VARIABILITY OF Hb CONCENTRATION DUE TO DIFFERENT MEASUREMENT SYSTEMS: A PILOT STUDY WITH ELITE CROSS-COUNTRY SKIERS

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There was a lot of public and scientific discussion during the Olympic Winter Games in Turino 2006 concerning the rules that define an upper limit for Hemoglobin (Hb)-concentration in international competition, especially in Cross-Country and Nordic Combined. Since a potentially high Hb concentration measured in athletes may have profound consequences, the quality of the Hb concentration measurement needs to be very high. To date no study has been performed investigating the variability of Hb concentration measurements, and this was the aim with the present study.

34 Cross-Country skiers on top international level from the German, Swedish and France. national team served as subjects during their training camps at various locations in the Alps. A sum of 10 blood samples was taken after the defined interventions from an arm vein without stasis and immediately analyzed. In order to quantify the inter- and intra-assay variability different analytical systems from different companies were used: Two Sysmex KX 21N units, one Sysmex R500 (Sysmex Germany), one OSM3 (Radiometer, Copenhagen, Denmark) and a HemoCue Hemoglobin 201 (HemoCue Germany). The same blood sample was measured with all devices including duplicate determination.

No significant statistical differences between all machines were found with regard to the average values. The correlations between the identical devices (Sysmex KX 21N) were very high and significant ($r > 0.95$). But also for duplicate determination a difference of 0.4 g/dl could be found. The correlations between non-identical machines, however, only reached $r=.83$ and thus a coefficient of determination of only $r^2=.68$ indicating a not acceptable measurement error of appr. 30%. For the same sample Hb-values of 13.8, 14.2 und 15.1 g/dl could be measured.

The data collected in this study shows that anti-doping agencies should decide on a standardized method/machine for the determination of Hb concentration to be used for anti-doping testing.

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