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Original Article

Could Telenutrition Be Applied Interchangeably with the Face-to-Face Interview for Dietary Intake Assessment in Patients with Type 2 Diabetes During the COVID-19 Pandemic?

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Abstract

Background: COVID-19 pandemic has caused limitations, in patients' accessibility in clinical and research settings. We sought whether telenutrition could be applied interchangeably with face-to-face interview for dietary intake assessment by 24-hour recall in patients with type 2 diabetes mellitus (T2DM) during the COVID-19 pandemic.

Methods: Sixty-eight females with T2DM aged 50-55 years were enrolled randomly in a descriptive-analytic cross-sectional study. The patients completed three consecutive 24-hour dietary recalls. The first one was a face-to-face interview, and the subsequent two recalls were conducted by telephone call. The total energy and 18 selected nutrients intake were calculated for the three interviews.

Results: The mean (±SD) age of participants was 53.97±2.14 years. The face-to-face interview resulted in significantly higher total energy and 18 selected nutrients intake than the two telenutrition interviews (*P* value range: 0.031 - 0.001). No significant differences were found between the data provided from the two telenutrition interviews.

Conclusion: Telenutrition underreports and underestimates the total energy and nutrient intakes compared with the face-to-face interview in the 24-hour dietary recall. Therefore, it cannot be recommended to be applied interchangeably with a face-to-face interview for dietary intake assessment during the COVID-19 pandemic, especially in patients whose nutrition assessment is of clinical importance. A combination of the two methods using new communication applications (e.g. WhatsApp) may cover the defects of telenutrition method.

Keywords: COVID-19, Diabetes, Dietary intake, Face-to-face interview, Telenutrition, Telephone interview, 24-hour recall

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Introduction

Nutrition and diet therapy for people with diabetes should be individualized based on the individual's current food pattern and eating behaviors, metabolic parameters, and treatment goals. Monitoring metabolic parameters, lifestyle, and food patterns is necessary to evaluate the need for modifications in diet therapy (1). The 24-hour recall is a subjective measure using open-ended questionnaires administered by a trained and skilled interviewer in clinic settings and epidemiologic studies (2). The 24-hour dietary recall can accomplish with either face-to-face or telenutrition interview, and these two approaches may be used to compare the difference in the amount of receiving nutrients (3). Collecting 24-hour dietary recall through the telephone (telenutrition) is introduced as a practical and valid data collection tool for national food consumption surveys (3). Telenutrition implicates the interactive use of electronic and telecommunication technologies to supply nutritional therapy to patients. This approach possessed a high potential to improve nutrition consequences (4) and to assisted reducing disease transmission during the COVID-19 pandemic (5). The advantages were also cost-effectiveness of interview approach for assessing usual dietary intakes and the capability of gathering data from a large number of individuals in geographic areas with widely scattered populations (6,7). Therefore, telenutrition can be a gadget to detect nutritional status during outbreak of coronavirus disease (8). However

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some studies have reported underreporting of energy intake through telenutrition approach (9-11). In a survey, the response rate for food items was higher in the face-to-face interview, and more missed data was explored in the telephone interview method (12). On the other hand, Janssen and colleagues revealed that telephone assessment with a structured interview is reliable with a good agreement with face-to-face assessment and recommended its use in clinical practice and trials (13). Kuzmar and colleagues concluded that in the obese patients the worthiness of telenutrition is higher than conventional consultation because of less limitation in using this method in these patients (14).

Due to the inconsistencies in the results of previous studies, we sought whether telenutrition could be applied interchangeably with the face-to-face interview to determine the total energy, energy contribution from macronutrients, and selected nutrients intake in the dietary intake assessment by the 24-hour recall in patients with type 2 diabetes mellitus (T2DM) during the COVID-19 pandemic. Nutrition assessment in these patients is of clinical importance as they have to be under continuous observation in parallel with medicine therapy strategies.

