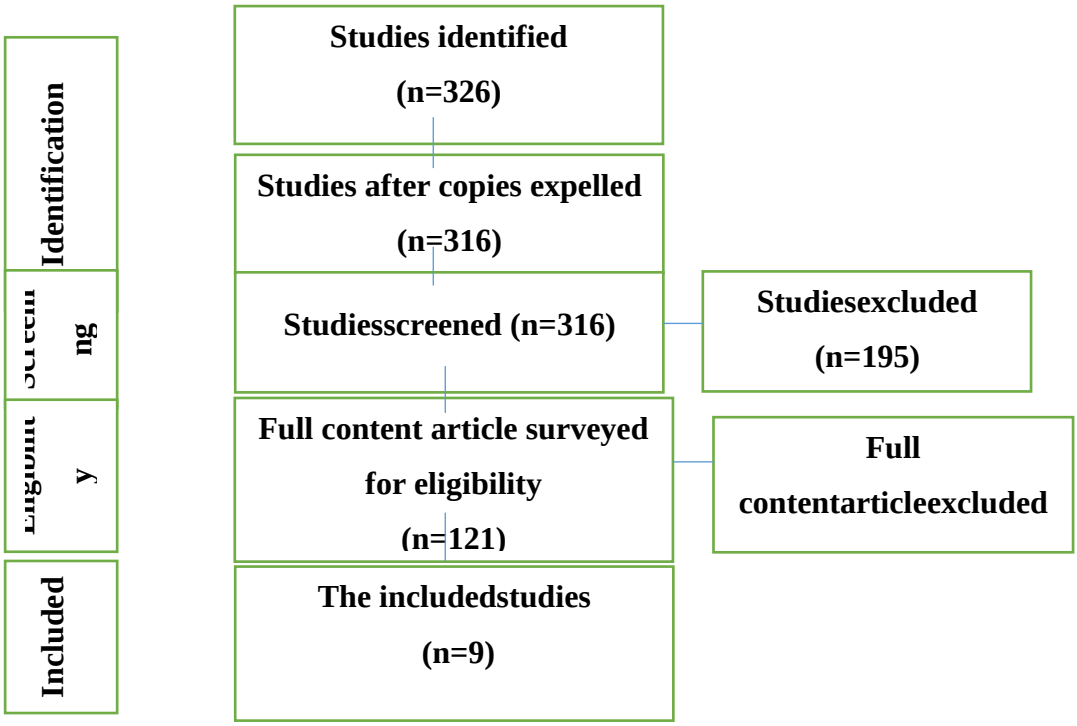


Figure 1. Study Attrition

Characteristics

Nine studies (three RCT and six clinical trial studies) have been included in present article. The number of participants in were 486 (male: 209; female: 277) with mean 66.6 years (Table2). Number of Implant in Intervention and control group was 271 and 267, respectively; a total 538. The mean of follow-up period was 7.33 months.

Of the 9 articles reviewed, 6 articles(21) (25) (26) (27) (28) (29)reviewed completely edentulous patients and threearticles (22) (23) (24)reviewed partially-edentulous patients.Nutrient bioavailability was reviewed in four articles(22) (25) (26)(28). In the rest of the articles, the daily diet was reviewed.

Bias assessment

According to Cochrane Collaboration's tool, twostudies had a total score of 5/6 and one study had a total score of 6/6. All RCT studies had high quality(Table3).

According to Joanna Briggs Institute Critical Appraisal Checklist, all clinical trial studies had a total score of 5/8; all studies had high quality or low risk of bias (Table3).

Table2. Studies selected for systematic review and meta-analysis.

Study. years	Study design	Number of patients		Number ofImplant		Mean of age	Follow-up (month)
		male	female	Intervention	control		
Amaral et al., 2019 (21)	clinical trial	4	8	12	12	69	2
Wöstmann et al., 2016 (22)	clinical trial	10	10	12	8	63	12
Gonçalves et al., 2015	clinical	4	8	12	12	60	2

(23)	trial						
Campos et al., 2014(24)	clinical trial	2	6	8	8	60	2
Muller et al., 2013 (25)	RCT	22	23	22	23	84	12
Awad et al., 2012 (26)	RCT	114	141	127	128	70	12
Gjengedal et al., 2012 (27)	RCT	27	33	30	30	68	12
Moynihan et al., 2012 (28)	clinical trial	16	38	28	26	66	6

