FOOD

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Personalized Nutrition Based on Continuous Glucose Monitoring: Evidence Base, Interpretive Limitations, and Research Prospects (A Critical Narrative Review)

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ABSTRACT

Background. Continuous glucose monitoring (CGM) is increasingly used by people without diagnosed diabetes to monitor responses to food intake, sleep, and physical activity. The technological availability of CGM has outpaced the development of rigorous principles for interpreting the resulting glucose traces; consequently, consumer and professional discourse often conflates the descriptive value of high-frequency measurements, diagnostic potential, and anticipated preventive benefit.

Purpose. To critically assess the extent to which continuous glucose monitoring data can serve as an evidence-based component of personalised nutrition in adults without diagnosed diabetes.

Materials and Methods. We conducted a critical narrative review of the literature on the use of continuous glucose monitoring in personalised nutrition among adults without diagnosed diabetes. Peer-reviewed studies of individual postprandial responses, the analytical accuracy and reproducibility of CGM, and randomised and non-randomised studies of personalised dietary interventions were identified in PubMed/MEDLINE, Scopus, and Web of Science Core Collection. Systematic reviews, meta-analyses, and current guidance documents issued by professional societies and regulatory agencies were also examined. Evidence was synthesised according to a sequential evidentiary framework encompassing the validity of the sensor signal, reproducibility of the individual response, its incremental predictive value, and the effectiveness of resulting recommendations for clinically meaningful outcomes.

Results. The accumulated evidence convincingly demonstrates interindividual variability in postprandial glycemia and supports the use of CGM to characterise recurring behavioural patterns. However, the device measures glucose in interstitial fluid rather than the laboratory-measured concentration of plasma glucose, and its readings depend on the device, measurement conditions, and within-person variability. Therefore, a single peak, postprandial dip, or overnight sensor glucose value does not in itself provide a basis for judging food quality or diagnosing prediabetes, reactive hypoglycaemia, stress hyperglycaemia, or so-called metabolic flexibility. Randomised studies indicate that personalised nutrition programmes may improve selected intermediate outcomes; however, these effects cannot be attributed to CGM as an isolated tool, and sustained clinical benefit has not yet been demonstrated in healthy normoglycaemic adults.

Conclusion. The central premise of this article is that, in people without diabetes, CGM should be understood primarily as a tool for high-frequency phenotyping and the generation of testable hypotheses, rather than as an autonomous diagnostic or therapeutic instrument. The next stage of development in this field should involve reproducible interventions, transparent algorithms, and clinically meaningful endpoints.

KEYWORDS
continuous glucose monitoring; CGM; adults without diabetes; postprandial glycaemia; personalised nutrition; glycaemic variability; preventive medicine; wearable devices; data interpretation

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ПИТАНИЕ

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Персонализированное питание на основе непрерывного мониторинга глюкозы: доказательная база, ограничения интерпретации и исследовательская перспектива (критический нарративный обзор)

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АННОТАЦИЯ

Введение. Непрерывный мониторинг глюкозы (НМГ) всё чаще применяется у лиц без диабета для оценки реакций на питание, сон и физическую активность. Однако доступность технологии опередила разработку правил интерпретации, поэтому смешиваются описательная ценность измерений, диагностические возможности и предполагаемый профилактический эффект.

Цель. Оценить, в какой мере данные НМГ могут служить научно обоснованным компонентом персонализированного питания у взрослых без диабета.

Материалы и методы. Выполнен критический нарративный обзор литературы. В PubMed/MEDLINE, Scopus и Web of Science Core Collection отбирали исследования постпрандиальных реакций, точности и воспроизводимости НМГ, а также рандомизированные и нерандомизированные исследования персонализированных пищевых вмешательств. Дополнительно анализировали систематические обзоры, метаанализы и документы профессиональных и регуляторных организаций. Данные синтезировали по модели, включавшей валидность сенсорного сигнала, воспроизводимость индивидуальной реакции, её добавочную прогностическую ценность и влияние рекомендаций на клинически значимые исходы.

Результаты. Данные подтверждают межиндивидуальную вариабельность постпрандиальной гликемии и возможность применения НМГ для выявления повторяющихся поведенческих паттернов. Вместе с тем сенсор измеряет глюкозу интерстициальной жидкости, а результаты зависят от устройства, условий измерения и внутрииндивидуальной вариабельности. Поэтому единичный пик, снижение после еды или ночное значение не служат самостоятельным основанием для оценки качества продукта или диагностики преддиабета, реактивной гипогликемии, стрессовой гипергликемии и метаболической гибкости. Программы персонализированного питания могут улучшать отдельные промежуточные показатели, однако этот эффект нельзя приписать НМГ как изолированному инструменту. Устойчивая клиническая польза для здоровых нормогликемических взрослых не доказана.

Заключение. НМГ у лиц без диабета следует рассматривать прежде всего как средство высокочастотного фенотипирования и формирования проверяемых гипотез, а не как автономный диагностический или терапевтический инструмент. Развитие области требует воспроизводимых вмешательств, прозрачных алгоритмов и клинически значимых конечных точек.

КЛЮЧЕВЫЕ СЛОВА
непрерывный мониторинг глюкозы; НМГ; CGM; взрослые без диабета; постпрандиальная гликемия; персонализированное питание; гликемическая вариабельность; профилактическая медицина; носимые устройства; интерпретация данных

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INTRODUCTION

Personalised nutrition has emerged as a field that seeks to refine population-level dietary guidance by taking measurable interindividual differences into account. Its scientific value lies not in individualising advice per se but in the ability to use a person's characteristics to formulate recommendations that improve dietary intake, metabolic indicators, or other relevant outcomes. Ordovas et al. (2018) define personalised nutrition as an approach in which individual characteristics are used to develop tailored nutrition recommendations, products, or services. A systematic review of randomised trials showed that personalised recommendations can improve selected aspects of dietary behaviour in healthy adults; however, the magnitude of the effect depends on the components of the intervention, participants' baseline characteristics, and the basis used for personalisation (Jinnette et al., 2021). Thus, the central question in personalised nutrition is not whether individual advice can be offered but whether that advice is based on valid data and outperforms standard recommendations on outcomes of practical relevance.