Materials and Methods

Eligibility of participants and study design

A pilot study was accomplished on thirty women with T2DM to provide an estimate for sample size in the main study. The maximum sample size, based on energy percent from carbohydrates to achieve a power of 80%, level of significance 5% (two-sided), mean difference of 0.2 between pairs, and assuming a standard deviation of the differences of 0.55 was determined to be 62 patients. Finally, seventy subjects were enrolled in the study considering the probable dropout. In a descriptive-analytic cross-sectional study, these subjects who were in the age range of 50-55 years, were selected randomly from the diabetic clinics in Kerman city. Each participant completed a written informed consent form. The inclusion criteria for eligibility were diabetes onset at 40 years of age or higher, fasting blood sugar equal to or higher than 126 mg/dL, the disease duration of at least one year, or consumption of glucose-lowering agents (15). The exclusion criteria were suffering from a combination of two metabolic diseases and severe metabolic failure.

Dietary intake assessment

The patients completed three consecutive 24-hour dietary recalls on three successive days. The first one was a face-to-face interview (to make the patients familiar with dietary intake assessment recall) followed by the second and third interviews that were performed by telephone (telenutrition). Face-to-face interview was accomplished on the morning of working days. We interviewed seven patients every day. To increase recall precision and decrease the bias in data gathering, only one trained interviewer completed the questionnaires. A food album was employed in face-to-face interview for estimating and measuring amounts eaten by participants. The interviewer asked participants to recall dietary intake in main meals and snacks in the previous 24 hours. Afterwards, all recorded consumed foods were encoded and transformed into grams and then analyzed through the modified Nutritionist IV database. Results of a draft section of the Nutritionist IV database were recorded into the SPSS software. Thereby, the relevant statistical analyses were performed.

Food album

Food album has been provided by the National Nutrition and Food Technology Research Institute and consists of 400 pages in which food substances are offered as colored illustrations and in different quantities. Each food image has a code based on the weight of the food substances.

Statistical analysis

Statistical analysis was performed using SPSS 21 software (IBM SPSS statistics for Windows, version 21.0. Armonk, NY: IBM Corp.). The Kolmogorov-Smirnov test was applied to determine the normality in distribution of data. We used a one-way repeated-measures analysis of variance to determine the differences in mean of total energy, energy contribution from macronutrients, and selected nutrients intakes of participants among face-to-face interview and two telenutrition interviews. The paired *t* test was applied to determine the mean differences of the described variables between the two telenutrition interviews as well as between the face-to-face interview and either of the two telenutrition interviews. The *P* value < 0.05 was assumed significant.

Results

Patients' characteristics

The response rate among all participants was 97% (68 from 70 patients). Two participants were excluded from the study due to incomplete interviews. The mean ($\pm$SD) age of participants was 53.97 ± 2.14 years. Baseline characteristics of participants are shown in Table 1.

Table 1. Baseline characteristics of participants

	Mean ± SD	Median (IQR)
Age (y)	53.97 ± 2.14	54.00 (3.00)
Duration of diabetes (y)	8.48 ± 5.28	8.50 (8.00)
Body mass index (kg/m^2)	29.35 ± 4.83	28.90 (5.45)
Weight to height	0.99 ± 0.08	0.98 (0.12)
Total kcal of diet	1250.5 ± 359.6	1208.0 (464.0)
Percent of kcal from protein	15.81 ± 3.04	16.00 (4.00)
Percent of kcal from carbohydrate	58.16 ± 7.16	59.00 (10.00)
Percent of kcal from fat	25.93 ± 6.91	25.00 (10.00)

IQR, Interquartile range.

Interview approaches

There were significant differences in the calculated mean energy and 18 selected nutrients intakes between face-to-face interview and each of the two telenutrition interviews (*P* values range from 0.047 to < 0.001) (Table 2).

As it is seen in Table 3, the first comparison shows the mentioned variables calculated using two telenutrition interviews. No significant differences were found between the data provided from the two telenutrition interviews.

However, as it is seen in Table 4, the mentioned variables in the face-to-face interview were significantly higher than the two telenutrition interviews (*P* values range from 0.031 to < 0.001).

