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ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

Social participation and diabetes control in Cypriot adults
A cross-sectional study

OBJECTIVE To examine the association between dietary behavior, social engagement and participation, and diabetes control among Cypriot adults with diabetes mellitus (DM). **METHOD** Adults aged between 18 and 75 years, diagnosed with DM, type 1 or type 2, were eligible for inclusion in the study. A questionnaire on general sociodemographic data, and health, nutritional and social factors was administered. The primary outcome was diabetes control as assessed by the mean fasting glucose (FG) levels of the last 3 months. **RESULTS** The sample consisted of 297 adults (59% men and 41% women), with an average age of 60.9 years (range 19–73 years), most of whom were married with children. More than half of the participants (61.6%) had mean FG levels above the normal levels (i.e. >126 mg/dL). Increased age was associated with a 0.8% lower risk of uncontrolled DM ($p<0.05$). Higher income was associated with a 3.8% lower risk ($p<0.05$), and increased exercise with a 3% lower risk ($p<0.05$) of uncontrolled DM. Higher frequency of going out for food was associated with a 5.5% higher risk of uncontrolled DM ($p<0.05$). With regard to personal beliefs, believing that DM affects social participation was associated with a 5.8% higher risk ($p<0.05$) of uncontrolled DM. **CONCLUSIONS** Going out for food and personal social perceptions that DM affects social participation are associated with poor control of DM in Cypriot adults.

Diabetes mellitus (DM) is a disease of metabolic dysregulation characterized by elevated levels of blood glucose, with long-term complications. The most common type of DM is type 2 (T2DM), which is usually diagnosed in adults. Type 1 DM (T1DM) is a chronic autoimmune disease with little environmental influence, presenting at a younger age.¹ Poor control of DM increases the risk of developing chronic complications, regardless the type.²

Worldwide, DM has become one of the top 10 causes of death, following a significant increase of 70% since 2000.¹ Based on information from the International Diabetes Federation (IDF), in 2017 there were 451 million adults with DM globally, and this number is predicted to reach 693 million by 2045.³ In the European Union (EU), 58 million adults are estimated to have DM and an increase to 66.7 million is predicted by 2045, highlighting the heavy healthcare burden of DM in Europe. In Cyprus, the prevalence of DM was reported at 9% in 2019, and it is estimated that about 10% of the total population of Cyprus has DM.⁴

The risk of developing DM is determined by the interaction of environmental and genetic factors. The most common environmental risk factors include an unhealthy diet and behavior, excess body weight, physical inactivity,^{4,5} smoking⁶ and psychological stress.⁷ During recent decades, most strategies for prevention of DM have focused on modification of environmental/lifestyle factors,⁸ but it is apparent that these strategies have not been adequately effective, and there is an obvious need for innovative strategies of population-based prevention of DM.

Measures to stop the rapid increase of DM should take into consideration the impact of social factors. Relevant studies suggest that participation in social networks is significantly correlated with health outcomes,^{9–12} including control of DM.¹³ The social network is a concept of ties among groups of people providing a way to view the structural properties of the relationships between them. Based on the literature, five pathways have been suggested for mediating the relationship between social networks and

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Κοινωνική συμμετοχή
και έλεγχος σακχαρώδους
διαβήτη σε Κύπριους ενήλικες.
Συγχρονική μελέτη

Περίληψη στο τέλος του άρθρου

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health outcomes: (a) Social support; (b) social influence; (c) access to healthcare resources; (d) social engagement and participation; and (e) person-to-person contact. The first four pathways could be applicable for people with chronic diseases, such as DM.¹⁴ For this reason we conducted the present study focusing on the pathway of social engagement and participation.

Social engagement and participation can be defined as the individual's participation in several social activities in the society, living with someone else, occupational activities and gathering with friends. There is evidence that suggests that a high level of social engagement and participation appears to facilitate a healthy lifestyle.^{15–22} When developing health promotion programs, it is therefore necessary to take into consideration the impact of social engagement and participation, in addition to other lifestyle factors, and to try to improve social engagement and participation rather than modifying individual lifestyle behaviors alone.

To our knowledge, the relationship between dietary behaviors, social engagement and participation, and DM have not been explored, and related studies are scarce. To date, no study in Cyprus has directly compared the influence of dietary behaviors and social engagement and participation in people with DM. The present study, therefore, aimed to examine the association between dietary behaviors, social engagement and participation, and control of DM among Cypriot adults.

