



Eating speed and the risk of type 2 diabetes: explorations based on real-world evidence

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Metabolic syndrome, especially diabetes, has gained global attention over the past few decades and became one of the major public health concerns. Alongside known and well-established risk factors, eating behaviors, mainly eating speed has shown the potential as one of the novel risk factors that could supplement the development of diabetes. However, there is a paucity in evidence, and only a few studies have addressed this question so far. In this review, with a focus on eating speed and the risk of developing diabetes, authors attempted to shed some light on the high-quality studies that were conducted around the world using real-world data in drawing inferences, which could add-on to the literature and assist public in making informed decisions.

Keywords: Diabetes, Metabolic syndrome, Eating behaviors, Blood glucose, Insulin resistance

Introduction

Diabetes is a highly prevalent disease that has become one of the major public health concerns these days. Emerging as a world pandemic, in 2019, approximately 463 million adults were living with diabetes globally,¹⁾ and despite that fact, around 46% of the people living with it are unaware and undiagnosed. Also, it is estimated that 1 in every 11 adults of the world population is having diabetes, and the prevalence is expected to reach 700 million by 2045.²⁾ Besides genetic background and environmental factors, risk factors that cause diabetes include advanced age, race/ethnicity, obesity, physical inactivity, high blood pressure, medication intake (i.e., antihypertensives and corticosteroids) and sedentary lifestyle.^{3,4)} It is essential to identify the modifiable risk factors causing diabetes, which are easily preventable. In recent times, the rate of food consumption has been of interest as a risk factor that contributes to the development of diabetes. Although there are considerable studies and established evidence on the relationship between type and amount of food consumption and the risk of diabetes, a few epidemiological studies have investigated this relationship and inferred that there exists a significant association between fast eating and onset of diabetes.⁵⁻⁸⁾ Besides, certain studies addressed this question with a general focus on cardiovascular and metabolic diseases.⁹⁻¹²⁾ The main goal of this review is to inspect the high-quality studies that were conducted around the world using real-world data and draw inferences regarding the association between speed of eating and the risk of diabetes, which could assist the public in making informed decisions.

Mechanisms behind eating fast and the risk of type 2 diabetes

The stomach takes around 20 minutes to signal the brain in sending out signals of fullness. When people eat fast, they tend not to feel full and are more likely to overeat.¹³⁾ The exact mechanism of fast eating leading to diabetes is not fully elucidated; however, there are certain hypotheses in support of this relationship. Firstly, it is believed that free fatty acids

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and adipokines that are produced by the adipose tissue abate insulin sensitivity and intensify insulin demand¹⁴) and thus cause rapid glucose fluctuations, which can lead to serum insulin resistance.⁶ Secondly, there may not be enough time for the secretion of hormones that are responsible for signaling when food is consumed rapidly. Therefore, a sense of fullness is delayed, which results in higher food intake and thereby elevating post-prandial blood glucose levels.⁶ Next, energy intake is lower when the food is consumed slowly, and thus satiety would be higher at the time of meal completion. Thus, eating fast is associated with energy intake and lack satiety.⁵ Furthermore, eating fast reduces the time for mastication, which leads to significantly higher glucose concentrations in the body.¹⁵ Lastly, eating fast could trigger specific cytokines, such as interleukin-1 β and interleukin-6 levels, which eventually increases insulin resistance.¹⁶

Real-world evidence from epidemiological studies

A cohort study conducted in Japan had investigated the association between eating speed and the incidence of type 2 diabetes among 2,050 middle-aged men.⁷ They have measured self-reported categorical eating speed (as slow, medium, and fast), and the incidence of diabetes was measured in annual medical examinations over a period of 7 years. Also, all the covariates were adjusted in determining the association using Cox proportional hazards models. Their study findings inferred that during the study period, 177 participants (8.6%, 15.6/1,000 person-years) developed diabetes, and crude incidence rates across the categories of eating speed were 9.9, 15.6, and 17.3 per 1,000 person-years, respectively. Based on the results, they concluded that eating speed was significantly associated with the risk of developing diabetes. However, after further adjustment of one of the variables, i.e., body mass index (BMI), the association was no more significant, meaning that eating speed might have its impact based on body weight. There are certain limitations with this study; firstly, as the eating speed was assessed by the self-reported method, there might be a higher chance for the reporting bias, and also outcome measures were categorized into those 3 categories, the information regarding the actual objective speed of eating is lacking. Secondly, as most of the study participants had their food sitting together in a common canteen, there are high chances that they could compare their speed of eating to those of other participants and people around which could have introduced bias in their responses (underestimation). Thirdly, the participants included were only those who are employed, meaning the results are not generalizable to the entire country, especially people who are not working, which might be one of the possible reasons for observing the lower incidence of diabetes in their sample than compared to the general Japanese population. Next, as the study design was observational in nature, conducting an interventional study might have better provided with additional information on the causal relationship between eating speed