Discussion

There were significant differences in the mean energy and intake of majority of selected nutrients between the face-to-face interview and either of the two telenutrition approaches. These comparison for the mean intakes among the two telenutrition interviews demonstrated no significant difference between them. By these comparisons, we may conclude that face-to-face interview provides more accurate and comprehensive results, at least in T2DM patients, and may not be replaced with telenutrition interview method unless applying a complementary modification in telenutrition method. Moreover, the results showed that the telenutrition interview method, itself, provides consistent results if repeated, and in serious conditions like COVID-19 outbreak, when it is not possible to apply face-to-face method, it may be used for follow up purposes.

Telenutrition is chiefly used to recommend and prescribe therapeutic diets to patients. Dietitians should keep the continuity of nutrition care for patients

Table 2. The mean intakes energy, energy contribution from macronutrients and selected nutrients of patients with type 2 diabetes calculated through three interview approaches

	Interview approaches*			*P* value
	Face-to-Face (n = 68)	Telenutrition (1st) (n = 68)	Telenutrition (2nd) (n = 68)	
Energy (kcal)	1414.9 ± 55.0[a]	1154.3 ± 49.2	1197.2 ± 66.6	< 0.001
Energy from protein (%)	15.2 ± 0.5	16.5 ± 0.8	16.3 ± 0.6	0.263
Energy from carbohydrate (%)	58.8 ± 1.2	57.7 ± 1.3	58.6 ± 1.3	0.736
Energy from fat (%)	25.9 ± 1.2	25.6 ± 1.2	24.9 ± 1.1	0.797
Protein (g)	54.2 ± 2.4[a]	46.8 ± 2.3	47.1 ± 2.7	0.042
Carbohydrate (g)	210.9 ± 8.6[a]	168.5 ± 7.6	176.9 ± 10.1	< 0.001
Total fat (g)	43.4 ± 3.0[b]	34.9 ± 2.6	35.4 ± 3.3	0.027
Saturated fatty acids (g)	10.6 ± 0.7	9.4 ± 0.6	9.6 ± 0.7	0.293
Mono unsaturated fatty acids (g)	12.2 ± 0.9	9.7 ± 0.8	11.1 ± 1.7	0.291
Poly unsaturated fatty acids (g)	14.7 ± 1.5[a]	10.8 ± 1.3	10.2 ± 1.1	0.006
Linoleic acid (g)	13.04 ± 1.49[a]	9.42 ± 1.25	8.70 ± 1.15	0.007
Linolenic acid (g)	0.14 ± 0.02	0.22 ± 0.06	0.13 ± 0.02	0.146
Cholesterol (mg)	124 ± 12	128 ± 14	117 ± 11	0.796
Fiber (g)	14.3 ± 1.0[b]	11.1 ± 0.8	11.8 ± 0.7	0.007
Soluble fiber (g)	0.55 ± 0.06[a]	0.37 ± 0.04	0.33 ± 0.03	0.003
Insoluble fiber (g)	2.66 ± 0.30[b]	1.87 ± 0.17	1.95 ± 0.16	0.012
Calcium (mg)	633 ± 40	599 ± 43	583 ± 41	0.502
Iron (mg)	13.1 ± 0.7[b]	10.5 ± 0.7	11.1 ± 0.7	0.005
Zinc (mg)	6.2 ± 0.3[a]	5.3 ± 0.3	5.3 ± 0.3	0.047
Potassium (mg)	2457 ± 116[a]	1923 ± 103	1911 ± 91	< 0.001
Thiamin (mg)	1.43 ± 0.06[a]	1.21 ± 0.06	1.21 ± 0.07	0.003
Riboflavin (mg)	5.25 ± 3.89	1.17 ± 0.06	1.19 ± 0.07	0.300
Folate (μg)	198 ± 17	154 ± 16	169 ± 12	0.077
Vitamin A (RE)	687 ± 60	562 ± 83	480 ± 46	0.071
Vitamin D (μg)	0.6 ± 0.2	0.7 ± 0.1	0.6 ± 0.2	0.962
α-Tocopherol (mg)	6.4 ± 0.8[a]	4.3 ± 0.4	4.4 ± 0.4	0.011
Vitamin C (mg)	104 ± 7[a]	66 ± 5	68 ± 5	< 0.001

* Repeated measure ANOVA, comparison of (Mean ± SE) the total energy intake, energy contribution from macronutrients and selected nutrients of 68 patients among three interview approaches.

