

BREAKFAST SKIPPING IS ASSOCIATED WITH INCREASED RISK OF TYPE 2 DIABETES AMONG ADULTS : A SYSTEMATIC REVIEW

*¹Ilma Fitriana, ¹Dela Intan Permatasari

¹Faculty of Medicine, Trisakti University, Jakarta Special Region, Indonesia

Correspondence Author:
ilmafitr@yahoo.com

ABSTRACT

Background: While certain lifestyle habits may be associated with arterial stiffness, there is limited literature investigating the relationship between lifestyle habits and longitudinal changes in arterial stiffness in patients with type 2 diabetes mellitus (T2DM).

Aims : This systematic review is to review the association of breakfast skipping and the risk of type 2 diabetes in adults.

Methods: This study demonstrated compliance with all requirements by means of a comparison with the standards established by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020. Thus, the specialists were able to guarantee that the research was as current as feasible. Publications released between 2014 and 2024 were considered for this search strategy. This was accomplished by utilizing a number of distinct online reference sites, including Pubmed, ScienceDirect, and SagePub. It was determined that reviews, previously published works, and partially completed works would not be included.

Result: In the PubMed database, the results of our search brought up 569 articles, whereas the results of our search on SAGEPUB brought up 2731 articles, our search on SCIENCE DIRECT brought up 1382 articles. The results of the search conducted for the last year of 2014 yielded a total 335 articles for PubMed, 1173 articles for SAGEPUB and 864 articles for SCIENCE DIRECT. In the end, we compiled a total of 7 papers, 4 of which came from PubMed, 1 of which came from SAGEPUB and 2 of which came from SCIENCE DIRECT. We included seven research that met the criteria.

Conclusion: In summary, breakfast skipping is associated in increasing of type 2 diabetes in adults but also need more studies because the studies of this topic is limited and less reported.

Keyword: Breakfast, diabetes, adult

INTRODUCTION

Diabetes is the most prevalent noncommunicable illness in the twenty-first century and is a serious public health concern. Globally, the incidence of diabetes has sharply grown; 451 million persons between the ages of 20 and 79 were predicted to have the disease in 2017 (8.8% of the global population). By 2045, this figure is predicted to increase to 629 million. Type 2 diabetes mellitus (T2DM) is most common among older persons (≥ 65 years of age), and it is expected that the number of cases in this age group would grow by more than 4.5 times between 2005 and 2050.^{1,2}

The most prevalent kind of diabetes, type 2, has a multivariate risk, with nutrition and other lifestyle variables being major contributors to the etiology. High consumption of red meat, foods high in glycemic index or load, and sugar-sweetened drinks have been linked to an increased risk of type 2 diabetes, whereas whole-grain goods and coffee consumption have been linked to a lower risk. These findings are based on epidemiologic research. Additionally, there is proof that a healthy eating regimen, such as following a Mediterranean diet, lowers the chance of developing type 2 diabetes.³

One of the most significant modifiable risk factors for type 2 diabetes is diet. However, because to a lack of research on the subject, there are no evidence-based guidelines for older persons addressing the frequency and/or timing of meals, snacks, and caloric drinks in order to safeguard their cardiometabolic health. Timing and frequency of breakfast eating have been associated with a number of cardiometabolic risk factors in the general population, including blood pressure, insulin resistance, weight gain, dyslipidemia, and ghrelin secretion; however, it is still unknown how breakfast eating patterns will affect the risk of developing type 2 diabetes in the long run.⁴

After thorough adjustment for demographic, dietary, and lifestyle factors, earlier systematic reviews and meta-analyses of ten observational studies found that skipping breakfast was associated with a significantly increased risk of type 2 diabetes in adults aged 14–99 years. However, no studies examined breakfast timing, which refers to the time of a person's first meal of the day when they break fast. It is unclear if these results apply to older individuals because none of the included research were done specifically on this population. Furthermore, the connections shown thus far are weak and need to be confirmed in further cohorts that reflect a wider range of socioeconomic backgrounds.⁵

METHODS

Protocol

The author of this study ensured that it complied with the standards by adhering to Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines. This is done to guarantee the accuracy of the results that are derived from the investigation.