and diabetes mellitus. Lastly, authors had not determined (or mentioned) whether diabetes that developed was type 1 or type 2; however, assuming that the study participants were middle-aged men, it might be most likely to be type 2 diabetes.

A similar kind of study that was conducted in Japan, which was cross-sectional in nature, had investigated the relationship between the speed of eating and insulin resistance among 3,465 middle-aged nondiabetic men and women.⁶ Authors had used a questionnaire on lifestyle factors and diet history with self-assessment of categorical speed of eating (very slow, relatively slow, medium, relatively fast, and very fast) and energy intake over a period of 1 month, where they had determined insulin resistance using the homeostasis model assessment of insulin resistance (HOMA-IR). They had used multiple regression analysis and adjusted variables such as age, energy intake and lifestyle factors. Their results showed a statistically significant gradual increase in insulin resistance with an increase in eating speed among men and as well as women. However, similar to the above study, after adjusting for BMI, the relationship was noticed only among men. The limitations of this study would be almost in-line with the study as mentioned earlier,⁷ they are, usage of self-reported method which might have led to the reporting bias, study participants had their food sitting together which could impact their responses, participants included were the workers, and of middle-aged leading to nongeneralizable results, the study design was cross-sectional which does not provide information on causal relationship between the exposure and the outcome.

A massive nation-wide study conducted in Japan using data from the nation-wide annual health check program (Specific Health Check and Guidance System) had investigated the relationship between eating speed and the new-onset of diabetes among 197,825 participants without diabetes.⁸ All the diet habits, including eating speed, were collected using a questionnaire, and multivariate-adjusted logistic regression models were used to measure the odds ratio of new-onset diabetes mellitus for a 3-year follow-up period. Their findings reported that fast eating was significantly associated with the increased risk of diabetes mellitus (odds ratio [OR], 1.26; 95% confidence interval [CI], 1.20–1.33; $P < 0.01$). Among participants that ate fast, the number of patients who developed diabetes mellitus was 30.9% compared with 26.1% who did not develop diabetes mellitus, inferring that fast eating is an exclusive predisposing risk factor among all the eating habits for developing new-onset diabetes. The only major drawbacks of this study are under-/overestimation of the outcomes because of the missing data due to lack of available information, not including patients with age under 40 years, which lacks information about juvenile-onset type 2 diabetes, and the observation period in the study was relatively short.

In a large cross-sectional study that was conducted among 7,972 Beijing adult population assessed the association between eating speed and metabolic syndrome (MetS).⁹ Eating speed was categorized into 3 possible responses (i.e., slow, medium, and fast), and outcomes were analyzed using logistic regression. During the study period, the prevalence of MetS was found

to be 24.65% (1,965). Compared with slow eating category participants, the multivariate-adjusted odds ratios of medium eating and fast-eating participants for MetS were found to be 1.65 (95% CI, 1.32–2.07) and 2.27 (95% CI, 1.80–2.86), inferring that eating speed was significantly associated with a high risk for MetS. The major limitations of this study are its study design, i.e., cross-sectional design, which does not infer any causal relationship between fast eating and development of MetS, and other drawbacks would be it is missing data, as a vast number of study participants (i.e., 8,248) who did not complete a questionnaire were excluded from the study which might have biased the results.