MATERIAL AND METHOD

Sample recruitment

Participants were recruited from public hospitals in Cyprus by a registered dietician. All participants included in the study were aged between 18 and 75 years, and had a diagnosis of T1DM or T2DM, regardless of the years of diagnosis or their method of treatment. In total, 294 adults, 41.2% women and 58.8% men, agreed to participate and signed the informed consent form, which had been approved by the Cypriot Bioethics Committee and the Office of the Commissioner for Personal Data Protection.

Data collection

A questionnaire covering sociodemographic, health and nutritional/social data was administered. The questionnaire had been developed based on focus group discussions about social participation and social needs conducted in a previous study by the same researchers²³ as a part of a European Research Project.²⁴ The questionnaire consists of three main parts. The first part included questions related to the socioeconomic and demographic

background of the participants (occupation, marital status, family income, having children, level of exercise); the second part included questions related to health status [type of DM, age at diagnosis, mean fasting glucose (FG) levels of the previous 3 months, type of medical treatment, health status and the effect of the disease on their financial status]; the third part included questions related to nutrition, dietary behavior and social activities/social participation.

Control of diabetes mellitus

The primary outcome in the study was control of DM, as assessed by the mean FG levels of the previous 3 months. Specifically, a mean FG >126 mg/dL was considered to indicate uncontrolled DM, and a mean FG <126 mg/dL was considered adequate control, based on the guidelines of the American Diabetes Association (ADA).²⁵

Dietary behavior and social engagement and participation

The main predictors explored in the study were dietary behaviors, social engagement and participation, which were assessed by questions on the frequency of eating out, buying takeaway food, inviting people home, and cooking at home. In addition, concerning personal beliefs, the participants were asked whether they believe that DM affects social participation.

Statistical analysis

Descriptive statistics were used to summarize the baseline sociodemographic characteristics. Normally distributed numeric variables were presented as mean±standard deviation (SD). Categorical variables were presented as absolute (n) and relative (%) frequencies.

A multiple linear probability model (LPM) was used to explore the correlation of uncontrolled DM with other attributes that capture the dietary behavior, social engagement and participation. To overcome the limitations of the LPM, a more sophisticated discrete model, the probit model, was used. Probit models are most often estimated using the maximum likelihood procedure. The dependent variable is a discrete variable with only two values; equal to unity in the case of uncontrolled DM and zero otherwise. The probit model was adjusted for explanatory variables as described above.

RESULTS

Personal characteristics and socio-economic background

The characteristics of the participants and the summary statistics of the variables used in estimations are shown in table 1. The sample consisted of 297 adults (59% men and 41% women), ranging in age from 19 to 73 years with a mean age of 60.9 years. A high proportion were married with children (83.3% and 86.05%, respectively). With regard

Table 1. Demographic and behavioral characteristics of a sample of adult patients with diabetes mellitus (DM) in Cyprus (n=297).

Total sample (n=297)	Mean (\pm SD)
Gender (male)	58.85% (n=175)
Age (years)	60.90 \pm 11.06
Type 1 DM	12.24%
Fasting glucose levels last 3 months (mg/dL)	144.1 \pm 39.77
Uncontrolled DM	61.56%
Marital status	
Married	83.30%
Single	16.70%
Have children	86.05%
Annual family income (€)	
Up to 11,000	27.40%
11,001–15,000	23.13%
15,001–20,000	15.31%
20,001–25,000	14.51%
25,001–30,000	9.86%
More than 30,000	13.61%
Educational level	
Primary or less	31.0%
Secondary	42.0%
Upper secondary	11.0%
Tertiary	16.0%
Frequency of exercise	
Every day	24.15%
3–5 times per week	12.93%
1–2 times per week	7.48%
2–3 times per month	7.48%
1 time per month	5.44%
Never	42.52%
Frequency of going out for food	
Every day	1.70%
3–5 times per week	2.38%
1–2 times per week	14.63%
2–3 per month	17.69%
1 per month	32.65%
Never	30.95%
Takeaway food	
Yes	45.58%
No	54.42%
Invite people at home	
Yes	78.57%
No	21.43%
Cooking at home	
Yes	96.94%
No	3.06%
Effect of DM on social participation (personal beliefs)	
None at all	59.86%
Very little	13.27%
To some extent	11.56%
Quite a lot	11.22%
Very much	4.08%