One of the most extensively discussed bases for individualising nutrition is the postprandial glycaemic response. Interest in this response arises from the fact that the same food can produce different glucose dynamics in different individuals. In a study of 800 participants, Zeevi et al. (2015) demonstrated marked interindividual variability in postprandial glycaemic responses to identical foods and developed an algorithm to predict these responses using clinical, anthropometric, behavioural, and microbiome characteristics. Mendes-Soares et al. (2019) confirmed that a personalised model can predict postprandial glycaemic responses more accurately than caloric content or carbohydrate content alone. The study PREDICT 1 (Personalised Responses to DIetary Composition Trial) by Berry et al. (2020) likewise identified substantial variability in postprandial responses to standardised meals and showed that the relative contribution of dietary and individual factors differed for glucose, insulin, and triglycerides. These studies provide a compelling rationale for examining individual dietary responses, but they do not establish that every observed source of variability should become a basis for modifying the diet.

Continuous glucose monitoring provides a technical means of observing postprandial glucose dynamics under everyday conditions. Unlike a single laboratory measurement, CGM makes it possible to relate the temporal profile of sensor glucose to meals, sleep patterns, physical activity, and other recorded circumstances. Shah et al. (2019) described the distribution of sensor glucose values in adults without diabetes and showed that glycaemic profiles display a degree of variability even in a clinically healthy population. However, CGM measures glucose concentration in interstitial fluid rather than in venous or capillary blood. A sensor reading therefore represents an estimate of physiological dynamics rather than an independent laboratory diagnosis. Merino et al. (2022) showed that the suitability of CGM for classifying dietary glycaemic responses depends on the characteristics of the specific sensor system and on the response criterion used. Accordingly, the ability to obtain a densely sampled time series does not in itself guarantee the validity of the inference drawn from it.

The issue of measurement validity is closely linked to the reproducibility of the individual glycaemic response. To regard a response to food as a relatively stable individual characteristic, it must be shown to recur when comparable dietary exposure is reproduced under similar conditions. Hengist et al. (2025) found that CGM responses to duplicate meals in adults without diabetes can vary substantially within the same person. This finding does not refute the interindividual variability reported by Zeevi et al. (2015) and Berry et al. (2020). Rather, it demonstrates that a single glucose trace cannot provide sufficient grounds for a categorical judgement about tolerance of a food, diet quality, or an individual's metabolic status. This leads to a methodological requirement for personalised nutrition: recommendations should be based on repeated observations, standardised recording of context, and analysis of stable patterns, rather than on the interpretation of a single peak or one postprandial episode.

A further issue is the distinction between predicting a response and demonstrating the benefit of a recommendation. An algorithm may predict an individual's glycaemic profile more accurately than a population-average model, but this does not in itself mean that recommendations based on the algorithm will improve clinically meaningful outcomes. Ben-Yacov et al. (2021) showed that, among participants with prediabetes, a personalised diet designed to reduce postprandial glycaemic responses produced more favourable changes in glycaemic control than a Mediterranean diet. By contrast, Popp et al. (2022) found no advantage of a personalised diet aimed at reducing postprandial glycaemia over a low-fat diet for weight loss at six months in adults with obesity and impaired glucose regulation. In a randomised study, Bermingham et al. (2024) reported that a multicomponent personalised programme improved several cardiometabolic indicators compared with standard advice, although the results differed by endpoint. A systematic review by Richardson et al. (2024) likewise indicated that CGM may strengthen behavioural feedback, but it does not permit an enduring, independent effect on clinically meaningful health outcomes to be attributed to sensor use alone. The available literature, therefore, supports the promise of personalised nutrition but does not confirm that CGM can already be regarded as a self-sufficient basis for individualised dietary prescriptions.

The authors' position is that CGM should be regarded as a tool for high-frequency phenotyping of the individual dietary

response, rather than as an autonomous criterion of food quality, diet quality, or metabolic health. Its use in personalised nutrition can be evidence-based only if four conditions are met sequentially: measurement validity, reproducibility of the individual response, incremental predictive value of the glycaemic profile, and confirmed effectiveness of recommendations for clinically meaningful outcomes. This framing is particularly important because the current Standards of Care of the American Diabetes Association do not recognise CGM as a screening or diagnostic method for prediabetes or diabetes owing to insufficient supporting evidence (American Diabetes Association Professional Practice Committee, 2026). This article aims to critically evaluate the evidence base for using CGM in personalised nutrition among adults without diagnosed diabetes, distinguish defensible from premature inferences drawn from individual postprandial response data, and substantiate the research model needed to move from observing glucose traces to evidence-based dietary interventions.

The central argument is that interindividual variability in postprandial responses justifies the need for personalised nutrition but does not exempt the investigator from demonstrating measurement validity, response reproducibility, and the clinical benefit of the recommendation. This proposition provides the logical structure for the subsequent sections of the article. Contemporary studies do indeed confirm marked interindividual variability in responses to food, but they also document limitations in reproducibility and ambiguity in the clinical findings of interventions.

MATERIALS AND METHODS

Review Design and Analytical Framework

This study was conducted as a critical narrative review with a forward-looking component. This format was selected because the aim was not to quantitatively pool the effects of individual interventions but to sequentially assess the evidence chain linking continuous glucose monitoring data to personalised dietary recommendations. The analysis focuses on the conditions under which an individual postprandial glycaemic response can be considered a well-founded basis for personalising nutrition in adults without diagnosed diabetes.