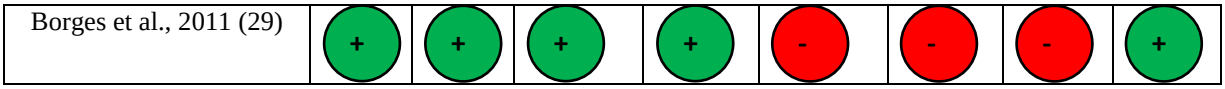
Table3. Risk of bias assessment (Cochrane Collaboration's tool(19))

study	Random sequence generation	allocation concealment	blinding of participants and personnel	blinding of outcome assessment	incomplete outcome data	selective reporting	Total score
Muller et al., 2013 (25)	+	+	+	+	+	?	5
Awad et al., 2012 (26)	+	+	+	?	+	+	5
Gjengedal et al., 2012 (27)	+	+	+	+	+	+	6

Low (+), unclear (?), high (-)

Table3. Risk of bias assessment (Joanna Briggs Institute Critical Appraisal Checklist (20))

study	Sample size	Sampling	sample size adequate	subjects and settings described in detail	data analysis	condition measured reliably	appropriate statistical analysis	subgroups' differences identified
Amaral et al., 2019 (21)	+	+	+	+	-	-	-	+
Wöstmann et al., 2016 (22)	+	+	+	+	-	-	-	+
Gonçalves et al., 2015 (23)	+	+	+	+	-	-	-	+
Campos et al., 2014(24)	+	+	+	+	-	-	-	+
Moynihan et al., 2012 (28)	+	+	+	+	-	-	-	+



Low (+), unclear (?), high (-)

Blood level of different nutrientsafter 12 months

According to the subgroup meta-analysis of Figure 2, the nutritional status of patients after 12 months of prosthesis use has been reported. Meta-analysis showed that serum folate concentration was not different after 12 months in the intervention and control groups. No significant differences were observed between groups for nutrient residues after 12 months. Significant differences were observed for albumin in the control and intervention groups; similarly, vitamin B12 levels also increased. The results of nutrition received a high heterogeneity between studies, with respect to study design, follow-up periods, and data analysis, which jeopardized further meta-analysis.