Values are presented as mean \pm standard deviation (SD) for quantitative variables and relative frequencies for qualitative variables

to the mean FG levels over the previous 3 months, more than half of the participants (61.6%) recorded a mean FG level above the normal limit, i.e. >126 mg/dL.²⁵ Many of the participants reported that they never exercise (42.52%), while a lower percentage (24.15%) reported that they exercise on a daily basis. Regarding educational status, the highest proportion (73.0%) has completed secondary education. With regard to income, a significant proportion of participants (27.4%) reported a very low annual family income (below € 11,000); the lowest proportions reported an annual family income of € 25,001–30,000 (9.86%), or more than € 30,000 (13.61%).

Regarding social engagement and participation, around one third of the participants reported that they never go out and almost one third that they go out very rarely (once a month). The rest of the participants (36.4%) reported going out more often (daily, weekly and monthly). The majority of the participants invite people home (78.57%) and almost all reported that they cook at home (96.94%). More than half of the participants (59.86%) reported that DM has no effect on their social participation and 40.83% reported from very little to very great effect.

Table 2 presents the results from the probit regression model, indicating standard errors, p-values and confidence index (CI) for the explanatory variables. All standard errors (SE) have been corrected for heteroscedasticity. Table 2 presents both the probabilities of each respective explanatory variable (column 1) but also, for interpretation reasons, the respective marginal effects (last column). As shown, increased age is associated with a 0.8% (p<0.05) lower risk of uncontrolled DM, having a higher income is associated with a 3.8% (p<0.05) lower risk of uncontrolled DM, and participation in exercise is associated with a 3% (p<0.05) lower risk of uncontrolled DM. With regard to dietary behavior and social engagement and participation, higher frequency of going out for food was associated with a 5.5% higher risk of uncontrolled DM (p<0.05). Concerning personal beliefs, believing that DM affects social participation was associated with a 5.8% higher risk of uncontrolled DM (p<0.05).

DISCUSSION

It is well known that nutrition therapy enables people with DM to manage their disease effectively, to prevent complications and to achieve good quality of life (QoL).²⁶ Although the need for data on the association between DM, dietary behavior and social networks, including social engagement and participation, has been expressed repeat-

Table 2. Factors associated with control of diabetes mellitus (DM) in adult Cypriots (n=297): Probit Regression Model.

Discrete model	Coeff	Robust* SE	p-value	95% CI		Marginal effects for coeff (β)
Dep Var: Uncontrolled (=1)	β					
<i>Personal and socioeconomic characteristics</i>						
Gender (males)	0.297	0.165	<i>0.071</i>	-0.026	0.620	0.113
Age	-0.020	0.009	<i>0.028</i>	-0.038	-0.002	-0.008
Type of DM	-0.120	0.267	0.655	-0.644	0.404	-0.046
Income	-0.101	0.049	<i>0.039</i>	-0.198	-0.005	-0.038
Educational level	-0.052	0.085	0.543	-0.219	0.115	-0.020
Having children	0.352	0.332	0.288	-0.298	1.002	0.137
Married	-0.079	0.309	0.798	-0.685	0.527	-0.030
<i>Dietary behaviour and social participation</i>						
Frequency of going out for food	0.146	0.074	<i>0.048</i>	0.001	0.290	<i>0.055</i>
Takeaway food	0.204	0.165	0.215	-0.119	0.527	0.077
Invite people at home	0.265	0.202	0.189	-0.130	0.660	0.102
Cook at home	-0.456	0.496	0.358	-1.428	0.516	-0.157
Effects of DM on social participation	0.154	0.069	<i>0.026</i>	0.019	0.289	<i>0.058</i>
Frequency of exercise	-0.078	0.038	<i>0.038</i>	-0.152	-0.004	-0.030
Type of DM	-0.120	0.267	0.655	-0.644	0.404	-0.046
Income	-0.101	0.049	<i>0.039</i>	-0.198	-0.005	-0.038
Education level	-0.052	0.085	0.543	-0.219	0.115	-0.020
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SE: Standard error, CI: Confidence interval

*Robust SE: Standard errors have been corrected for heteroscedasticity; significance: $p < 0.05$; significant relationships shown in italics

edly,⁹⁻¹³ relevant studies are scarce. This study examined the association between dietary behavior, social engagement and participation and control of DM in Cypriot adults with DM, and showed that younger people, with lower family income, and who are less active are at higher risk of uncontrolled DM. With regard to social engagement and participation, the frequency of going out for food was positively associated with uncontrolled DM, as was the personal belief that DM affects social participation.