The methodological organisation of the review was guided by principles for narrative reviews articulated by Green et al. (2006) and Baethge et al. (2019), including transparent reporting of the objective, search strategy, use of sources, critical reasoning, and presentation of data. The review does not purport to be a systematic review because its purpose was not to conduct an exhaustive search for all publications, formally assess the risk of bias in each study, or perform a quantitative meta-analysis. Nevertheless, the criteria for inclusion, exclusion, and analytical appraisal of sources were specified in advance to enhance the reproducibility of the argument and reduce the risk of selective interpretation of the literature.

The analysis was organised around five sequentially linked questions. First, the ability of CGM to reliably represent postprandial glucose dynamics in people without diabetes was assessed. Second, the reproducibility of individual glycaemic responses when comparable dietary exposures were repeated was examined. Third, the analysis considered whether CGM data add predictive information beyond food characteristics, anthropometric measures, and standard clinical indicators. Fourth, the results of intervention studies in which individualised dietary recommendations were formulated using CGM data or models of the individual postprandial response were evaluated. Fifth, the clinical, regulatory, and ethical boundaries of applying such recommendations were defined.

Information Sources and Search Strategy

Literature searches were conducted in PubMed/MEDLINE, Scopus, and Web of Science Core Collection. Reference lists of included studies, systematic reviews, and key conceptual publications on personalised nutrition were also examined. The search covered studies published from 2020 to 2026.

The search strategy combined three groups of terms. The first group described the measurement technology: “continuous glucose monitoring,” “CGM,” “flash glucose monitoring,” and “interstitial glucose.” The second reflected the dietary and metabolic context: “personalised nutrition,” “precision nutrition,” “postprandial glucose,” “postprandial glycaemic response,” “dietary intervention,” and “meal response.” The third defined the target population: “healthy adults,” “adults without diabetes,” “nondiabetic,” “non-diabetic,” “prediabetes,” “overweight,” and “obesity.”

To identify studies critically relevant to CGM interpretation, combinations of the terms “accuracy,” “validity,” “bias,” “reproducibility,” “repeatability,” “duplicate meals,” “within-person variation,” “sensor agreement,” and “capillary glucose” were additionally used. To identify intervention studies, combinations of “randomised trial,” “randomised controlled trial,” “intervention,” “dietary advice,” “personalised diet,” and “clinical outcomes” were applied.

The final synthesis included peer-reviewed English-language publications published from 2020 to 2026. Priority was given to studies with a complete description of the population, dietary protocol, characteristics of the sensor system, methods for recording food intake and concomitant behaviour, and prespecified endpoints. Current documents issued by professional societies and regulatory organisations were additionally analysed for normative and clinical interpretation.

Inclusion and Exclusion Criteria

Studies were included if they met at least one of the following criteria:

1. Primary studies of individual postprandial glycaemic responses in adults without diagnosed diabetes.
2. Studies assessing analytical accuracy, systematic bias, agreement among readings from different CGM systems, or reproducibility of the response to repeated meals.
3. Randomised and non-randomised studies of personalised nutrition in which CGM data or models of the individual postprandial response were used to formulate dietary recommendations.
4. Systematic reviews and meta-analyses addressing the use of CGM as a tool for changing dietary behaviour, weight management, or improving glycaemic or other cardiometabolic indicators.
5. Documents issued by professional societies and regulatory organisations that define indications, limitations, and the clinical status of CGM.

Studies devoted exclusively to the management of type 1 or type 2 diabetes were excluded unless results for participants without diabetes were reported separately. Studies of paediatric and adolescent populations, preprints, manufacturers' promotional materials, publications without an accessible description of methods, and studies in which CGM was used without reference to diet, the postprandial response, or personalised prevention were also excluded. Preprints could be used only to identify emerging directions but did not serve as a basis for the article's key conclusions.

Source Selection and Critical Appraisal

Selection was conducted in two stages. At the first stage, publication titles and abstracts were assessed for alignment with the objective of the review. At the second stage, the full texts of studies meeting the inclusion criteria were analysed. When multiple publications were based on the same cohort or intervention, preference was given to the most complete report, containing a description of the design, sample characteristics, measurement methods, and prespecified endpoints.

Each source was critically appraised according to the following parameters: study design; participant characteristics and clinical status; sample size; type and model of sensor system; method of dietary recording; use of standardised test meals; repeated measurements; reference method for glucose assessment; duration of follow-up; composition of the control group; nature of the endpoints; and completeness of disclosure of funding and potential conflicts of interest.

Particular importance was attached to distinguishing four levels of evidence. The first level comprised studies demonstrating individual variability in postprandial glycaemic responses. The second encompassed studies confirming the reproducibility of such responses within a given person. The third included studies showing the incremental predictive value of CGM data over conventional characteristics of food and the individual. The fourth consisted of intervention studies in which personalised recommendations were evaluated using durable and clinically meaningful outcomes. This approach avoided conflating the statistical predictability of the postprandial response with the demonstrated benefit of a personalised dietary intervention.

Data Synthesis

The synthesis was conducted as a thematic critical comparison of findings. Sources were grouped into five analytical domains: individual variability in postprandial responses to food; the accuracy and limitations of CGM; within-person reproducibility of glycaemic responses; the effectiveness of personalised dietary interventions; and the clinical and research boundaries of CGM data interpretation.

No quantitative pooling of results was undertaken because of pronounced heterogeneity across studies in populations, sensor models, monitoring duration, methods of recording dietary behaviour, personalisation algorithms, and outcomes assessed. In interpreting the evidence, priority was given to randomised studies with clinically meaningful endpoints, followed by validation and reproducibility studies and large prospective cohorts. Observational associations among glycaemic profiles, diet, sleep, and physical activity were treated as a basis for generating hypotheses, rather than as sufficient evidence of the causal effectiveness of individualised dietary recommendations.