[a] Significant differences for the mean intakes among face-to-face interview and the other two interview approaches.

[b] Significant differences for the mean intakes among face-to-face interview and the first telenutrition interview.

Table 3. Comparison of the mean energy intake, energy contribution from macronutrients and selected nutrients of patients with type 2 diabetes between the two telenutrition interviews

	Interview approaches *		
	Telenutrition (1st) (n = 68)	Telenutrition (2nd) (n = 68)	*P* value
Energy (kcal)	1154.3 ± 49.2	1197.2 ± 66.6	0.497
Energy from protein (%)	16.5 ± 0.8	16.3 ± 0.6	0.809
Energy from carbohydrate (%)	57.7 ± 1.3	58.6 ± 1.2	0.576
Energy from fat (%)	25.6 ± 1.2	24.9 ± 1.1	0.703
Protein (g)	46.8 ± 2.3	47.1 ± 2.7	0.930
Carbohydrate (g)	168.5 ± 7.6	176.9 ± 10.1	0.332
Total fat (g)	34.9 ± 2.6	35.4 ± 3.3	0.885
Saturated fatty acids (g)	9.4 ± 0.6	9.6 ± 0.7	0.874
Mono unsaturated fatty acids (g)	9.7 ± 0.8	11.1 ± 1.7	0.482
Poly unsaturated fatty acids (g)	10.8 ± 1.3	10.2 ± 1.2	0.689
Linoleic acid (g)	9.42 ± 1.25	8.70 ± 1.15	0.629
Linolenic acid (g)	0.22 ± 0.06	0.13 ± 0.02	0.130
Cholesterol (mg)	128.8 ± 14.7	117.8 ± 11.8	0.551
Fiber (g)	11.1 ± 0.8	11.8 ± 0.7	0.449
Soluble fiber (g)	0.37 ± 0.04	0.33 ± 0.03	0.479
Insoluble fiber (g)	1.87 ± 0.17	1.95 ± 0.16	0.677
Calcium (mg)	599.2 ± 43.1	583.1 ± 41.3	0.723
Iron (mg)	10.5 ± 0.7	11.1 ± 0.7	0.393
Zinc (mg)	5.3 ± 0.3	5.3 ± 0.3	0.946
Potassium (mg)	1924 ± 104	1911 ± 92	0.916
Thiamin (mg)	1.21 ± 0.06	1.21 ± 0.07	0.990
Riboflavin (mg)	1.17 ± 0.06	1.19 ± 0.07	0.797
Folate (µg)	154.1 ± 17.0	169.5 ± 12.6	0.446
Vitamin A (RE)	562.7 ± 83.6	480.3 ± 46.9	0.383
Vitamin D (µg)	0.7 ± 0.1	0.6 ± 0.2	0.920
α-Tocopherol (mg)	4.3 ± 0.4	4.4 ± 0.4	0.864
Vitamin C (mg)	66.4 ± 5.7	68.3 ± 5.5	0.789

* Paired *t* test, comparison of (Mean ± SE) the mean energy intake and selected nutrient intake between the two interview approaches.

Table 4. Comparison of the mean energy intake, energy contribution from macronutrients and selected nutrients of patients with type 2 diabetes calculated through face-to-face interview versus two telenutrition interviews