Most of the study participants were married with children, but none of these sociodemographic factors was as-

sociated with control of DM. It is documented that people who live alone tend to have an unhealthy diet,²⁷ and that they may not receive adequate social support from family members, close friends or coworkers, which can contribute to unhealthy behavior.^{28,29} Our study showed no such significant association, probably because of the sample size, which included only 16.7% single participants and 13.9% participants without children.

Our results demonstrated that people with DM of higher financial status appear to be at lower risk of poor control than people with a lower income, in line with previ-

ous studies. Poor people may be more vulnerable to DM because of unhealthy living conditions, limited access to healthy food and high-quality health care and reduced opportunity to prevent and or treat complications.³⁰ Concerning exercise, there is already a consensus that regular exercise is associated with higher QoL and better health outcomes in people with DM^{31,32} and this is also confirmed by our study. With regard to age, although the relative risk was very low (0.8%), the older people in the sample were less likely to present uncontrolled DM, probably because older people are more conscious of the fact that adhering to the treatment regime is crucial for better management of the disease, although previous studies reported that among older adults, the prevalence of non-adherence to treatment is as high as 50%.^{33–36} Further studies are required to clarify these associations, in order to identify high-risk age groups when developing health promotion programs for people with DM.

Among the studied factors of dietary behavior, social engagement and participation, it appears that only the frequency of going out for food is associated with the risk of uncontrolled DM. Based on previous data, participation in social networks through social engagement can decrease the negative health effects of social isolation³⁷ and increase opportunities for receiving social support from other network members, thereby contributing to prevention of DM, but these findings refer to prevention of DM, and not management. Other studies have also reported that eating less meals away from home is associated with better health outcomes.³⁸ To our knowledge, this is the first to examine the association between participation in social activities and control of DM. Although going out for food is a part of social engagement and participation, and based on previous data might be expected to be associated with better control of DM, our findings were the opposite. A possible explanation is lack of nutritional awareness; when people with DM go out for food, they need to be adequately informed of the appropriate choices of food to order, to conform to their dietary requirements. Another possible explanation could be the low availability of healthy food choices for patients with DM who want to eat out. Including healthy food choices in menus suitable for common chronic diseases, such as DM is of great importance and should be considered as an effective strategy for promotion of management of DM in terms of a healthy and adequately socialized lifestyle.

Also, notable in our findings was that other behaviors related to social engagement and participation, such as inviting people home, cooking at home and buying take-away food, were not significantly associated with control of DM. Notably, previous research demonstrated correla-

tion between eating home-cooked meals and beneficial health outcomes.³⁸ Specifically, one cross-sectional study found that eating home-cooked meals more frequently is associated with lower adiposity, better diet quality,³⁹ and many other health benefits.^{40,41} Further research is required, through larger prospective studies, to identify the effect of such behaviors on the optimal control of DM.

Previous studies have indicated that personal perceptions of illness can influence the willingness of patients to engage in various lifestyle activities.^{42,43} Our study indicated that if a person with DM believes that the disease affects social participation, the risk of uncontrolled DM is increased. Research findings support the concept that the way of talking to patients about the diagnosis and treatment of DM should be based on their individual beliefs about their disease^{44,45} and that health professionals can influence those beliefs and ideas of patients about the disease that are related to with disease self-management, with favorable results.^{46,47} It is therefore advisable for the health professionals to discuss with patients their personal beliefs and ideas about DM, and counsel accordingly. Based on our findings, it appears that negative beliefs could impede control of DM. In such a case, the health professionals should discuss with their patients the evidence that DM is compatible with their participation in social activities, provided nutritional planning is made for optimal control of DM.