Methodological Limitations of the Review

The limitations of this review are determined by its narrative nature. The study does not include a registered protocol, does not provide a formal calculation of inter-reviewer agreement in source selection, and does not contain a quantitative meta-analysis. In addition, published studies differ substantially in the technical characteristics of CGM, criteria for defining the glycaemic response, and the composition of populations and interventions. Accordingly, the conclusions of this article primarily concern the logic for interpreting the existing evidence base, rather than establishing a single quantitative effect of CGM in personalised nutrition.

RESULTS

The contemporary literature on the use of continuous glucose monitoring in personalised nutrition constitutes a heterogeneous body of evidence. Some studies describe interindividual differences in postprandial responses, some assess the accuracy of sensor systems, some test the reproducibility of individual glucose traces, and others examine the outcomes of dietary interventions. These strands cannot be collapsed into a single conclusion without losing the logic of the evidence. The presence of individual glycaemic variability does not establish that a single trace is suitable for guiding dietary recommendations, and successful prediction of a response does not demonstrate the clinical benefit of a recommendation derived from it.

Table 1 summarises the evidence across six inferential levels. Figure 1 shows their sequence: each subsequent level is possible only when the preceding one has been supported sufficiently. Therefore, CGM can be considered a basis for personalised nutrition only if the sensor signal is valid, the individual response is reproducible, its association with dietary and behavioural factors has been confirmed, and recommendations based on that association improve meaningful health outcomes.

Table 1

Evidentiary Framework for the Use of Continuous Glucose Monitoring in Personalized Nutrition

Таблица 1

Доказательная матрица применения непрерывного мониторинга глюкозы в персонализированном питании

Level of evidence	Key studies	What has been established	What the available evidence does not establish
Sensor signal characteristics in people without diabetes	Shah et al. (2019)	People without diabetes show measurable day-to-day variability in sensor glucose; in the selected healthy cohort, median time in the 3.9–7.8 mmol/L range was 96 %.	Universal individualised CGM targets, diagnostic thresholds, or criteria for “normal metabolism».
Accuracy and agreement of sensor measurements	Howard et al. (2020); Merino et al. (2022); Hutchins et al. (2025)	Agreement among results depends on the sensor model, research protocol, individual user, and test meal challenge.	Equivalence of every sensor trace to capillary or venous glucose; error-free ranking of individual meals on the basis of a single measurement.
Interindividual variability in dietary responses	Zeevi et al. (2015); Mendes-Soares et al. (2019); Berry et al. (2020)	The same dietary challenges can produce substantially different postprandial responses in different people; individual data improve predictive accuracy.	The clinical benefit of every personalisation algorithm: the need to abandon general principles of healthy eating.
Within-person reproducibility and behavioral context	Wyatt et al. (2021); Yao et al. (2024); Hengist et al. (2025)	Postprandial profiles are associated with meal timing, sleep, physical activity, and antecedent behaviour; responses to duplicate meals may differ substantially.	Interpretation of a single peak, dip, or test breakfast as a stable individual characteristic.
Effectiveness of personalized dietary interventions	Popp et al. (2022); Bermingham et al. (2024); Richardson et al. (2024); Liao et al. (2026)	Multicomponent personalised nutrition programmes may improve selected indicators of diet quality and cardiometabolic risk; CGM may strengthen behavioural feedback.	An independent causal effect of CGM; guaranteed superiority of a personalised strategy for body weight and all clinical outcomes.
Clinical and regulatory interpretation	American Diabetes Association Professional Practice Committee (2026); U.S. Food and Drug Administration (2024); Hjort et al. (2024)	CGM may be used to observe glucose dynamics and as part of feedback programmes.	Screening or diagnosis of prediabetes and diabetes; definition of “metabolic flexibility” from the shape of a single glycaemic curve.

Note. The table reflects not a hierarchy of the value of individual studies but the sequence of conditions that must be fulfilled before CGM data can be used as a basis for a personalised dietary recommendation.

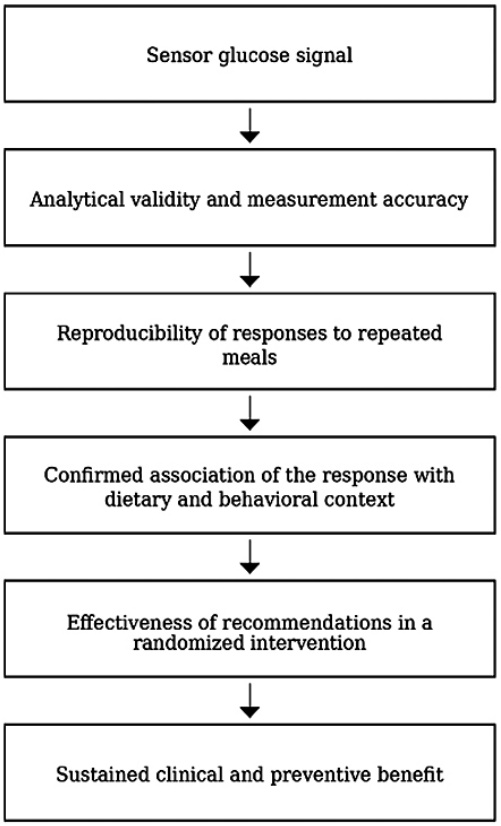
Примечание. Таблица отражает не иерархию ценности отдельных исследований, а последовательность условий, которые должны быть выполнены, прежде чем данные НМГ могут быть использованы как основание персонализированной пищевой рекомендации.