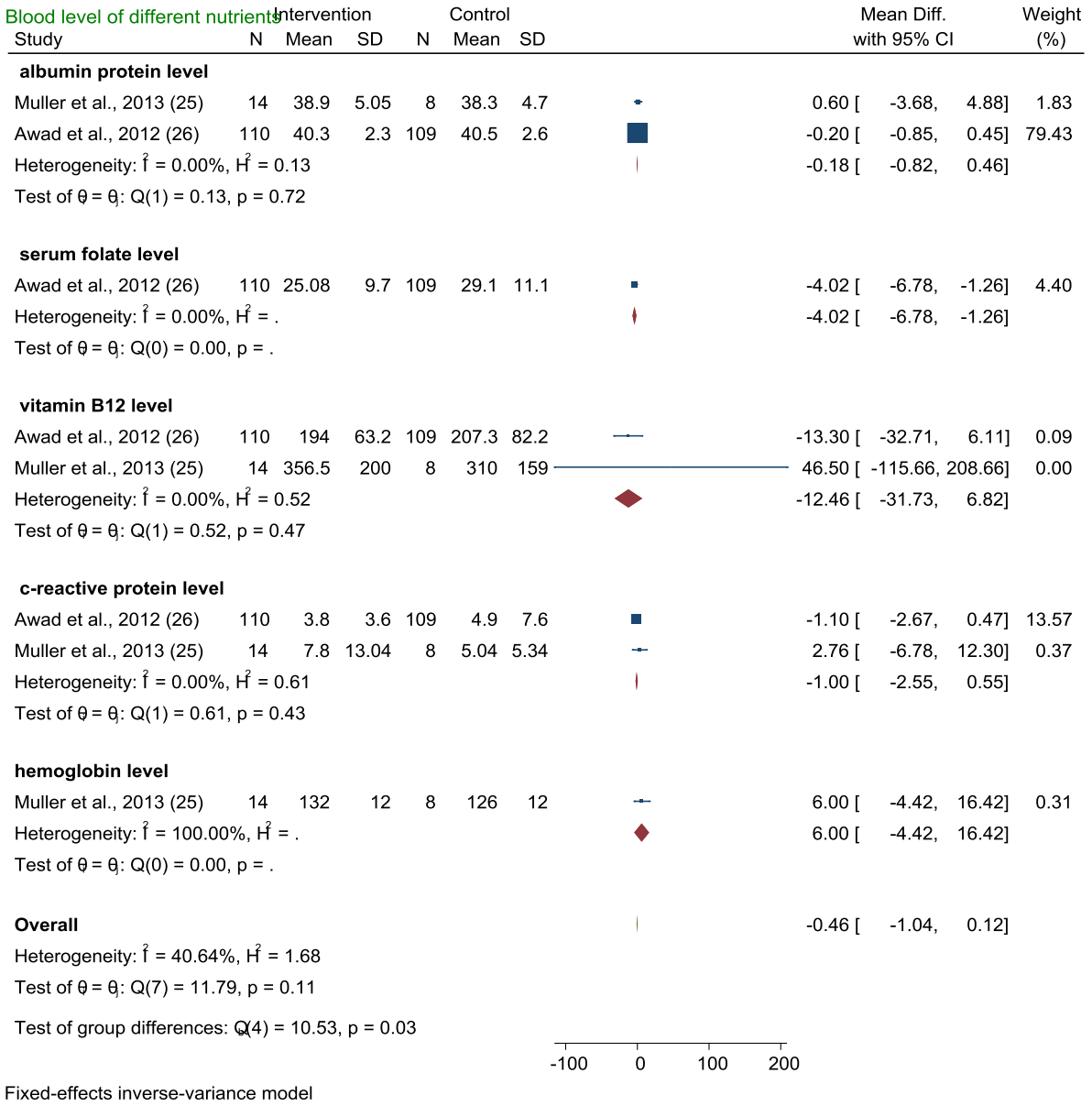


Figure2. Forest plot showed blood level of different nutrients after 12 months

Mastication outcomes

Patients in the intervention group produced significantly more voluntary byte forces during follow-up than patients in the control group. In addition, the master muscle thickness increased significantly in the intervention group on the preferential side, while no change was observed in the control group, and finally the perceived chewing ability was improved in the intervention group.