In another Japanese study that was published in one of the American Heart Association journals had evaluated the association between eating speed and the prevalence of MetS among 1,083 non-MetS participants.¹⁰⁾ Information on lifestyle factors, such as dietary behaviors and physical activity, as well as medical history, were collected using a self-administered questionnaire, and the participants were categorized based on their eating speed into slow, normal and fast categories. Their findings inferred that during the 5-year follow-up period, around 84 participants developed the MetS, and the incidence rates of MetS among slow, normal and fast-eating categories were 2.3%, 6.5%, and 11.6%, respectively. The incidence of MetS using the multivariate-adjusted hazard ratio in the fast-eating group compared to the normal and slow group was 1.89 (95% CI, 1.21–2.98; $P < 0.05$) and 5.49 (95% CI, 1.30–23.3; $P < 0.05$), inferring a significant risk of developing MetS among participants who are in the fast-eating group.

A case-control study that was conducted in Lithuania (Europe) had evaluated the relationship between eating speed and the risk of type 2 diabetes mellitus among 702 participants (234 cases and 468 controls).⁵⁾ All the information related to the risk factors of type 2 diabetes was collected using a specifically designed self-reported questionnaire and eating speed were self-reported by the study participants. Outcomes were calculated using the OR with 95% CI, and all the confounders were adjusted using the multivariate logistic regression models. The study findings reported that there was more than the 2-fold increased risk for type 2 diabetes among those who ate faster (OR, 2.52; 95% CI, 1.56–4.06) compared to those participants who ate slower. However, there are some limitations for this study which includes, eating speed was not quantified (not objectively measured), outcome measure, i.e., eating speed was subjectively self-reported by the participants which could lead to reporting bias, and self-reporting by the participants may lead to underestimation of the outcome measure, i.e., eating speed.

In Japan, a population-based cohort study had examined the relationship between eating speed and incidence of the MetS among 8,941 middle-aged as well as older adults.¹¹⁾ All the patients, along with their lifestyle factors, were followed for 3 years after the baseline measurements, and the association was measured using Cox proportional hazards models. Their results revealed that after 3 years of follow-up, 647 participants (7.2%) were diagnosed with MetS (25 cases/1,000 person-years). After adjusting for all the potential confounders, the multivariate-

adjusted hazard ratio for the incidence of MetS in the fast-eating group compared to the non-fast-eating group was 1.30 (95% CI, 1.05–1.60), exhibiting a significant association. The major limitation of this study, as discussed earlier with the other studies is, as eating speed was subjectively reported by the study participants, it might have led to reporting bias.

Discussion

There has been a lot of buzz out there over the blogs and various online discussion platforms about the food consumption speed and its effect on the risk of developing diabetes. Unfortunately, none of such discussions have turned into a scientific publication, leaving it as grey information. Furthermore, there are very few researchers who have looked at this relationship, and along these lines, there exists a paucity in the high-quality evidence in this area. Therefore, through this review, authors have thoroughly appraised the high-quality, real-world evidence that was conducted and published around the globe, which could add-on to the literature in this specific area and eventually assists further research. Findings of all the studies that are considered in this review have shown a positive relationship between eating fast & risk of diabetes to various extents, even after controlling for the possible confounders. The exact physiology behind the link between the speed of eating and diabetes is unknown. However, it has been suggested that eating fast may contribute to a delayed feeling of fullness and satiety compared to eating slow.^{17,18)} The literature that has been reviewed in this paper has explicit drawbacks that must be addressed by future studies. Almost all the studies had categorized their study participants into various categories, i.e., slow, normal and fast, subjectively; however, interestingly, none of those studies had indicated the cutoff time points that were considered in making such categories. Moreover, it is surprising that none of these studies have neither mentioned nor discussed the actual length of time that one should maintain while eating in order to prevent the risk of diabetes.

The future directions that this review paper would like to pass-on to the upcoming researchers in this specific area are advanced methodological studies such as, interventional or randomized-controlled studies should take-over the charge in evaluating the causal association between eating rate and developing diabetes; rather than relying on the self-reported responses, research could focus on developing a standard speed measurement scale or a smartphone application, that could significantly address the issues related to the bias (reporting, information, and recall biases).

Conclusions

In conclusion, after all the explorations of the real-world evidence that looked at the association between eating fast and the risk of developing type 2 diabetes, data support a possible relationship between them. The eating speed is a modifiable risk factor, and eating slowly could be, therefore given a priority

as one of the essential lifestyle modifications in preventing the risk of diabetes. Also, interventions should be aimed at altering eating habits, such as education initiatives to reduce eating speed at the population level. However, interventional and long-term studies are warranted to evaluate the causal relationship, and whether avoidance of fast eating is beneficial for the prevention of diabetes.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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