



Plasma Glucose Level as a Predictor of In-Hospital Mortality in Patients at an Emergency Room: A Retrospective Cohort Study

Diabetes Care 2019;42:e6–e7 | <https://doi.org/10.2337/dc18-1978>

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A few studies have examined the association between plasma glucose (PG) levels of emergency room (ER) patients and their in-hospital mortality (1–3), but the threshold value of hypoglycemia at which the risk is increased has not been established. The objective of the current study was to investigate this issue.

A retrospective cohort study of ER patients and various risk factors for in-hospital death has been under way since 2014 at Iizuka Hospital (4), a teaching hospital with 1,048 beds located at the center of the Chikugo region of Fukuoka Prefecture on Japan's Kyushu Island. A detailed description of this survey has already been published (4). All 57,443 consecutive patients ≥ 18 years old who presented to Iizuka Hospital's ER by ambulance between 1 February 2006 and 30 September 2014 were evaluated. Among the 57,443 patients, 391 patients had repeated ER visits on two consecutive days; in those patients, only the index case was used, in order to comply with the assumption of independent observations. The 2,317 patients who experienced cardiopulmonary arrest, the 298 patients who were pregnant, and the 3,823 patients whose glucose level at baseline was not obtained were excluded. Ultimately, 50,614 patients were included in the current

study. Each patient's age, sex, medication(s), length of hospital stay (days), and outcome data were retrieved from their medical records. As part of the routine clinical examination for each ER patient, PG levels were obtained by venipuncture into tubes containing sodium fluoride soon after the patient arrived at the ER and measured immediately in the hospital laboratory using the glucose-oxidase method. The end point of this study was mortality due to any cause during hospitalization. Patients who remained in the hospital on 30 November 2014 were considered alive in this analysis. Patients who did not require hospitalization and were discharged from the ER were also considered alive, and their stay in the hospital was regarded as 1 day. The age- and sex-adjusted hazard ratios (HRs) and their 95% CIs were examined using the Cox proportional hazards model. All analyses were performed using the SAS software package version 9.4 (SAS Institute, Cary, NC). Ethical approval by the Ethics Committee of Iizuka Hospital was obtained (no. CRM-27015), and the requirement of informed consent was waived because of the retrospective nature of this study.

The median age of the patients was 72 years (range 18–106), and the proportion

of males was 53%. A total of 3,577 case subjects were dead (mortality 7.1%; median hospital days 5.0). A U-shaped relationship was observed between PG levels measured in the ER and the patients' in-hospital mortality (Fig. 1). The lowest mortality was in the 5.0–5.9 mmol/L group. As the PG levels decreased from 3.0–3.9 mmol/L, the in-hospital mortality greatly increased. The highest mortality was in the < 1.0 mmol/L group, at 34.6%. By contrast, the in-hospital mortality progressively increased with elevation from PG levels of > 5.0 mmol/L. When the case subjects with PG levels < 3.0 mmol/L were divided into two groups based on whether they were taking glucose-lowering agents, the in-hospital mortality of the group without glucose-lowering agents was 44.0% ($n = 273$), much higher than that of the group taking glucose-lowering agents (1.5%; $n = 459$) ($P < 0.001$).

In 2017, the International Hypoglycemia Study Group defined a PG concentration of < 3.0 mmol/L as a cutoff point that can be used as clinically important hypoglycemia (5). This cutoff point was originally adopted for some physiological responses to hypoglycemia and some large-scale intervention studies (5). However, those intervention studies might

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Received 18 September 2018 and accepted 22 October 2018