Figure 1

Evidence Chain From a Sensor Signal to a Personalized Dietary Recommendation

Рисунок 1

Доказательная цепочка перехода от сенсорного сигнала к персонализированной пищевой рекомендации



Note. The figure was developed by the author on the basis of the studies presented in Table 1. A break in the evidentiary chain at any level limits the validity of conclusions at subsequent levels.

Примечание. Рисунок составлен автором по материалам исследований, представленных в Таблице 1. Нарушение доказательности на любом уровне ограничивает правомерность выводов на последующих уровнях.

CGM captures Signals, Not Diagnoses

The first level of the evidence chain concerns what CGM actually measures and the limits within which these data can be interpreted in adults without diagnosed diabetes. The sensor determines glucose concentration in interstitial fluid; its readings therefore reflect interstitial glycaemic dynamics rather than a direct measurement of venous plasma or capillary blood. This distinction is especially important in the normoglycaemic range, where a small absolute discrepancy between sensor and reference measurements can alter interpretation of the postprandial response.

Shah et al. (2019) provided one of the most informative descriptions of CGM profiles in people without diabetes. The multicentre study included 153 participants; mean sensor glucose was approximately 5.4–5.5 mmol/L, and the median percentage of time in the 3.9–7.8 mmol/L range was 96 %. These data are important from a research perspective because they show that the glycaemic profile is not completely uniform even in a carefully selected population without diabetes. However, the study was not designed to establish individual diagnostic thresholds or personalised CGM target values. The descriptive distribution of readings therefore cannot be converted into a normative scale of "proper metabolism" for each individual user.

The second body of findings presented in Table 1 concerns the analytical uncertainty of sensor measurements. Howard et al. (2020) showed that two concurrently used sensors can rank the same meals differently according to the magnitude of the incremental postprandial glycaemic response. By contrast, Merino et al. (2022) found good within-brand repeatability and acceptable agreement among CGM systems when classifying dietary responses in a standardised protocol. These findings are not contradictory: they indicate that accuracy and agreement depend on the specific device, the assessment criterion, study design, and conditions of use.

The most direct evidence of the practical importance of this problem was provided by the randomised crossover trial of Hutchins et al. (2025). The authors found that CGM, on average, overestimated fasting and postprandial values relative to capillary glucose, with the magnitude of bias varying across participants and test meals. Thus, visually different curves after two meals may reflect a biological response, measurement error, or a combination of both. This finding establishes the first principle of CGM-based personalised nutrition: the trace should be treated as a source of a hypothesis rather than as a conclusive criterion of food quality.

Key studies show that CGM greatly expands the observability of glycaemic dynamics but does not remove the limitations of measurement. The next question is therefore not whether individual differences can be observed, but the extent to which these differences genuinely exist between people and what they can explain.

Individual Postprandial Responses: a Fact, Not a Diet Recommendation

The strongest evidentiary basis for personalised nutrition is the observation that the same food does not elicit the same postprandial response in all people. Zeevi et al. (2015) examined glycaemic responses in 800 participants and identified substantial interindividual variability after identical foods and standardised meals. On this basis, the authors developed a model that incorporated clinical, anthropometric, dietary,

and microbiome characteristics and predicted postprandial responses more accurately than simplified estimates based only on food properties.

An external assessment of this line of research was performed by Mendes-Soares et al. (2019) in a cohort of adults without diabetes in the United States. The authors showed that a personalised approach to predicting the postprandial response outperformed models relying only on caloric content or carbohydrate content. This result is of fundamental importance because it confirms the possibility of statistically more accurate modelling of the individual response. However, a model that predicts a response better does not itself demonstrate that a diet based on that model will improve the health of a particular person.

The PREDICT 1 study substantially expanded the evidence base by combining standardised meal tests with dietary recording in real-life conditions. The UK cohort included 1,002 adults, and an independent US cohort included 100 participants. For identical dietary challenges, coefficients of variation were 103 % for triglycerides, 68 % for glucose, and 59 % for insulin. Berry et al. (2020) showed that, for postprandial glycaemia, the macronutrient composition of food explained a larger proportion of the variance than personal factors, whereas individual characteristics had greater relative importance for postprandial lipaemia. Personalised nutrition should therefore not be positioned in opposition to general principles of dietary prevention: food composition remains important, but its effects must be considered in the context of individual characteristics.

Thus, the studies by Zeevi et al. (2015), Mendes-Soares et al. (2019), and Berry et al. (2020) convincingly confirm the existence of individual glycaemic heterogeneity. However, they do not demonstrate that every measured glucose rise indicates that a food is harmful or that every relatively low response makes a food optimal for a particular person. To move from established variability to an individual recommendation, it is necessary to show that the identified response is reproducible when comparable conditions are repeated.

Reproducibility Is a Necessary Precondition for an Individualized Inference

An individual response to food can be considered a basis for a personalised recommendation only when it is maintained under repeated exposure to a comparable dietary stimulus. This criterion is reflected in the fourth row of Table 1 and occupies a central position in Figure 1. If the same breakfast produces substantially different sensor responses in the same person on different days, a single trace cannot provide sufficient grounds for excluding a food, modifying the diet, or assessing metabolic status.

Hengist et al. (2025) assessed within-person variability in postprandial responses in 30 adults without diabetes under controlled feeding conditions. Participants received 1,189 duplicate identical meals distributed across four dietary patterns. The authors found only weak-to-moderate agreement in responses to repeated meals and low intraclass correlation coefficients. The most important conclusion of this study is not a denial of interindividual differences but a refinement of the evidentiary standard: CGM-based recommendations should be formed from aggregated data across repeated observations, rather than from a single postprandial episode.

Behavioural context further complicates interpretation of an individual trace. In 1,070 participants, Wyatt et al. (2021) showed that a deeper fall in sensor glucose two or three hours after a standardised breakfast was associated with greater hunger, a shorter interval before the next meal, and higher subsequent energy intake. This finding suggests the potential importance of the dynamic structure of the postprandial response but does not establish a universal threshold at which a decline in sensor glucose should be considered pathological or require dietary correction.

