Relationship Between Early Onset Type 2 Diabetes Mellitus And Late-Night Dinner Along With Skipping Breakfast In AL Madinah, Saudi Arabia: Case Control Study

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Abstract

The aim of this study is to detect the magnitude of bad nutritional habits and assess the strength of association between T2DM and late-night dinner and skipping breakfast in Medina, Saudi Arabia.

Methods: A case control study was conducted at Diabetic centre and PHC centres. The cases were Early-onset T2DM (30–45 years of age). A self-administered questionnaire consisted of three parts including socio-demographic information, eating behaviors and questions focusing on DM. Data were analyzed by using SPSS version 28 statistical package software.

Results: A total 47 cases with diabetes mellitus type 2 and 188 controls were included. Cases were more prone to be obese with median BMI 30.5. Overall, 74.5% of cases were reported to be physically inactive. 72.4% of cases were skipping breakfast weekly as compared to 65% of controls [p-value 0.015]. Smoking, frequency of exercise, BMI and frequency of eating of fast food were found to be significant risk factors for developing T2DM with OR 4.0, 3.6, 5.5 and 2.0 respectively.

Conclusions: Our data confirmed that skipping breakfast and late-night dinner were prevalent, and many risk factors associated with diabetes mellitus have been identified. Therefore, we recommend introducing health education programs to address misconceptions towards prevention and better control of diabetes mellitus.

Keywords: Diabetes mellitus type 2, skipping breakfast, late-night dinner.

Introduction

Diabetes mellitus (DM) is rapidly becoming one of the main health issues in the 21st century and the number of patients is steadily increasing, both in the developed and developing countries.

The World Health Organization (WHO) has reported that Saudi Arabia ranks the second highest in the Middle East and is seventh in the world for the rate of diabetes(1).
T2DM is the most common form of DM, which accounts for 90% to 95% of all diabetic patients and according to the IDF, adult diabetes prevalence in Saudi Arabia is 18.3%(2,3).

Although there are a variety of factors affecting the development of type 2 diabetes, lifestyle habits typically associated with urbanization are likely the most important ones.(4).

Ending dinner early and fasting until breakfast provides an ample opportunity for the body to "run low" on glucose and glycogen and begin to metabolize a larger percent of stored body fat (5).

There is lack of evidence-based recommendations regarding eating habits (timing, quantity, energy content, and frequency) in adults in most nutritional guidelines (6). In a study conducted in October 2013, they found breakfast skipping was significantly associated with higher HbA1C values, even after adjusting for age, sex, race, BMI, and percentage of daily caloric intake at dinner. An additional study in Japan also found such has been suspected as a risk factor for type 2 diabetes, but the associations are not entirely consistent across ethnicities or sexes(7,8) .

Rong et al's study reported that skipping breakfast was significantly associated with the risk of cardiovascular mortality(9). So, improved understanding of the impact of skipping breakfast on the onset of diabetes may help to inform guideline development and public health interventions.

We hypothesized that late night dinner and skipping breakfast has an association with increased risk of T2DM. This association is well studied overall though but there is little published data available on the Saudi population.
Thus, we conducted this case control study to detect the magnitude of these bad nutritional habits and to assess the strength of association between T2DM and late-night dinner and skipping breakfast.

Subjects and Methods

Study Design and Setting
A case control study was carried out in Madinah, Saudi Arabia from 5/2021 to 2/2022

The cases were Early-onset T2DM (30–45 years of age), selected from the Diabetic centre and PHC centres; we chose this age group to control the effect of aging and genetic causes of T2DM.

The controls were group matched with cases as 4:1 ratio.

Selection of cases
The inclusion criteria were adults with type 2 diabetes, aged between 30-45, non-insulin dependent diabetes mellitus, or late-onset diabetes (above 45 years old).

The exclusion criteria were patients with type 1 diabetes, impaired glucose tolerance, metabolic syndrome, maturity onset diabetes of youth, and gestational diabetes and new onset diabetes after organ transplant.

