

ACCURACY OF GPS-TRACKING DEVICES IN EXPOSURE ASSESSMENT STUDIES

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Background and Aims: Current lightweight Global Positioning System (GPS) receivers can be used to track an individual's location over several days to weeks. These tracking devices are increasingly used in epidemiological studies for time-allocation analyses to assess exposure to air pollution or electromagnetic fields. There is little information about the accuracy of these devices and to which extent e.g. different wearing or transport modes affect the performance of a GPS.

Methods: We tracked 12 individuals on two days during their commute to work. The tracked routes included different transport modes (walking, biking, car, bus, train). Each individual carried three different GPS tracking devices simultaneously on the left shoulder and a second set of identical GPSs in a backpack. We assessed the performance by first digitizing the true paths travelled by the participants with aerial imagery and subsequently computing the distance of the locations logged by the GPS to the true paths.

Results: The median error for walking was 3.7m (IQR 1.6-7.6m), biking 2.9m (IQR 1.3-5.9m), train 4.8m (IQR 2.3-8.9m), bus 4.9m (IQR 2.2-9.5m) and car 3.3m (IQR 1.5-5.9m). A higher accuracy (~1m) was observed for wearing the GPSs on the shoulder versus backpack for the transport modes biking and walking. Although 86% of all logged locations fell within 10m of the true path, about 1% of the errors were larger than 50m. Complete signal loss also occurred, in particular in the train where 28% of the total distance was not tracked.

Conclusions: The average accuracy of the GPSs was high. Thus, tracking devices are useful tools for time- and location-based exposure assessment. However, large GPS errors might affect estimates of exposures in the case of exposures with extreme high spatial variability such as radiofrequency fields from mobile phone base stations.