An intensive longitudinal study by Yao et al. (2024), which included 789 adults and 11,333 recorded meals, showed that postprandial glycaemia was associated with meal composition, timing of consumption, sleep, and post-meal physical activity. Higher responses were associated with refined grain products and fried foods, whereas longer sleep and greater physical activity after meals were associated with lower postprandial glycaemia. Because the study had an observational design, its results should be used to generate testable behavioural hypotheses rather than to make automatic causal prescriptions.

Thus, CGM can show that the postprandial response varies with behaviour and time of day, but it cannot independently establish the mechanism of these changes. A glucose elevation without a recorded meal does not prove the influence of cortisol or another stressor, and a single low nocturnal reading does not confirm clinically significant hypoglycaemia without appropriate clinical and laboratory context. These limitations make a transition from descriptive observations to intervention studies necessary.

Predicted Food Response is Not Proven Diet Benefit

Randomised studies provide the most rigorous test of the concept of personalised nutrition because they assess not only the shape of the glucose trace but also durable health outcomes. The fifth row of Table 1 presents studies showing that the findings of such interventions are heterogeneous. This means that nutrition personalisation remains a promis-

ing direction but does not yet have uniformly confirmed clinical effectiveness.

Popp et al. (2022) conducted a randomised study among 204 adults with obesity and impaired glucose regulation. Participants received either a personalised diet designed to reduce the postprandial glycaemic response or a standardised low-fat diet. At six months, the personalised intervention did not produce greater weight loss than the control strategy. This finding is particularly important because it shows that an algorithmically more accurate characterisation of the postprandial response does not guarantee superiority on a long-term clinical outcome.

A different type of evidence was obtained in the METHOD (Measuring Efficacy THrough Outcomes of Diet) study. Bermingham et al. (2024) randomised 347 generally healthy adults to a multicomponent personalised nutrition programme or standard recommendations. The programme incorporated postprandial glycaemic and lipid responses, the microbiome, dietary characteristics, health history, and behavioural feedback delivered through an application. At 18 weeks, participants in the personalised programme showed more favourable changes in triglycerides, body weight, waist circumference, HbA1c, and diet quality, whereas an advantage for low-density lipoprotein cholesterol was not confirmed. However, CGM was only one element of the intervention; this study therefore cannot isolate its independent contribution to the observed effects.

A systematic review by Richardson et al. (2024) included 25 randomised trials involving 2,996 participants. The authors found a modest favourable effect of CGM-based programmes on some glycaemic indicators but noted substantial heterogeneity of the interventions and a limited number of studies that evaluated changes in diet or physical activity. Importantly, most included studies were conducted among people with type 2 diabetes; their findings therefore cannot be unconditionally extrapolated to healthy adults.

A more focused systematic review by Liao et al. (2026) included 23 studies in populations without diabetes, seven of which were randomised. The authors reported possible improvements in mean glucose and behavioural adherence but found no statistically significant effect on body mass index. In the subgroup of adults with normoglycaemia, a convincing glycaemic benefit was not established, whereas more favourable findings were reported among people with prediabetes. Therefore, the current literature supports the use of CGM as a biofeedback tool within structured programmes but does not confirm it as an independent mechanism for sustained health improvement.

This asymmetry of evidence has fundamental implications for personalised nutrition. CGM may be useful as part of a broader system for analysing behaviour, diet, and metabolic risk, but its independent causal contribution must be tested in studies in which sensor measurement, the recommendation algorithm, and behavioural support are evaluated separately.

CGM Does Not Replace Screening or Assess Diet From a Single Curve

The final level of the evidence chain concerns clinical applicability. The American Diabetes Association states that the available data are insufficient to use CGM as a method for screening or diagnosing prediabetes and diabetes (American Diabetes Association Professional Practice Committee, 2026). Recurrent unusual CGM profiles may therefore justify seeking clinical evaluation, but not establishing a diagnosis independently.

The regulatory position of the FDA is consistent with this distinction. The over-the-counter Stelo system is cleared for adults who do not use insulin, including for feedback on the relationship of diet and physical activity to glucose levels. However, the FDA emphasises that such systems are not intended for people with problematic hypoglycaemia and should not be used as the sole basis for medical decisions. Accordingly, consumer availability of a device is not equivalent to recognition of its diagnostic value.

Similar caution is required when using the term “metabolic flexibility." This term refers to a broader set of processes associated with switching between energy substrates and insulin sensitivity, rather than to the rate at which sensor glucose returns to its baseline after a meal. A systematic review by Hjort et al. (2024) showed that associations between short-term glycaemic variability in people without diabetes and cardiometabolic risk factors remain equivocal and require further prospective confirmation.

The results of the critical synthesis support the main conclusion of this section. Interindividual variability in dietary responses has been convincingly demonstrated; measurement accuracy and within-person reproducibility require more rigorous control; and clinical benefit from personalised recommendations has been shown only in some multicomponent interventions and cannot be attributed to CGM alone. CGM should therefore be considered a tool for structured observation and for generating testable hypotheses about diet, rather than an autonomous source of ready-made individualised prescriptions.

DISCUSSION

This review shows that continuous glucose monitoring cannot yet be regarded as a standalone evidence-based foundation for personalised nutrition in adults without diagnosed

diabetes. However, this does not mean that its relevance is limited solely to diabetes management. CGM makes it possible to observe individual postprandial dynamics under everyday conditions and thereby expands the empirical basis for studying interactions among diet, meal timing, sleep, physical activity, and metabolic response. The problem lies elsewhere: the current literature has not yet completed the transition from recording an individual signal to demonstrating that a recommendation based on that signal improves the health of the individual.