Sample size was calculated by Epi info, with 95% confidence interval and 80% power. The proportion of controls with exposure was 35. The total sample size was calculated as 235 participants and 47 of them were cases.

Data Collection Tools and Instruments
The data was collected by using a self-administered semi-structured questionnaire which included two parts:
Part I: questions on socio-demographic information such as age, gender, smoking status, BMI, exercise status, and doing exercise 3 to 4 times per week was considered regular physical activity.
Part II: The UK Diabetes and Diet Questionnaire was used, which focuses on three eating behaviors (having a bedtime snack, having a late dinner, and skipping breakfast) over the last six months and was assessed. Having bedtime snacks at least three times per week was considered positive. Having dinner within 2 hours before bedtime at least three times per week was considered a late dinner and skipping breakfast at least three times per week was considered skipping breakfast.
Part III: questions focusing on DM, as type of diabetes, how long they had been diagnosed with diabetes, using insulin and so on.

Pilot study:
Before the start of the study, the semi-structured questionnaires were pre-tested on 10 patients to explore if there was any ambiguity or items leading to misunderstanding in order for the questionnaire to reach its current final form. The findings of the pilot study were not included in the final analysis.

Statistical Analysis
Data was coded, entered, and analyzed using the Statistical Package for Social Science (SPSS) version 28.0 (SPSS, Chicago, IL, USA). We calculated odds ratios using unconditional logistic regression. Chi square and t-test were used to compare between categorical and continuous variables, respectively. Statistical significance was taken as <0.05.

Ethical considerations:
Official permission was obtained from the scientific ethical committee of the Ministry of Health. Informed consent was obtained from all the participants after describing the aim of the study. Privacy and confidentiality was duly assured.

Results

Cases were found to be significantly older (P=0.02) than controls, but they were equally distributed regarding gender. We found that 38.3% of cases were smokers as compared to only 15.4% of controls with p<0.001. Cases were more prone to be obese with median BMI 30.5 in contrast to BMI of controls which was in the range of overweight (median 26.6) and which was still considered as a risk for developing T2DM.

Overall 74.5% of cases were reported to be physically inactive in comparison to 55.3% of controls; walking was noted as the main type of physical activity among 71.8% of controls and 57.4% of cases. Both groups were found to have inadequate sleep pattern with no significant difference regarding average night sleep as 80.9% of cases sleep less than 5-6 hours while it was 67% in controls. [See Table 1].

More than one third (38%) of controls were eating snacks usually after dinner as compared to 40.4% of cases with a statistically higher significant (p value 0.001) trend among cases.

Cases and controls usually reported as eating dinner within 3 hours of bedtime, 74.5%, 72.4% respectively.

Regarding breakfast, 72.4 of cases were skipping breakfast weekly while 35% of controls were regularly eating breakfast which is a significant difference (p value 0.015) and those eating breakfast, used to have it within 2 hours of waking up, 53.2%, 56.4% respectively.

Moreover, it was found that controls were more likely to eat dinner before 8 pm and at regular times.

It was noted that both groups had bad dietary habits of not eating enough fruit & vegetables 17%,17.6%, also both groups have a low fibre diet, 63.8%, 54.3% for cases and controls respectively

Both groups do not eat processed meat but cases were more prone to eat fast food than controls ; (61.7%, 42.6% respectively) and the difference was statistically significant (p value 0.01).

It was reported that 78.2% of controls used to drink full fat or skimmed milk compared to 85.1% of cases (p value 0.001).

From Table 2 we noticed of most patients diagnosed with diabetes for more than 6 months 25.6% of them were on diet and exercise only since diagnosis and they did not use medication and most of them, 74.5%, did not complain of any other disease.

Table 3 shows that smoking habit, exercise frequency, BMI and frequency of eating fast food all significantly showed risk factors for developing T2DM with OR 4, 3.6, 5.5 and 2 respectively.

Nonetheless, male gender, eating dinner at a regular time, eating high fibre diet and drinking milk were protective factors, but without any significant difference.

