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ORIGINAL RESEARCH

Fasting plasma glucose level in the 90-99 mg/dL range and risk of type 2 diabetes onset: Panasonic population-based cohort study 2 - Evidence review

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1. ABSTRACT

The analyzed study evaluated whether fasting plasma glycemia values still below 100 mg/dL might signal a higher future risk of type 2 diabetes. In a retrospective cohort of 37,148 Japanese workers without diabetes and with an initial glycemia below 100 mg/dL, followed from 2008 to 2018, the risk increased progressively when moving from values equal to or lower than 89 mg/dL to values between 90 and 99 mg/dL.The research contributes to the passage from “The Choice to Live in Health or Illness” by Dr. A. Colonnese and R. Panzironi, according to which the high end of glycemia considered normal can be a prognostic indicator of metabolic risk, even in people with obesity. Independent studies in US, Mediterranean, and Israeli populations show a consistent association. However, observational cohorts do not prove that a small increase in glycemia directly causes diabetes, nor do they establish a universal clinical threshold on their own.

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MISSION

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Through articles, reviews, in-depth analyses and expert contributions, the Journal champions evidence-based medicine and science, fostering a correct interpretation of scientific data and countering misinformation. Every piece of content is developed with the aim of translating the complexity of research into understandable, useful and applicable information, while keeping intact the principles of accuracy, transparency and scientific independence.

Free from political, industrial and commercial influence, the journal stands as an authoritative and independent editorial space, dedicated to promoting scientific culture, professional development and the growth of health awareness among the public.

2. ANALYZED STUDY

The research question was whether, in individuals with fasting glycemia below 100 mg/dL, values between 90 and 99 mg/dL were associated with a higher probability of developing type 2 diabetes over time. The hypothesis was that the risk does not appear suddenly only upon exceeding diagnostic thresholds, but increases gradually even in the high range of values commonly considered normal.The relevance to paragraph 2.4.1 is precise. In "The Choice to Live in Health or Illness" by Dr. A. Colonnese and R. Panzironi, the publication is cited to support the claim that, between 90 and 99 mg/dL, the increase in fasting glycemia is associated with a progressively higher risk of diabetes and that this trend is also observable in participants with obesity. The study can document a prognostic association within the context of the examined cohort. However, it cannot demonstrate that glycemia is the sole cause of diabetes or that the same results apply identically to all populations.

3. MATERIALS AND METHODS OF THE ORIGINAL STUDY

The authors conducted a retrospective cohort study, which is an analysis of health data collected in the past and observed over time. They used the annual medical check-ups of Panasonic employees in Japan from 2008 to 2018. All participants underwent annual blood tests and completed a standardized questionnaire on habits and lifestyle.Of the 140,590 workers evaluated in 2008, those who did not have consecutive check-ups, already had diabetes, had an initial glycemia between 100 and 125 mg/dL, or had missing data were excluded. The final population included 37,148 people with an initial glycemia of less than 100 mg/dL. Incident diabetes was defined as a fasting glycemia equal to or greater than 126 mg/dL, the use of antidiabetic medication, or a history of diabetes reported by the participant.Glycemia was divided into six categories: equal to or less than 89, 90-91, 92-93, 94-95, 96-97, and 98-99 mg/dL. The main analysis used Cox regression, a method that estimates the relative rate at which an event occurs over time. The results are expressed as hazard ratio or HR, which is the ratio between the rate of diabetes onset in the groups compared. The models were adjusted for age, sex, body mass index, blood pressure, lipids, smoking, dietary habits, alcohol, and physical activity. A separate analysis was also performed on people with obesity, defined as a body mass index equal to or greater than 25 kg/m² according to the criteria adopted by the authors.

4. RESULTS

During the observation period, 1,028 of the 37,148 participants developed type 2 diabetes. At baseline, those who later developed diabetes had, on average, higher glycemia compared to those who did not: 92.69 versus 89.35 mg/dL. They also had, on average, a higher body mass index, blood pressure, and triglycerides, while HDL cholesterol, commonly known as “good cholesterol,” was lower.The central finding was a progressive increase in risk associated with glycemia. After adjusting for other measured factors, each 1 mg/dL increase in the 90-99 mg/dL range was associated with a 9% increase in the rate of diabetes onset. Compared to the group with glycemia at or below 89 mg/dL, the HR was 1.53 for 90-91 mg/dL, 1.76 for 92-93 mg/dL, 1.89 for 94-95 mg/dL, 3.17 for 96-97 mg/dL, and 3.41 for 98-99 mg/dL. In practical terms, in the 98-99 mg/dL group, diabetes appeared at a rate more than three times higher than in the reference group; all these comparisons were statistically significant.The direction of the association remained similar in people with obesity. In this subgroup, compared to glycemia at or below 89 mg/dL, the HRs were 1.56 for 90-91 mg/dL, 1.82 for 92-93 mg/dL, 2.05 for 94-95 mg/dL, 3.53 for 96-97 mg/dL, and 3.28 for 98-99 mg/dL. The absolute incidence also increased: in people with obesity, it rose from 3.97 cases per 1,000 person-years in the group at or below 89 mg/dL to 15.48 cases per 1,000 person-years in the 98-99 mg/dL group.