Criteria for Eligibility

In order to complete this literature evaluation, we looked at published research that discusses the association of breakfast skipping and the risk of type 2 diabetes in adults. This is done to enhance the patient's therapy management and to offer an explanation. This paper's primary goal is to demonstrate the applicability of the issues that have been noted overall.

To be eligible to participate in the study, researchers had to meet the following requirements: 1) English must be used to write the paper. The manuscript must fulfill both of these conditions in order to be considered for publication. 2) A few of the examined studies were released after 2013 but prior to the time frame considered relevant by this systematic review. Editorials, submissions without a DOI, already published review articles, and entries that are nearly exact replicas of journal papers that have already been published are a few examples of research that are prohibited.

Search Strategy

We used "breakfast", "diabetes" and "adult" as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SAGEPUB databases by inputting the words: (("breakfast"[MeSH Terms] OR "breakfast"[All Fields] OR "breakfasts"[All Fields] OR "breakfasting"[All Fields]) AND ("diabete"[All Fields] OR "diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields] OR "diabetes"[All Fields] OR "diabetes insipidus"[MeSH Terms] OR ("diabetes"[All Fields] AND "insipidus"[All Fields]) OR "diabetes insipidus"[All Fields] OR "diabetic"[All Fields] OR "diabetics"[All Fields] OR "diabets"[All Fields]) AND ("risk"[MeSH Terms] OR "risk"[All Fields]) AND ("adult"[MeSH Terms] OR "adult"[All Fields] OR "adults"[All Fields] OR "adult s"[All Fields])) AND ((clinicalstudy[Filter] OR clinicaltrial[Filter]) AND (2014:2024[pdat])) used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else