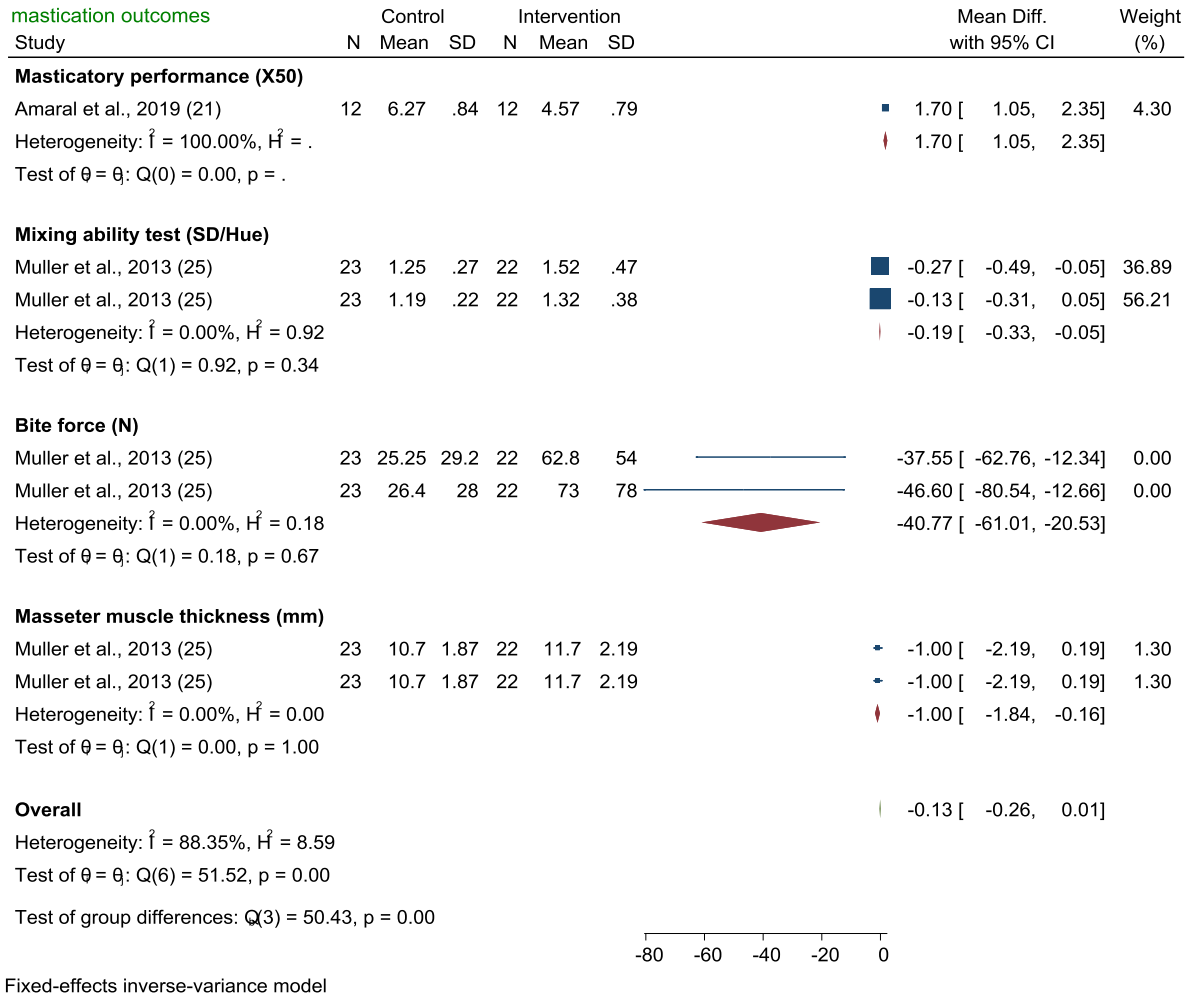


Figure3. Forest plot showed mastication outcomes

Discussion

The aim of this study was to investigate the effect of implant-supported prostheses in complete and partially edentulous patients on the bioavailability of several nutrients.Yamazaki et al., 2016 in a systematic review and meta-analysis reported most nutrient bioavailability is severely affected by the use of implant support prostheses(30). In the present study, only adults were examined; the heterogeneity between studies was also very high. In the present meta-analysis, it was observed that serum folate concentration was lower in the intervention group during the 1-year follow-up period than the control group. These findings need to be further explored as increased consumption of natural foods, such as leafy vegetables, legumes, nuts, seeds, and raw vegetables, increases serum folate(31). Studies show that folate deficiency is rare even in the elderly(32). Hence, the meta-analysis

shows a very small mean difference that the values were in the normal range.According to the meta-analysis findings, after one year of follow-up, the concentration of vitamin B12 decreased in both intervention and control groups.

In terms of albumin concentration, the mean changes after one year of follow-up were observed in both groups. Albumin and vitamin B12 concentrations remained within the reference range in all of these analyzes. Although albumin has been used for many years as an indicator of nutritional status (along with other serum components), recent studies have shown that albumin concentrations may be easily affected by factors such as disease or acute inflammation(33, 34).Studies have shown that the aging process and the presence of gastric diseases can also affect the concentration of vitamin B12(35, 36). The mean reduction observed in both nutrients does not appear to be critical for healthy patients. In addition, the small number of studies, the evaluation of small samples, certainly reduced the levels of this evidence, and ultimately revealed the need for future studies with a strong methodology.

It is suggested that future studies lead to more comprehensive dietary assessments in the elderly. It is possible that the methodological heterogeneity between the studies may lead to this discrepancy in the findings. A weak correlation between mixing ability test and biting force was reported in the previous study(37). Although MNA is a valid tool, it is based on subjective analysis, which jeopardizes stronger results and reinforces the need for a combination of subjective and objective assessments in a multidisciplinary approach.

The effect of implant prostheses on chewing and feeding seems to be more evident in people with minor edentulousness, especially when subjective parameters are assessed. One of the limitations of the present study is that very few studies were able to be included in the meta-analysis; there was a high heterogeneity between the results of the studies; the methodology of the articles was heterogeneous; there were very few RCTs on this subject; the follow-up period of the studies was different. It is recommended that more RCT studies be performed with a larger sample size and a follow-up period of 6 to 12 months to provide more evidence on the present subject.

Conclusion

Based on the findings of the present meta-analysis, the use of dental implant-supported prostheses has no significant effect on the bioavailability of several nutrients in patients with complete or partiallyedentulous. In the studied studies, no significant relationship was observed between the improvement in chewing and the improvement of patients' nutrition. Accordingly, evidence suggests that nutritional changes are more affected by dietary counseling than dental implant-supported prostheses. Therefore, nutritional counseling is very important to improve the Bioavailability of Nutrients.

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