On applying binary logistic regression, 82% of the predictability of the model is confirmed and also Hosmer test verified that with p value of.48. For every one unit increase in smoking status, exercise and BMI, the logit is increased significantly to 142%, 123% and 143% respectively, while Fast food consumption per unit increase lead to 41% increase in the logit of being diabetic.

Table 1: Characteristics of Cases and Control

Variables	Case (N=47)	Control (N=188)	P value
Age	40(36-44)*	37(34-41)*	0.026
Gender			0.89
Male	23(48.9%)	94(50%)	
Female	24(51.1%)	94(50%)	
Smoking			0.001
Never smoked	19(40.4%)	138(73.4%)	
Quit smoking	10(21.3%)	21(11.2%)	
Light smoker	10(21.3%)	22(11.7%)	
Heavy smoker	8(17%)	7(3.7%)	
Nationality			0.67
Saudi	45(95.7%)	177(94.1%)	
Non-Saudi	2(4.3%)	11(5.9%)	
BMI	**30.5(27.5-34.5)	**26.6 (23.8-30.1)	0.001
Exercise Frequency			0.001
3 to 4 times per week	5 (10.6%)	47(25%)	
1 to 2 times per week	7(14.9%)	57(30.3%)	
1 to 2 times per month	14(29.8%)	47(25%)	
Not at all	21(44.7%)	37(19.7%)	
Exercise Type			0.03
walking	27(57.4%)	135(71.8%)	
jogging	3(1.6%)	3(1.6%)	
yoga	0	2(1.1%)	
strengthening exercise	1(2.1%)	13(6.9%)	
not at all	16(34%)	35(18.9%)	
Average daily night sleep			0.177
less than 5 hours	24(51.1%)	67(35.6%)	
5 to 6 hours	14(29.8%)	59(31.4%)	
6 to 7 hours	5(10.6%)	37(19.7%)	
7 to 8 hours	4(8.5%)	16(8.5%)	
More than 8 hours	0	9(4.8%)	
Eating snack after dinner			0.001
1-2 times per week	5(10.6%)	42(22.3%)	
≥3 times per week	14(29.8%)	30(16%)	
Rarely	11(23.4%)	82(43.6%)	
Not at all	17(36.2%)	34(18.1%)	
Eating dinner within 3 hours before bedtime			0.066
1-2 times per week	6(12.8%)	52(27.7%)	
≥3 times per week	29(61.7%)	84(44.7%)	
Rarely	8(17%)	43(22.9%)	
Not at all	4(8.5%)	9(4.8%)	
Skipping breakfast in last 3 months			0.015
1-2 times per week	6(12.8%)	39(20.7%)	
≥3 times per week	28(59.6%)	83(44%)	
Rarely	2(4.3)	38(20%)	
Not at all	11(23.4%)	28(15%)	

Table 1: Characteristics of Cases and Control (continued)

Eating breakfast within about 2 hours of waking			0.69
Yes	25(53.2%)	106(56.4%)	
No	22(46.8%)	82(43.6%)	
Eating dinner usually before 8 p.m.			0.29
Yes	7(14.9%)	42(22%)	
No	40(85%)	146(77.7%)	
Eating dinner regularly at same time			0.41
Yes	14(29.8%)	45(23.9%)	
No	33(70.2%)	143(76.1%)	
Frequency of eating a vegetables & fruit			0.88
Never or very rarely	2(4.3%)	19(10%)	
Once a week or less	21(44.7%)	75(39.9%)	
2-4 times a week	16(34%)	61(32.4%)	
5-6 times a week	3(6.4%)	14(7.4%)	
1-2 times a day	4(8.5%)	16(8.5%)	
3 or more times a day	1(2.1%)	3(1.6%)	
Frequency of eating higher fibre breads, brown rice or wholegrain pasta / noodles			0.74
Never or very rarely	16(34%)	57(30.3%)	
Once a week or less	14(29.8%)	45(23.9%)	
2-4 times a week	7(14.9%)	37(19.7%)	
5-6 times a week	4(8.5%)	22(11.7%)	
1-2 times a day	6(12.8%)	22(11.7%)	
3 or more times a day	0	5(2.7%)	
Frequency of eating sweets, chocolate or sugary beverage			0.82
Never or very rarely	1(2.1%)	12(6.4%)	
Once a week or less	10(21.3%)	48(25.5%)	
2-4 times a week	16(34%)	61(32.4%)	
5-6 times a week	8(17%)	26(13.8%)	
1-2 times a day	10(21.3%)	32(17%)	
3 or more times a day	2(4.3%)	9(4.8%)	
Frequency of eating processed meat			0.57
Never or very rarely	36(76.6%)	153(81.4%)	
Once a week or less often	8(17%)	19(10.1%)	
2-4 times a week	2(4.3%)	6(3.2%)	
5-6 times a week	0	4(2.1%)	
1-2 times a day	1(2.1%)	6(3.2%)	
3 or more times a day	0	0	
Frequency of eating 'fast foods', crisps, corn chips, full-fat cheese, or butter			0.01
Never or very rarely	2(4.3%)	19(10.1%)	
Once a week or less	16(34%)	89(47.3%)	
2-4 times a week	15(31.9%)	54(28.7%)	
5-6 times a week	4(8.5%)	13(6.9%)	
1-2 times a day	10(21.3%)	10(5.3%)	
3 or more times a day	0	3(1.5%)	