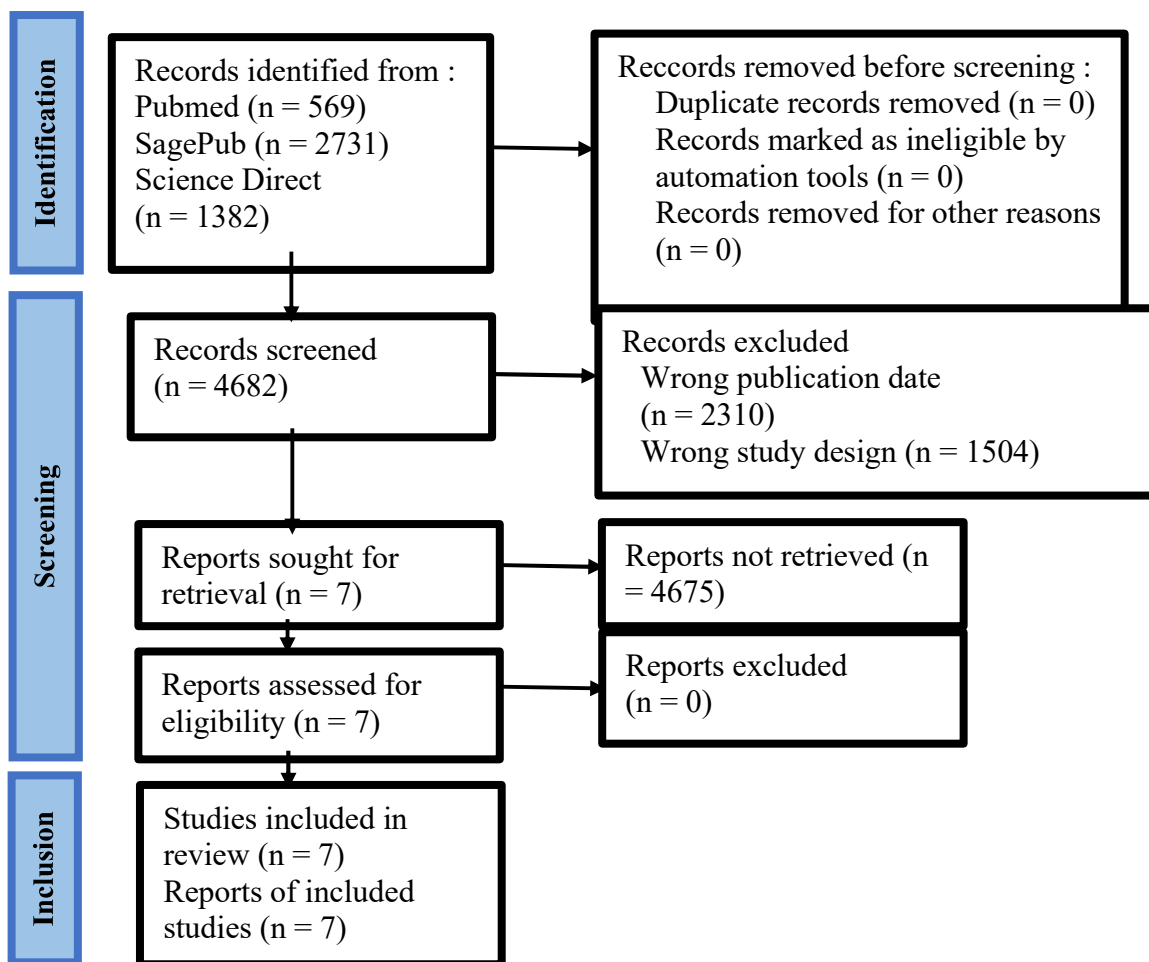


Figure 1. Prisma Flow Diagram

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. In order to simplify the process as much as feasible when selecting papers to evaluate, which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

In the PubMed database, the results of our search brought up 569 articles, whereas the results of our search on SAGEPUB brought up 2731 articles, our search on SCIENCE DIRECT brought up 1382 articles. The results of the search conducted for the last year of 2014 yielded a total 335 articles for PubMed, 1173 articles for SAGEPUB and 864 articles for SCIENCE DIRECT. In the end, we compiled a total of 7 papers, 4 of which came from PubMed, 1 of which came from SAGEPUB and 2 of which came from SCIENCE DIRECT. We included seven research that met the criteria.

Mita, et al⁶ (2020) showed that patients with Type 2 Diabetes have a practice of missing breakfast, which is linked to a continuous increase in arterial stiffness.

Carew, et al⁷ (2022) showed that in contrast, a later (after 09:00) daily first eating occasion time was linked with a decreased risk of type 2 diabetes in participants with impaired fasting glucose at baseline. Eating breakfast every day was not related with either a greater or lower risk of T2DM in this cohort of older persons.

Byrne, et al⁸ (2016) showed that programs aimed at promoting health should highlight modifiable lifestyle choices based on empirical data. The promotion of workplace health should place a high priority on a low-fat diet, aerobic activity, quitting smoking, and getting enough sleep.

Uemura, et al⁹ (2015) showed that in middle-aged Japanese workers, missing breakfast increased the incidence of type 2 diabetes (T2DM). This link held true regardless of baseline BMI and FBG levels, as well as a number of dietary and lifestyle variables. Public health messaging that highlight the advantages of eating breakfast might be disseminated to the general public and Japanese civil service agencies.