	Interview approaches *		
	Face-to-Face (n = 68)	Telenutrition (1st & 2nd) (n = 68)	*P* value
Energy (kcal)	1414.9 ± 55.0	1168.2 ± 48.3	< 0.001
Energy from protein (%)	15.2 ± 0.5	16.5 ± 0.5	0.076
Energy from carbohydrate (%)	58.8 ± 1.2	57.6 ± 1.0	0.356
Energy from fat (%)	25.9 ± 1.2	25.8 ± 0.9	0.897
Protein (g)	54.2 ± 2.4	47.6 ± 2.0	0.024
Carbohydrate (g)	210.9 ± 8.6	171.9 ± 7.7	< 0.001
Total fat (g)	43.4 ± 3.0	34.8 ± 2.1	0.002
Saturated fatty acids (g)	10.6 ± 0.7	9.5 ± 0.5	0.093
Mono unsaturated fatty acids (g)	12.2 ± 0.9	10.3 ± 0.9	0.077
Poly unsaturated fatty acids (g)	14.7 ± 1.5	10.3 ± 0.9	0.001
Linoleic acid (g)	13.04 ± 1.49	8.84 ± 0.85	0.001
Linolenic acid (g)	0.14 ± 0.02	0.15 ± 0.02	0.436
Cholesterol (mg)	124.5 ± 12.4	123.1 ± 9.7	0.926
Fiber (g)	14.3 ± 1.0	11.4 ± 0.6	0.005
Soluble fiber (g)	0.55 ± 0.06	0.34 ± 0.03	0.002
Insoluble fiber (g)	2.66 ± 0.30	1.91 ± 0.14	0.011
Calcium (mg)	633.3 ± 40.6	590.0 ± 36.0	0.237
Iron (mg)	13.1 ± 0.7	10.7 ± 0.6	0.003
Zinc (mg)	6.2 ± 0.3	5.3 ± 0.2	0.009
Potassium (mg)	2457 ± 117	1919 ± 79	< 0.001
Thiamin (mg)	1.43 ± 0.06	1.20 ± 0.05	0.001
Riboflavin (mg)	1.34 ± 0.07	1.18 ± 0.05	0.020
Folate (µg)	198.4 ± 17.4	161.3 ± 11.1	0.031
Vitamin A (RE)	687.4 ± 60.9	488.3 ± 39.9	0.001
Vitamin D (µg)	0.6 ± 0.1	0.6 ± 0.1	0.841
α-Tocopherol (mg)	6.4 ± 0.8	4.2 ± 0.3	0.007
Vitamin C (mg)	104.1 ± 7.6	67.2 ± 4.4	< 0.001

* Paired *t* test, the differences (Mean ± SE) of the mean energy intake and selected nutrient intake among the interview approaches.

who cannot visit a face-to-face interview for example during the COVID-19 pandemic (4). A few studies demonstrated that telenutrition approaches were a preferable option in these circumstances. They proposed that telenutrition interview was a practical and valid tool for collecting 24-hour dietary recall data. They indicated that the advantages of telenutrition were cost-effective and capable of gathering data from a large sample sizes and from individuals in geographic areas with widely scattered populations (3,7,8,16). On the other hand, some researchers revealed that the telenutrition interview was comparable to the face-to-face interview in collecting dietary data (13,17,18) provided using a structured interview or closed-ended questionnaire (13). The interviewer bias effect was the other limitation that caused the vulnerability of the 24-hour dietary recall method (18) and for this, we used only one interviewer for all interviewees and for both interview sessions in this study. However, our study revealed that telephone interview underreports and underestimates the total nutrient intakes compared with the face-to-face interview in the 24-hour dietary recall. Nevertheless, in a study performed by Briefel et al, in the third National Health and Nutrition Examination Survey on the US population by a mobile examination survey (a kind of telenutrition), underreporting of energy intake was reported. In that survey underreporting was higher in women and people who were older, overweight, or trying to lose weight (11). It seems that to some extent the over- or underreporting depends on sex, age or the underlying diseases of the interviewees. The underestimation of total energy and selected nutrients intake of participants with T2DM in

telenutrition method found in the present study may be due to the fact that in face-to-face interviews, interviewee can explain daily food intake in more detail. Figure 1 compares the advantages and disadvantages of the face-to-face and telenutrition interviews.

The response rate for food items in the face-to-face interview was considerable, while more data was being deleted or missed in the telephone interview (12). Complete population coverage for sampling, item response, completion of the questionnaire, survey response, length of verbal response/amount of information, and respondents' preferences for mode of administration were high for a face-to-face interview; while, these factors were low for a telenutrition interview. It should be noted that interviewer bias for both of the interviews exists (19). It is recommended that the defects of telenutrition method to be overridden by combining it with some features of face-to-face interview. During conditions such as COVID-19 outbreak it may be possible to send the color pictures of the foods or their measuring cups to the interviewee by communication applications such as WhatsApp before interview, and employ this application instead of telephone call to complete the questionnaire while the interviewee is looking at the pictures simultaneously. We may call this method as "face-to-face telenutrition". Similar facilities have been used in conditions with restricted face-to-face communication as blended learning in patients during the pandemics (20). This would resolve the concerns about incomplete evaluation and defective communication in the telenutrition approach. Precise principles and well-designed guidelines may be developed to make telenutrition as effective as face-to-face interview (21).