Table 1: Characteristics of Cases and Control (continued)

Type of milk they drink			0.001
Full fat	31(66%)	136(72.3%)	
Semi-skimmed	9(19.1%)	11(5.9%)	
Skimmed	0	26(13.8%)	
Soya, oat, rice or other nondairy milk or None	7(14.9%)	15(8%)	

Table 2: Clinical profile of Cases

Variables	Cases (N=47)
How long they have had diabetes	
Less than 6 months	9(19.1%)
More than 6-12 months	38(80.9%)
Level of HbA1c	7(6.5-9)
Treatment of diseases at the beginning	
Diet	9(19.1%)
Exercise and diet	7(14.9%)
Hypoglycaemic agent	10(21.3%)
Diet and hypoglycaemic	2(4.3%)
Exercise & diet & hypoglycaemic	19(40.4%)
Treatment of diseases at the beginning	
Diet	6(12.8%)
Exercise and diet	6(12.8%)
Hypoglycaemic agent	12(25.5%)
Diet and hypoglycaemic	9(19.1%)
Exercise & diet & hypoglycaemic	14(29.8%)
Complain of other diseases:	
Dyslipidemia	8(17%)
Hypertension	3(6.4%)
Stroke	0
Kidney Disease	0
Dyslipidemia And HTN	1(2.1%)
No Disease	35(74.5%)

Table 3: Association of sociodemographic and eating habits among cases and controls