Table 1. The literature include in this study

Author	Origin	Method	Sample	Result
Mita et al, 2020 ⁶	Japan	Randomized cohort study	734 patients	Irrespective of other lifestyle choices, a low frequency of breakfast eating was substantially linked with continuously high baPWV in a multivariable linear mixed-effects model that controlled for age and gender. Moreover, the only independent predicted predictor for consistently high baPWV in a multivariable linear mixed-effects model that took into account lifestyle choices and potential atherosclerotic risk factors was a low frequency of breakfast consumption. Less frequent breakfast eaters also likely to have other risk factors for atherosclerosis and an unhealthy lifestyle.
Carew et al, 2022 ⁷	Canada	Randomized cohort study	547 patients	A total of 547 T2DM cases were recorded throughout the follow-up. There was not much evidence found to support a relationship between breakfast frequency and T2DM risk. Participants who broke fast after 09:00 had an aHR for T2DM of 0.71 (95% CI: 0.51, 0.99) compared to those whose breakfast timing (first eating event of the day) was 07:00-09:00. Participants with impaired fasting glucose at baseline showed this connection (aHR: 0.61; 95% CI: 0.39, 0.95), whereas those without it did not (aHR: 0.83; 95% CI: 0.50, 1.38). There were no correlations found between the frequency or timing of eating and type 2 diabetes in any of the other predefined categories.
Byrne et al, 2016 ⁸	USA	Randomized cohort study	10.248 patients	Dietary fat consumption was linked to a dose-response

				<p>impact on cardiac disease, diabetes, hypertension, obesity, and hypercholesterolemia. Aerobic exercise was the second most important activity linked to the development of outcomes, after dietary fat consumption. adults who exercised four days a week had lower rates of heart disease (HR=0.46, 95% CI=0.27, 0.80), hypercholesterolemia (HR=0.61, 95% CI=0.50, 0.74), and new-onset diabetes (HR=0.31, 95% CI=0.20, 0.48) than sedentary adults. A low-fat diet and enough sleep were more important than widely advised healthy habits, such having breakfast every day.</p>
<p>Uemura et al, 2015⁹</p>	<p>Japan</p>	<p>Randomized cohort study</p>	<p>4631 patients</p>	<p>Maximally-adjusted hazard ratios and 95% confidence intervals (CI) for individuals reporting almost daily breakfast consumption, 3-5, 1-2, and 0 days/week were 1.06 (95% CI, 0.73–1.53), 2.07 (95% CI, 1.20–3.56), 1.37 (95% CI, 0.82–2.29), and 2.12 (95% CI, 1.19–3.76), respectively, in comparison to those who reported eating breakfast daily. A dichotomized analysis revealed a significant correlation between the incidence of T2DM and missing breakfast (maximally-adjusted hazard ratio 1.73; 95% CI, 1.24–2.42). Men and women, smokers who were now or had never smoked, normal weight and overweight people (BMI ≥ 25 kg/m²), and those with normal and impaired fasting glycemic status (FBG 110 to <126 mg/dL) at baseline all showed positive relationships (Ps for interaction all >0.05).</p>
<p>Yaguchi et al, 2020¹⁰</p>	<p>Japan</p>	<p>Randomized cohort study</p>	<p>8805 patients</p>	<p>The mean PDC was 80.1%, while the non-adherence rate across patients was 32.8%. According to a logistic analysis, skipping breakfast (odds ratio 0.66 [95% CI 0.57–0.76]), late-night eating (0.86 [0.75–0.98]), and current smoking (0.89 [0.80–0.99]) were significantly associated with non-adherence, while</p>

				older age and taking concurrent medications were significantly associated with adherence.
Dong et al, 2020¹¹	Japan	Randomized prospective study	1935 patients	The 1935 instances of GDM were reported out of 84,669 pregnant women used for analysis. The multivariable-adjusted ORs of GDM for women who ate breakfast five to six times a week, three to four times a week, and two to two times a week were 1.09 (95% CI: 0.93, 1.27), 1.14 (95% CI: 0.96, 1.34), and 1.21 (95% CI: 1.05, 1.41), respectively, after adjusting for potential confounding factors such as prepregnancy BMI. The connection was not substantially affected by prepregnancy BMI and seemed to be dosage dependent (P-trend = 0.006).
Lee et al, 2023¹²	South Korea	Cross sectional study	16.925 patients	The odds ratio for high insulin resistance was 1.39 times (95% confidence interval (CI), 1.21–1.59) and 1.17 times (95% CI, 1.04–1.32) higher in the group whose breakfast frequency was 0 times and 1–4 times per week, respectively, compared with the group whose frequency was 5–7 times per week.