One of the strengths of this study is that the data reported represent, to the best of our knowledge, the first nationwide examination of the association between various dietary and social behaviors and control of DM. Several limitations of this study should be acknowledged, one of which is that all the data derived from the questionnaires were self-reported, which could lead to misreporting and information bias. In addition, there was a referral bias, since all the patients were recruited from hospitals rather than the community. The use of mean FG over 3 months as the measurement of control of DM is another limitation. The most commonly used index of control of DM is glycosylated hemoglobin (HbA_{1c}),²⁵ but access to the medical records was not feasible, and since participants were more familiar with their mean FG levels because of frequent self-monitoring, we decided to use mean FG instead of HbA_{1c} as the outcome measure.

Our overall conclusion, based on the current findings, is that health professionals should be careful when encouraging people with DM to engage in social activities, and particularly eating out. Social engagement and participation of people with DM should be conducted with care, and always under the supervision of health specialists,

with particular attention to dietary behavior, to ensure an optimal control of DM. The enrichment of nutritional education related to social participation could have the potential to treat lifestyle-related diseases, including DM, more effectively.

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ΠΕΡΙΛΗΨΗ

Κοινωνική συμμετοχή και έλεγχος σακχαρώδους διαβήτη σε Κύπριους ενήλικες. Συγχρονική μελέτη

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ΣΚΟΠΟΣ Εξέταση της πιθανής συσχέτισης μεταξύ διατροφικών συμπεριφορών, κοινωνικής συμμετοχής-δραστηριότητας και ελέγχου του διαβήτη σε Κύπριους ενήλικες. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Ενήλικες ηλικίας 18–75 ετών, με διάγνωση διαβήτη (τύπου 1 ή τύπου 2), επιλέχθηκαν για ένταξη στην παρούσα μελέτη. Σε όλους τους συμμετέχοντες δόθηκε ένα ερωτηματολόγιο με σκοπό τη συλλογή πληροφοριών σχετικά με το κοινωνικο-δημογραφικό προφίλ, τις διατροφικές συνήθειες και τις κοινωνικές δραστηριότητες. Ο έλεγχος του διαβήτη αξιολογήθηκε με βάση τα μέσα επίπεδα γλυκόζης νηστείας του τελευταίου τριμήνου. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Το δείγμα αποτέλεσαν 297 ενήλικες (59% άνδρες και 41% γυναίκες). Ο μέσος όρος ηλικίας ήταν τα 60,9 έτη (19–73 έτη). Περισσότεροι από τους μισούς συμμετέχοντες (61,6%) είχαν μέσα επίπεδα γλυκόζης νηστείας πάνω από τα φυσιολογικά επίπεδα (>126 mg/dL) και οι περισσότεροι από αυτούς ήταν παντρεμένοι με παιδιά. Περαιτέρω ανάλυση έδειξε ότι η αυξημένη ηλικία σχετιζόταν με 0,8% ($p<0,05$) χαμηλότερο κίνδυνο μη ικανοποιητικού ελέγχου του διαβήτη. Επί πλέον, το υψηλότερο εισόδημα σχετιζόταν με 3,8% ($p<0,05$) χαμηλότερο κίνδυνο μη ικανοποιητικού ελέγχου του διαβήτη. Επίσης, η αυξημένη άσκηση σχετιζόταν με 3% ($p<0,05$) χαμηλότερο κίνδυνο μη ελεγχόμενου διαβήτη και η αυξημένη συχνότητα εξόδου για φαγητό με 5,5% ($p<0,05$) υψηλότερο κίνδυνο μη ικανοποιητικού ελέγχου του διαβήτη. Όσον αφορά στις προσωπικές πεποιθήσεις, η πεποίθηση ότι ο διαβήτης επηρεάζει την κοινωνική συμμετοχή-δραστηριότητα φάνηκε να σχετίζεται με 5,8% ($p<0,05$) υψηλότερο κίνδυνο μη ελεγχόμενου διαβήτη. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Η έξοδος για φαγητό και οι προσωπικές κοινωνικές πεποιθήσεις συνδέονται θετικά με τον κίνδυνο μη ελεγχόμενου διαβήτη.

Λέξεις ευρετηρίου: Διαβήτης, Διατροφική συμπεριφορά, Έλεγχος διαβήτη, Κοινωνική δραστηριότητα, Κοινωνική συμμετοχή

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