Variable	Case	Control	OR(95%CI)
Gender			
Male	23(19%)	94(80%)	0.95(0.50- 1.8)
Female	24(20%)	94(80%)	
Smoking			
Yes	28(59.6%)	50(26.6%)	4(2.08 - 7.9)
No	19(40.4%)	138(73.4%)	
BMI			
Overweight	43(91.5%)	124(66%)	5.5(1.9 - 16.1)
Normal	4(8.5%)	64(34%)	
Exercise Frequency			
1 to 2 times per month or less	35(74.5%)	84(44.7%)	3.6(1.7 -7.4)
1 to 4 times per week	12(25.5%)	104(55.3%)	
Average daily night sleep			
Not adequate sleep	24(51.1%)	67(35.6%)	1.9(1 - 3.6)
Adequate sleep	23(48.9%)	121(64.4%)	
Eating snack after dinner			
Yes	19(40.4%)	72(38.3%)	1.1(0.57 - 2)
No	28(59.6%)	116(61.7%)	
Eating dinner within 3 hours before bedtime			
Yes	35(74.5%)	136(72.3%)	1.1(0.5 - 2.3)
No	12(25.5%)	52(27.7%)	
Skipping breakfast in last 3 months			
Yes	34(72.3%)	122(64.9%)	
No	13(27.7%)	66(35.1%)	1.4(0.7 - 2.9)
Eating breakfast within about 2 hours of waking			
No	22(46.8%)	82(43.6%)	1.1(0.5 - 2.2)
Yes	25(53.2%)	106(56.4%)	
Eating dinner usually before 8 pm			
No	40(85%)	146(77.7%)	1.6(0.7 - 4)
Yes	7(15%)	42(22%)	
Eating dinner regularly at same time			
No	33(70.2%)	143(76.1%)	0.7(0.4 -1.5)
Yes	14(29.8%)	45(23.9%)	
Frequency of eating vegetables & fruit			
Less than 2-4 times/week	39(83%)	155(82.4%)	1 (0.44 - 2.4)
More than 5-6 times/week	8(17%)	33(17.6%)	
Frequency of eating higher fibre breads, brown rice or wholegrain pasta / noodles			
Low	30(63.8%)	102(54.3%)	1.5 (0.77 - 2.8)
High	17(36.2%)	86(45.7%)	
Frequency of eating sweets, chocolate, or sugary beverage			
Acceptable	36(76.6%)	128(68.1%)	1.5(0.7 - 3.2)
Not acceptable	11(23.4%)	60(31.9%)	
Frequency of eating processed meat			
Not acceptable	11(23.4%)	35(18.6%)	1.3(0.6 - 2.8)
Acceptable	36(76.6%)	153(81.4%)	

Table 4: Logistic Regression:

Variables	B	S.E.	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Upper
Smoking status	1.426	.368	<.001	4.162	2.024	8.556
Exercise frequency	1.236	.394	.002	3.441	1.591	7.443
BMI	1.434	.570	.012	4.194	1.371	12.825
Fast-food consumption	.410	.369	.267	1.507	.731	3.105
Constant	-.391	.333	.240	.677		

Discussion

The primary aim of this study was to detect the magnitude of bad nutritional habit and assess the association between T2DM and late-night dinner and skipping breakfast in Al Madinah city, Saudi Arabia. This study found that obesity, smoking and being physically inactive are risk factors for T2DM, which is similar to studies conducted in Europe(10–12), Korea(13) and also this study found controls are more likely to be overweight which is a risk factor for developing diabetes and they must control their weight and this is similar to the finding of Radzeviciene L(10).

This study found both groups do not have enough sleep which is risk factor for developing T2DM as reported in a previous study(14). Cases are eating more snacks after dinner and this is most probably to overcome a hypoglycaemic episode, but it is not associated with increased risk of T2DM in contrast to finding of Mekary(15) that found this habit associated with increased T2DM.

Also, this study found approximately 2/3 of cases and control have bad nutritional habits such as skipping breakfast, not eating dinner within 3 hours before bedtime and not eating dinner before 8 pm, but it is not associated with increased risk of T2DM, and this is possibly because both groups have this bad habit with similar percentages and notice that people have the wrong idea, and they think if they are skipping breakfast, they will be healthier. While in previous Japanese studies it was found skipping breakfast was positively associated with T2DM incidence, others found skipping breakfast and late-night dinners were associated with poor glycemic control(8,16,17).

This study found eating fast-food was associated with increased risk of T2DM as in a previous study(18) while consuming milk is protective, but it is insignificant. The same result was found by Liu's study and meta-analysis(19,20).

This study is limited by possibility of recall bias, low response rate in newly diagnosed diabetics and most of them deny that they have a disease. However, this study has several strengths. Firstly, our study design was a case control study. Secondly, there is limited study assessing skipping breakfast and late-night dinner in our middle east countries. Thirdly, this study was carried out in a multicenter rather than one center, so it is possible to generalize our results to diabetic patients elsewhere in Saudi Arabia. Fourthly, in this study 82% of variability is explained by logistic model.

In conclusion, this study indicates that there are widespread bad nutritional habits such as skipping breakfast and late night dinner, and numerous risk factors associated with diabetes mellitus have been identified. Therefore, we recommend to increase health education programs directed to the general population and for diabetic patients specifically to improve their knowledge and influence their attitudes to live healthier lives.

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