Strengths and Limitations

The noticeable strength of this study was comparison of the results received between face-to-face interview and telenutrition interviews where the researcher cannot contact or meet the patient directly in COVID-19 pandemic and similar situations. The other strength was to assess the dietary intake by the 24-hour recall in patients with T2DM for the first time, because of nutrition assessment in these patients possesses clinical importance. Limitations include some factors such as mood, attention, spirit, and intelligence that were integral parts of this kind of dietary intake assessment.

Conclusion

We conclude that telenutrition underreports and underestimates the total energy and nutrient intakes compared with the face-to-face interview in the 24-hour dietary recall. Therefore, we cannot recommend that telenutrition be applied interchangeably with a face-to-face interview for dietary intake assessment during the COVID-19 pandemic and similar circumstances, especially in patients whose nutrition assessment is of clinical importance. A combined "face-to-face telenutrition" using new communication applications (e.g. WhatsApp) may compensate for the defects of telenutrition method.

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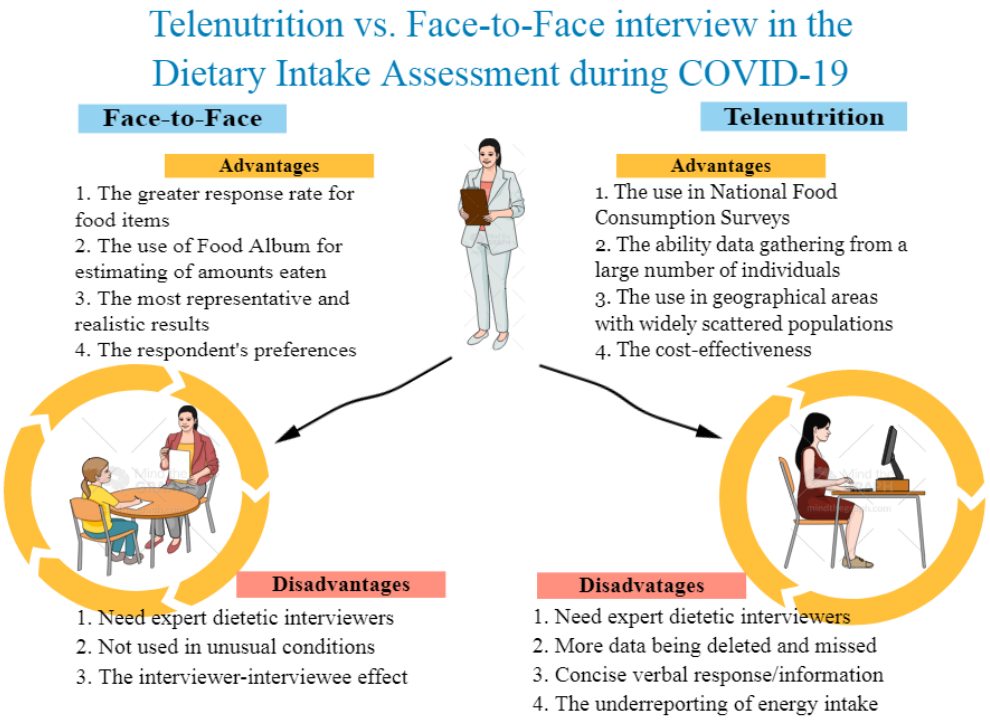

Figure 1. Comparison of the advantages and disadvantages of face-to-face and telenutrition interviews

Authors' Contribution
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Competing Interests
No potential conflict of interest is reported.

Consent for Publication
Not applicable.

Data Availability Statement
The data that support the findings of this study are available from the corresponding author, subject to providing reasonable request.

Ethical approval
The Research Ethics Committee of the Kerman University of Medical Sciences approved the study protocol (Ethical code: IR.KMU.REC.1398.014).

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