Yaguchi, et al¹⁰ (2020) showed that in order to obtain effective medication adherence, physicians need pay attention to certain health-related habits, such as skipping breakfast, eating late at night, and smoking. These behaviors were found to be strongly connected with medication adherence.

Dong, et al¹¹ (2020) showed that eating breakfast less than three times per week prior to and throughout the early stages of pregnancy, as opposed to every day, was linked to a higher risk of developing gestational diabetes mellitus

Lee, et al¹² (2023) showed that in Korean people with prediabetes, consuming breakfast less frequently was substantially linked to an increased risk of insulin resistance. A large-scale prospective longitudinal investigation will be needed in the future to determine the exact cause of the association between insulin resistance and breakfast frequency.

DISCUSSION

While certain lifestyle habits may be associated with arterial stiffness, there is limited literature investigating the relationship between lifestyle habits and longitudinal changes in arterial stiffness in patients with type 2 diabetes mellitus (T2DM). Mita, et al in their study with 734 japanese outpatients with T2DM with 5 years of follow up, showed that baPWV values significantly increased. Irrespective of other lifestyle choices, a low frequency of breakfast eating was substantially linked with continuously high baPWV in a multivariable linear mixed-effects model that controlled for age and gender. Patients with Type 2 Diabetes have a practice of missing breakfast, which is linked to a continuous increase in arterial stiffness.⁶

Carew, et al in their study also wrote that no evidence based recommendations of optimal breakfast frequency and timing with T2DM because of the limited studies, and showed in their study with 3747 older adults that followed up for years. Their study showed that the majority of CHS participants (median age: 74 years; IQR: 71-78 years) ate breakfast every day (85.5%), and 73% of them ate their first meal of the day between 07:00 and 09:00. These two behaviors were linked to lower baseline levels of cardiometabolic risk indicators, higher socioeconomic status, and factors that indicate a healthier lifestyle. A total of 547 T2DM cases were recorded throughout the follow-up. In this cohort of older persons,

having breakfast every day was not related with a greater or reduced risk of type 2 diabetes (T2DM). However, participants with impaired fasting glucose at baseline were linked to a decreased risk of T2DM if their daily first eating occasion occurred after 09:00.⁷

Byrne, et al in their study with 10,248 participants that followed up until 9 years showed that the behaviors that had the biggest impact on future results were giving up smoking, exercising aerobically, eating a low-fat diet, and getting enough sleep. Dietary fat consumption was linked to a dose-response impact on cardiac disease, diabetes, hypertension, obesity, and hypercholesterolemia. Aerobic exercise was the second most important activity linked to the development of outcomes, after dietary fat consumption. Programs aimed at promoting health should highlight modifiable lifestyle choices based on empirical data. The promotion of workplace health should place a high priority on a low-fat diet, aerobic activity, quitting smoking, and getting enough sleep.⁸

Type 2 diabetes (T2DM) has been linked to breakfast skipping, yet the relationships vary between ethnic groups and genders, and the problem has not received enough attention. Uemura, et al followed 4631 patients (3600 men and 1031 women) with aged 35–66 years from 2002 to 2011 for T2DM development. Their study showed here there 285 T2DM cases (231 males and 54 women) throughout the 8.9-year follow-up period. Men and women, smokers who were now or had never smoked, normal weight and overweight people (BMI ≥ 25 kg/m²), and those with normal and impaired fasting glycemic status (FBG 110 to <126 mg/dL) at baseline all showed positive relationships (Ps for interaction all >0.05).⁹

Yaguchi, et al in their study analyzed 8805 patients with diabetes for 1 year. Days covered (PDC) was used as a measure of medication adherence. Utilizing a multivariate logistic regression model, clinical factors that were substantially linked to non-adherence were found. Following the correction for health-related behaviors, the association between PDC and HbA1c was assessed using multiple regression analysis. In order to obtain effective medication adherence, physicians need pay attention to certain health-related habits, such as skipping breakfast, eating late at night, and smoking. These behaviors were found to be strongly connected with medication adherence.¹⁰

