

## Partial Pressure of Oxygen in Capillary Blood Samples from the Fingertip

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Many people with diabetes routinely measure their blood glucose (BG) on capillary blood samples from the fingertip. Beside other interfering factors, the blood samples' partial pressure of oxygen ( $pO_2$ ) can affect BG measurements, particularly in systems based on glucose oxidase (GOx) enzyme reactions on test strips.<sup>1,2</sup>

Indeed, many of the available home-use systems for self-monitoring of blood glucose (SMBG) utilize the GOx enzyme reaction, which is prone to oxygen interference; however, in the literature, poor information is available concerning physiological  $pO_2$  values and possible variations in capillary blood from the fingertip in people with diabetes.

In this investigation, the  $pO_2$  of capillary blood samples obtained from fingertips was determined in 110 subjects (55 female, 31 with type 1 diabetes mellitus, 69 with type 2 diabetes mellitus, 10 without diabetes; mean age 61 years, from 19 to 78 years); most of them were expected to perform SMBG regularly. The subjects had no acute serious diseases. They participate regularly in SMBG system evaluation studies at the Institute for Diabetes-Technology GmbH at Ulm University, Ulm, Germany. The study protocol was approved by the Ulm University Ethics Committee.

Capillary blood samples were obtained by skin puncture, and the  $pO_2$  was analyzed on a blood gas analyzer (OPTI™ CCA-TS Analysator, OPTI Medical System Inc., Roswell, GA). Maintenance, handling, and quality control of the blood gas analyzer were performed according to the manufacturer's labeling. Regular internal and external quality control measurements were performed, as required by German national guidelines. Sample collection and  $pO_2$  measurements were performed by trained clinical personnel.

The 110 subjects showed a mean  $pO_2$  of 71.1 mmHg (standard deviation  $\pm$  6.9 mmHg), ranging from 49 to 86 mmHg. Female and male subjects showed similar mean  $pO_2$  values (72.5 and 69.8 mmHg, respectively). Ninety-four subjects (~85%) showed  $pO_2$  values between  $>60$  and  $\leq 80$  mmHg, 6 subjects (~5%) showed  $pO_2$  values  $\leq 60$  mmHg, and 10 subjects (~9%) showed  $pO_2$  values  $>80$  mmHg (**Figure 1**). Lowest  $pO_2$  values (53 and 49 mmHg) were found in two subjects with stable chronic respiratory disease.

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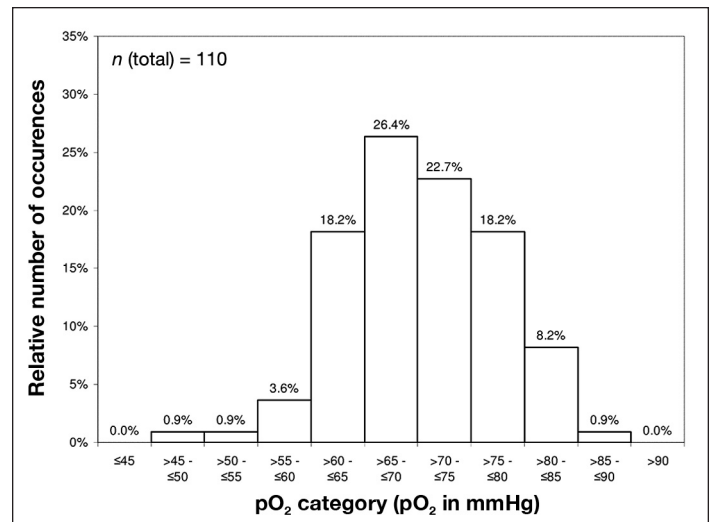
**Abbreviations:** (BG) blood glucose, (GOx) glucose oxidase, ( $pO_2$ ) partial pressure of oxygen, (SMBG) self-monitoring of blood glucose

**Keywords:** capillary blood samples from fingertips, glucose oxidase, partial pressure of oxygen, self-monitoring of blood glucose

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Our results indicate that a broad range of capillary  $pO_2$  values occur among a population of healthy people and people with diabetes without acute serious diseases.

In a previous study using venous blood samples adjusted to different  $pO_2$  levels, we observed remarkable measurement deviations with some GOx systems. Particularly at  $pO_2 \leq 45$  mmHg, we found considerably overestimated measurements.<sup>2</sup> Decreased  $pO_2$  values can occur in patients with respiratory diseases, such as chronic obstructive pulmonary disease,<sup>3</sup> which is described as being associated with type 2 diabetes.<sup>4</sup> At high altitudes or also during long-distance flights, up to ~40% decreased  $pO_2$  is reported for arterial blood samples;<sup>5</sup> a similar behavior can also be expected for capillary blood samples from the fingertip. In conditions with decreased  $pO_2$  values in capillary blood, measurements with oxygen-sensitive systems could be affected, and hypoglycemic events might not be detected adequately. Further investigations should be performed focusing on  $pO_2$  variations in capillary blood from fingertips in people with diabetes and the possible impact on glucose measurement results obtained with oxygen-sensitive systems.



**Figure 1.** Relative number of subjects with  $pO_2$  values within the respective category.

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#### Disclosures:

All authors are employees of the Institute for Diabetes-Technology GmbH at Ulm University (IDT), Ulm, Germany. Guido Freckmann is general manager of the IDT, which carries out studies evaluating BG meters and medical devices for diabetes therapy on behalf of various companies. Guido Freckmann/IDT have received speakers' honoraria or consulting fees from Abbott, Bayer, Menarini Diagnostics, Roche Diagnostics, Sanofi, and Ypsomed.

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