This distinction constitutes the central conclusion of the article. Table 1 shows that the evidence base is not homogeneous. Interindividual differences in postprandial responses are supported most convincingly. The accuracy of sensor measurement in the normoglycaemic range and the reproducibility of an individual response when the same dietary exposure is repeated remain less certain. The least developed level is the demonstration of durable clinical benefit from recommendations based specifically on CGM. Figure 1 should therefore be understood not as a technical sequence of stages, but as a logical boundary between observation and recommendation: personalisation becomes evidence-based only when every preceding level is supported by appropriate data.

Individual Variability Does Not Supersede General Principles of Healthy Eating

The principal contribution of studies of individual postprandial responses is that they challenge an excessively simplified model according to which the physiological effect of food can be fully inferred from its composition. The work of Zeevi et al. (2015), Mendes-Soares et al. (2019), and Berry et al. (2020) showed that the same dietary challenge can elicit substantially different glycaemic responses in different people. This finding makes the search for more individualised approaches to nutrition scientifically justified.

However, interpretation of this finding often extends beyond what has actually been established. Interindividual variability does not mean that general dietary recommendations have lost their relevance. On the contrary, data from PREDICT 1 show that the macronutrient composition of food retains a substantial explanatory role in postprandial glycemia, although its effects differ between people. Personalised nutrition should therefore not be framed as a rejection of general principles of prevention. Its task is to refine the application of those principles in a specific physiological and behavioural context.

A more important theoretical proposition follows from this point. The object of personalisation should not be a single food classified as “suitable” or “unsuitable” on the basis of the shape of one glycaemic curve. The object of personalisation is the system of interactions among the person, the diet, meal timing, antecedent behaviour, and the environment. This position preserves the connection between personalised nutrition and evidence-based nutritional science while avoiding the reduction of diet quality to short-term glucose dynamics.

Uncertainty in Data Interpretation

The findings summarised in Table 1 indicate that the weakest link in the current discussion is the transition from the sensor signal to its physiological and dietary meaning. CGM measures glucose in interstitial fluid; the recorded curve therefore reflects an estimate of its dynamics rather than a direct blood glucose concentration. This circumstance is particularly important in people without diabetes because research and consumer interest are focused precisely on relatively small differences between meals and days.

Studies of sensor agreement and comparisons of CGM with capillary glucose show that differences between curves cannot always be attributed unambiguously to food properties. They may reflect a combination of biological response, systematic device bias, and random measurement error. The visual salience of a glycaemic graph is therefore not evidence of the accuracy of its interpretation. This is especially important in personalised nutrition because the user is evaluating not a group-average effect but a single episode of everyday life.

This leads to a fundamental conclusion: CGM should not be used to definitively classify a food product on the basis of one observation. Its rational role is to generate a hypothesis that must then be tested under repeated conditions. Otherwise, the technology risks converting measurement uncertainty into apparent biological individuality.

Personal Observations and Personalized Recommendations

Figure 1 places reproducibility after analytical validity for a reason. Even an accurate measurement cannot provide a basis for a recommendation if the observed response is not reproducible in the same person. The studies of Hengist et al. (2025) are especially important precisely because they call into question not the existence of individual differences, but the stability of a single individual response. Their findings show that CGM responses to repeated identical meals can vary substantially within one person.

This circumstance changes the very unit of analysis in personalised nutrition. It cannot be an isolated peak, a single breakfast, or one reduction in glucose several hours after eating. A more appropriate unit is a recurring pattern ob-

served under comparable conditions. This shift is not only methodological but also practical. It moves the use of CGM from spontaneous interpretation of graphs to individual experimental observation.

In this context, data on sleep, physical activity, meal timing, and subsequent hunger should be interpreted not as ready-made explanations but as factors that may modify the response. Observational evidence does show associations of postprandial glycemia with dietary characteristics, sleep duration, and post-meal activity. However, it does not follow that CGM can independently reveal the mechanism of every change or determine the causal contribution of a particular stressor, sleep deprivation, or food.

Inconsistency of Intervention Findings

The most important result of this review is that the current evidence base does not allow the ability to predict a glycaemic response to be equated with the ability to improve a clinical outcome. These are different research tasks. The first pertains to predictive modelling. The second requires randomised comparison of recommendations, equally intensive support, clinically meaningful endpoints, and sufficiently long follow-up.

This explains the differences among the findings of intervention studies. In the study by Ben-Yacov et al. (2021), a personalised diet improved selected indicators of glycaemic control in people with prediabetes. In the study by Popp et al. (2022), the personalised strategy did not outperform a low-fat diet for weight loss in adults with obesity and impaired glucose regulation. In the METHOD study, a multicomponent personalised nutrition programme improved some cardiometabolic indicators and diet quality, but CGM was only one of several intervention components. These studies address different questions, use different populations, and assess different outcomes. They cannot be reduced to the conclusion that personalised nutrition has either already been proven or completely refuted.

CGM should therefore be viewed not as an independent therapeutic factor but as a potential component of a more complex preventive programme. Its value may lie in strengthening feedback, increasing awareness of dietary patterns, or supporting adherence to recommendations. However, the independent contribution of sensor information to behavioural change and metabolic outcomes has not yet been identified with sufficient certainty. Systematic reviews, likewise, point to heterogeneity of interventions and insufficient evidence for a confident conclusion regarding the independent benefit of CGM in adults without diabetes (Oganesova et al., 2024).

The Role of CGM Within a Broader Framework of Diet and Prevention

Short-term glycaemic dynamics cannot serve as the sole criterion of diet quality. Diet affects health through dietary fibre, fat quality, protein composition, micronutrients, the degree of industrial processing, energy density, food substitutions, and the sustainability of eating behaviour (Wang et al., 2023). CGM captures only one metabolic axis and does so within a limited time window. An attempt to minimise every rise in sensor glucose may therefore lead to a methodologically unjustified narrowing of the concept of healthy eating.