Dong, et al involved 84,669 pregnant women for analysis but only 1935 cases of GDM were documented. Consuming breakfast less than three times per week prior to and throughout the early stages of pregnancy, as opposed to every day, was linked to a higher risk of gestational diabetes mellitus.¹¹

Lee, et al also in their study of 16,925 patients whose frequency of breakfast was 5–7 times per week, showed in Korean people with prediabetes, consuming breakfast less frequently was substantially linked to an increased risk of insulin resistance. A large-scale prospective longitudinal investigation will be needed in the future to determine the exact cause of the association between insulin resistance and breakfast frequency.¹²

CONCLUSION

In summary, breakfast skipping is associated in increasing of type 2 diabetes in adults but also need more studies because the studies of this topic is limited and less reported.

REFERENCE

- [1] Ballon A, Neuenschwander M, Schlesinger S. Breakfast Skipping Is Associated with Increased Risk of Type 2 Diabetes among Adults: A Systematic Review and Meta-Analysis of Prospective Cohort Studies. *Journal of Nutrition*. 2019 Jan 1;149(1):106–13.
- [2] Carew AS, Mekary RA, Kirkland S, Theou O, Siddiqi F. Prospective study of breakfast frequency and timing and the risk of incident type 2 diabetes in community-dwelling older adults: the Cardiovascular Health Study. *Am J Clin Nutr*. 2022;116(2):325–34.
- [3] Schwingshackl L, Hoffmann G, Lampousi AM, Knüppel S, Iqbal K, Schwedhelm C, et al. Food groups and risk of type 2 diabetes mellitus: a systematic review and meta-analysis of prospective studies. *Eur J Epidemiol*. 2017 May 1;32(5):363–75.
- [4] Wang H, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*. 2017 Sep 16;390(10100):1084–150.
- [5] Bi H, Gan Y, Yang C, Chen Y, Tong X, Lu Z. Breakfast skipping and the risk of type 2 diabetes: A meta-analysis of observational studies. Vol. 18, *Public Health Nutrition*. Cambridge University Press; 2015. p. 3013–9.
- [6] Mita T, Osonoi Y, Osonoi T, Saito M, Nakayama S, Someya Y, et al. Breakfast skipping is associated with persistently increased arterial stiffness in patients with type 2 diabetes. *BMJ Open Diabetes Res Care*. 2020;
- [7] Carew AS, Mekary RA, Kirkland S, Theou O, Siddiqi F, Urquhart R, et al. Prospective study of breakfast frequency and timing and the risk of incident type 2 diabetes in community-dwelling older

- adults: the Cardiovascular Health Study. *American Journal of Clinical Nutrition*. 2022 Aug 1;116(2):325–34.
- [8] Byrne DW, Rolando LA, Aliyu MH, McGown PW. Modifiable Healthy Lifestyle Behaviors: 10-Year Health Outcomes From a Health Promotion Program. *Am J Prev Med*. 2016;51(6):1027–37.
- [9] Uemura M, Yatsuya H, Hilawe EH, Li Y, Wang C, Chiang C, et al. Breakfast skipping is positively associated with incidence of type 2 diabetes mellitus: Evidence from the Aichi Workers' Cohort Study. *J Epidemiol*. 2015;25(5):351–8.
- [10] Yaguchi Y, Fujihara K, Yamada MH, Matsubayashi Y, Kitazawa M. Skipping breakfast, late-night eating and current smoking are associated with medication adherence in Japanese patients with diabetes. *Prim Care Diabetes*. 2020;14(6):753–9.
- [11] Dong JY, Ikehara S, Kimura T, Cui M, Kawanishi Y, Kimura T, et al. Skipping breakfast before and during early pregnancy and incidence of gestational diabetes mellitus: The Japan Environment and Children's Study. *American Journal of Clinical Nutrition*. 2020 Apr 1;111(4):829–34.
- [12] Lee S, Lee DC, Lee HJ. Association between breakfast frequency and insulin resistance in Korean adults with prediabetes: A nationwide population-based cross-sectional study. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*. 2023 Apr 1;17(4).