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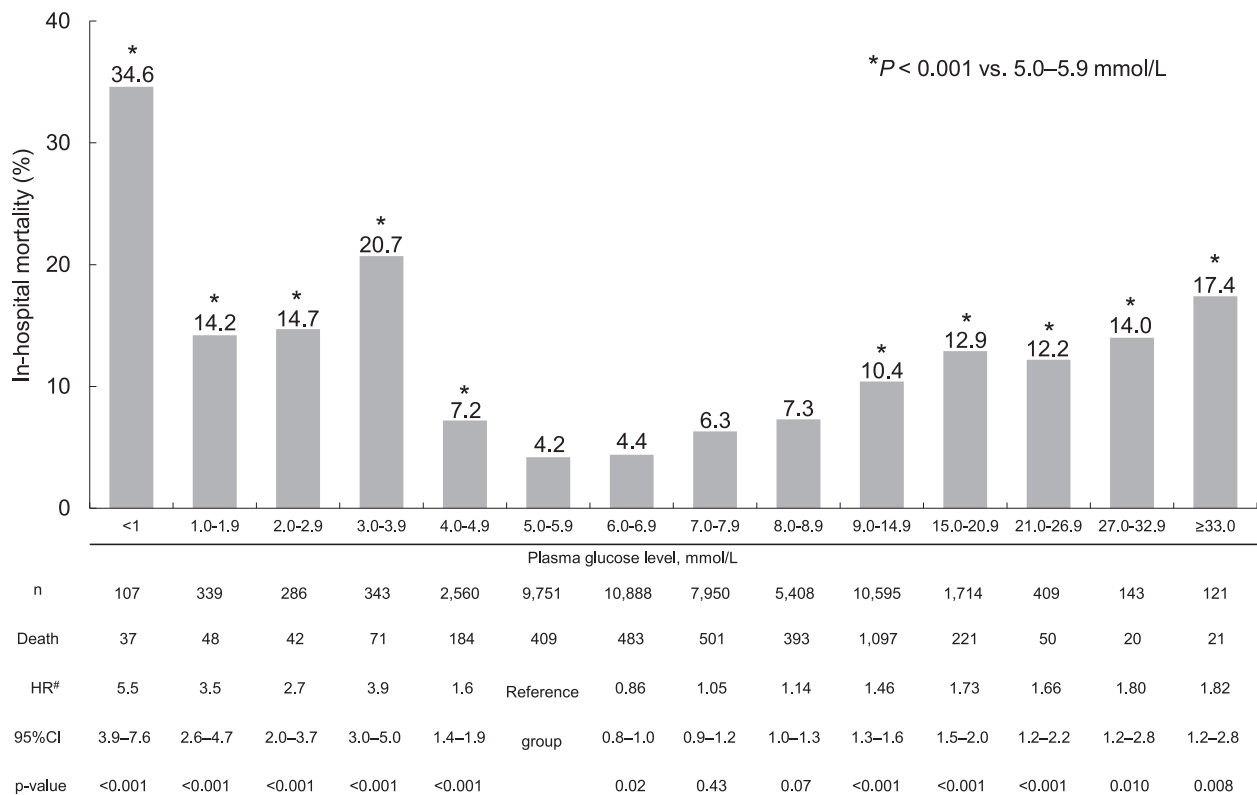


Figure 1—In-hospital mortality and the age- and sex-adjusted HRs when patients were divided into 14 groups based on their PG levels upon arrival at ER. A U-shaped relationship was observed between PG levels of ER patients and their in-hospital mortality. #Adjustment was performed for age and sex.

not directly reflect the glucose threshold value, indicating an increased risk of mortality in ER settings. To the best of our knowledge, this is the first report to show that the PG concentrations of 3.0–3.9 mmol/L in an ER setting were associated with higher mortality after hospital admission. One limitation is that this study was conducted at a single hospital. It is possible that our medical care may differ from that at other hospitals around the world. However, to maintain its standard of medical care, Iizuka Hospital has affiliations with overseas medical institutions, including the University of Pittsburgh Medical Center, El Camino Hospital, and Virginia Mason Institute. In addition, our hospital has been designated a residency training hospital since 1989, and it is renowned in Japan as an educational hospital. We thus believe that standard medical care is provided at our hospital.

In conclusion, both hypoglycemia starting at PG levels <4.0 mmol/L and hyperglycemia predicted an increased risk of in-hospital death. Patients with hypoglycemia who do not take glucose-lowering agents should receive extra attention in the ER.

Acknowledgments. The authors would like to thank all the participants and medical staff at the Iizuka hospital who provided medical care to ER patients during the study period.

Duality of Interest. No potential conflicts of interest relevant to this article were reported.

Author Contributions. R.Y. contributed to formal analysis. R.Y. and Y.D. contributed to visualization. Y.D. supervised the study. Y.D. contributed to study conceptualization. S.I. and K.A. contributed to validation. R.Y. and Y.D. contributed to writing of the manuscript. All authors contributed to methodology. Y.D. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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