This boundary is especially important for clinical inferences. The American Diabetes Association explicitly states that the available evidence is insufficient to use CGM as a method of screening or diagnosing prediabetes and diabetes. A recurrent unusual CGM pattern may justify seeking medical evaluation, but it does not replace laboratory diagnostic methods.

Accordingly, the most well-founded model for using CGM in adults without diabetes is educational and research-orientated. The device can help a person formulate a question about their own diet or behaviour, test it under repeated conditions, and discuss consistent observations with a specialist. It should not be used as a tool for self-diagnosis, as a basis for excluding entire food groups, or as a substitute for a comprehensive assessment of nutritional status.

Future Research Directions

Further development of personalised nutrition requires a shift from demonstrating individual curves to studying causal effectiveness. First, assessment of CGM accuracy in the normoglycaemic range must be standardised. This will require parallel sensor, capillary, and plasma measurements, repeated standardised meal challenges, and transparent reporting of data-processing algorithms.

The next step is to evaluate the components of a personalised intervention separately. Future studies should compare open-label CGM, blinded monitoring, standard counselling of equivalent intensity, and a comprehensive personalised programme. Only such a design will make it possible to determine whether an effect is attributable to sensor information, the interpretation algorithm, professional support, or their combination.

Finally, the assessment of effectiveness should extend beyond mean glucose and short-term glycaemic metrics. Data are needed on diet quality, maintenance of behavioural change, body weight, confirmed laboratory indicators, psychological consequences, anxiety, restrictive eating behaviour, and quality of life. Reviews of CGM use in people without diabetes emphasise that potential behavioural and

psychological risks remain insufficiently studied, although they may determine the acceptability of the technology in preventive practice.

Thus, the promise of CGM is determined not by how convincingly it visualises an individual response to food, but by whether subsequent studies can demonstrate the incremental value of this information for dietary decision-making. Personalised nutrition will become evidence-based not when every user receives more glucose data but when it is shown which data change the diet, for which groups of people this produces benefit, and for which outcomes that benefit is sustained.

CONCLUSION

The aim of this article was to determine the extent to which continuous glucose monitoring can serve as an evidence-based component of personalised nutrition in adults without diagnosed diabetes. The critical analysis permits an unambiguous conclusion: CGM expands the capacity to observe individual postprandial glucose dynamics but does not in itself provide sufficient grounds for prescribing a personalised diet. Its value lies in generating high-frequency data on the dietary response, but the clinical and preventive significance of these data arises only after methodologically rigorous interpretation.

The principal result of this work is the distinction among four levels that are often conflated in current practice: recording a sensor-derived glycaemic signal, interpreting the individual postprandial response, formulating a dietary recommendation, and demonstrating its health benefit. There is no automatic progression between these levels. Differences in the glycaemic response to the same food confirm physiological heterogeneity but do not prove that every identified pattern is stable, causally attributable to a specific dietary factor, and requires a dietary change. Nutrition personalisation, therefore, cannot be built on the direct translation of a single glycaemic curve into an individualised prescription.

The proposed evidence chain defines the conditions under which CGM may acquire a well-founded role in personalised nutrition. First, the sensor signal must be analytically reliable in the range of values of interest. Next, the hypothesised response must be reproducible when a comparable dietary exposure is repeated. It is then necessary to establish its association with specific dietary or behavioural characteristics, separating a stable pattern from the effects of sleep, physical activity, meal timing, preceding diet, health status, and measurement error. Only at the next stage can it be tested whether a recommendation informed by such a pattern improves relevant dietary and health indicators. Thus, an individual glycaemic curve should be regarded not as a final answer but as source material for sequential hypothesis testing.

This leads to a more precise definition of the practical role of CGM. In adults without diagnosed diabetes, it is rational to use CGM as a structured feedback tool that makes it possible to examine recurrent associations among diet, eating patterns, and everyday behaviour. Such work requires a prespecified question, repeated observation of comparable eating situations, detailed recording of context, and avoidance of conclusions based on isolated extreme values. CGM should not be used for self-diagnosis of disorders of glucose metabolism, for classifying individual foods as “harmful” or “suitable,” or for determining metabolic status from a single graph.

The relationship between glycaemic dynamics and diet quality deserves particular attention. A short-term glucose response reflects only one aspect of the dietary response and does not encompass the nutritional value of a food, fibre content, the quality of fats and protein, micronutrient composition, degree of industrial processing, energy density, or the place of a food in the structure of the overall diet. Personalised nutrition should refine the application of general principles of healthy eating, rather than replace them with an effort to minimise every rise in sensor glucose. Otherwise, technological individualisation risks narrowing the understanding of nutrition to a single physiological indicator.

The future of CGM in personalised nutrition depends on the quality of subsequent research. Independent randomised trials are needed to separately assess the contribution of sensor monitoring, the interpretation algorithm, professional counselling, and digital behavioural support. Such studies should include repeated meal tests, reference glucose measurements, transparent rules for data processing, and long-term follow-up. Their endpoints should include not only glycaemic indicators but also diet quality, the sustainability of eating behaviour, body weight, laboratory markers, quality of life, anxiety, and the risk of restrictive eating behaviour.

Thus, continuous glucose monitoring should be regarded as a promising but currently methodologically incomplete tool for personalised nutrition. Its scientific value lies in its ability to make the individual dietary response observable. Its practical value will be demonstrated only when it becomes clear which glycaemic patterns are reproducibly associated with modifiable factors, for which groups of people recommendations based on those patterns are beneficial, and whether they outperform standard preventive nutrition strategies on durable and clinically meaningful outcomes.

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