5. INTERPRETATION

The most immediate implication is that a fasting glycemia still below 100 mg/dL does not necessarily identify individuals with the same future risk. In the studied cohort, rising within the 90-99 mg/dL range was associated with a higher probability of a future diagnosis of diabetes, showing an increasing gradient rather than a jump observable only after a single threshold.The segment of the narrative directly documented by the study is: higher fasting glycemia, even if below 100 mg/dL greater future risk of type 2 diabetes. The analysis in people with obesity

reinforces the fact that the association was present even in this subgroup, after statistical adjustment for other available characteristics. However, it does not prove that the association is completely independent of any possible effect of excess weight, because statistical adjustment does not eliminate unmeasured factors, measurement errors, or changes that occurred during follow-up.The authors hypothesize that, in some people, higher but non-diagnostic values may reflect early alterations in insulin secretion or insulin sensitivity. This is a biologically plausible interpretation, but the study did not measure insulin, oral glucose tolerance tests, or glycated hemoglobin; therefore, it cannot establish which mechanism produced the increased risk.

6. INDEPENDENT SUPPORTING EVIDENCE

A large U.S. cohort examined 46,578 adults with an initial glycemia below 100 mg/dL. After adjusting for age, sex, body mass index, blood pressure, lipids, smoking, cardiovascular disease, and hypertension, each 1 mg/dL increase in fasting glycemia was associated with a 6% increase in the risk of diabetes. Participants with values of 95-99 mg/dL had an HR of 2.33 compared to those below 85 mg/dL. This directly confirms the passage in the book stating that the high end of normoglycemia can be associated with a higher future risk, even after statistical consideration of other metabolic factors [1]. The limitation is that this is also an observational cohort and that the participants were members of a U.S. healthcare system, not Japanese workers.A Mediterranean cohort of 13,845 apparently healthy adults, followed for 108,061 person-years, identified 307 new cases of diabetes. Compared to the group with glycemia of 51-82 mg/dL, the 91-99 mg/dL range was associated with an adjusted HR of 2.03; the 95% confidence interval was 1.18-3.50. The 83-90 mg/dL range, however, did not show a statistically conclusive estimate, with an HR of 1.42 and a confidence interval of 0.42-4.74 [2]. This result confirms the direction of the association but also signals that estimates may be less precise in the lower ranges or when the number of events is limited.In an Israeli cohort of 13,163 young men with initial glycemia below 100 mg/dL, 208 incident cases of diabetes occurred over 74,309 person-years. The risk increased progressively starting from glycemia values equal to or greater than 87 mg/dL, after adjusting for age, family history, body mass index, physical activity, smoking, and triglycerides. The association was also particularly high when values of 91-99 mg/dL coexisted with obesity or elevated triglycerides [3]. This evidence is consistent with the Panasonic observation in people with obesity, but it does not prove that the effect of glycemia is identical in women, the elderly, or populations with different characteristics.

7. CONFLICTING EVIDENCE

No directly conflicting evidence of sufficient relevance has been identified; this does not prove the absence of contrary findings. Differences between studies primarily concern the shape of the relationship and the value at which the risk appears to increase most clearly. In the Mediterranean cohort, for example, the association was statistically clear for 91-99 mg/dL but not for 83-90 mg/dL [2]. This suggests that the continuum should not be interpreted as an identical, linear, and universally quantifiable curve across every population.Furthermore, the available results are derived from observational studies with definitions of diabetes, follow-up duration, age, sex, healthcare context, and obesity distribution that are not perfectly overlapping. For this reason, the association between high-normal glycemia and future risk is consistent, while the precise threshold and the magnitude of the increased risk remain context-dependent.

8. QUADRO COMPARATIVO E SINTESI DELLE EVIDENZE

The table distinguishes the study under review from the independent cohorts used to evaluate the same scientific narrative.

Quadro comparativo

Reference	Study type	Population or model	Main result	Direction of evidence	Strength of evidence
Original study	Retrospective cohort	37,148 Japanese workers without diabetes	Between 90 and 99 mg/dL, the risk of diabetes increases progressively; similar trend in people with obesity.	direct confirmation	moderate
[1]	Retrospective cohort	46,578 US adults with baseline glycemia below 100 mg/dL	Each 1 mg/dL increase is associated with an HR of 1.06; 95-99 mg/dL: HR 2.33 compared to less than 85 mg/dL.	direct confirmation	moderate
[2]	Observational cohort	13,845 apparently healthy Mediterranean adults	Glycemia of 91-99 mg/dL is associated with an HR of 2.03 for diabetes compared to 51-82 mg/dL.	direct confirmation	moderate
[3]	Observational cohort	13,163 young Israeli men with baseline glycemia below 100 mg/dL	Risk increases progressively from 87 mg/dL; glycemia of 91-99 mg/dL combined with obesity is associated with higher risk.	indirect confirmation	moderate

9. SINTESI EDITORIALE E CONCLUSIONI

CONCLUSIONS

The Panasonic study clearly supports the association between higher fasting glycemia in the 90-99 mg/dL range and an increased future risk of type 2 diabetes. This result is also consistent within the subgroup with obesity. The independent cohorts make the narrative quite well-supported from a prognostic standpoint. It remains necessary to distinguish a risk indicator from a proven cause: these data do not establish that every increase in glycemia causes diabetes, nor do they, on their own, indicate a threshold for diagnosis or treatment.

Aggiornato al 17/11/2026. Questo contenuto riflette una sintesi divulgativa delle evidenze scientifiche al momento della pubblicazione e non sostituisce il parere medico.

10. TRANSPARENCY AND SCIENTIFIC RESPONSIBILITY

Artificial Intelligence was used solely as a tool for editorial and documentary support. All content, interpretations, bibliographic citations and conclusions have been verified, reviewed and approved by the author, who assumes full scientific responsibility for them.

The manuscript was also subjected to independent peer review prior to publication.

To ensure the greatest transparency, the complete history of the article, including the dates of submission, revision, acceptance and publication, as well as information on the peer review process, is available on the dedicated Article History page.

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