1. **Method**
   1. Participants

Fifty-one participants were recruited to post a flyer on ‘social media’, the SWOV website, and through the SWOV research database. All participants were required: to have a bicycle and smartphone available to use, to cycle at least four times a week at least five kilometres per trip, and not own a bicycle helmet. The testing protocol has been approved by the Ethics Committee of SWOV (ECOS) under the condition that participants owning a bicycle helmet were excluded from the study. ECOS stated that it is unethical to forbid participants to not use their own helmet as it could deprive them of their safety. A total of 26 participants were not able or willing to participate in the study; 22 participants because they did not meet the requirements, and four participants because they did not want to wear the helmet. Finally ten participants declined the invitation. The characteristics and the descriptive statistics for cycling experience of fifteen remaining participants are presented in Table 1.

Table 1 Demographic variables, gender ratio, and cycling background (Means, standard deviation, and t-tests)

|  |  |  |  |
| --- | --- | --- | --- |
|  | N | Mean | SD |
| mean age |  |  |  |
| min-max age |  |  |  |
| female / male (N) |  |  |  |
| Bicycle type |  |  |  |
| Kilometres per week |  |  |  |
| Cycling frequency b |  |  |  |

* 1. Data collection and procedure

All participants were invited to come the SWOV office located in The Hague with their bicycle and their smartphone. At home they filled in an online questionnaire with questions concerning their cycling habits, type of bicycle commonly used, and purpose of their bicycle trips. After a short introduction participants signed an informed consent form, and were instructed about the testing protocol. Participants were instructed to download an application – BlueTOI - on their smartphone and their bicycles were equipped with a GPS tracker. The application automatically detects a bicycle trip and logs speed (+/ 1kmh) and GPS coordinates. Participants received a bicycle helmet. The study consisted of an one-week pre-trial period where none of the participants used a helmet and a two week trial period were they were instructed to wear a helmet for all trips. After each week, and at the end of the study, participants responded to a survey about their cycling activities and helmet use during that week. The order of the trial period (helmet vs no helmet) was counterbalanced across participants. After the study participants received a gift voucher of 25 euros

* 1. Instruments

2.3.1 BlueTOI application

Cycling speed was measured with a beacon, mounted under the saddle of the bicycle. An application – BlueTOI – was downloaded and installed on the smartphone of the participant. Initially, the application would have been developed for both Android as well as iOS smartphones. However, during start-up of the study it turned out that it was not possible to use iOS smartphones. This caused the high dropout rate of participants. Once the beacon and the BlueTOI app are paired, the app registered all cycling. The app made the smartphone send out a signal every 90 seconds. If the signal detected the beacon, the app fired up the GPS sensors of the smartphone. GPS tracking data were then collected until the app lost connection with the beacon. At regular intervals, when in connection with a Wi-Fi, the app uploaded the collected data to a cloud storage.

2.3.2 Questionnaires

2.3.3 Handgrip strength

Physical strength was assessed with handgrip strength which is a common clinically used strength capacity measure shown to be related to leg extension strength (Stel et al., 2003, Pijnappels et al., 2008). Handgrip strength was measured using a JAMAR Hydraulic Hand Dynamometer. All participants were asked to squeeze as hard as possible for about 2s. The task was performed twice with each hand. For the final scores the highest scores of the right and left hand were summed and divided by two (Stel et al., 2003).

* 1. Data analysis

All sections with speeds less than 5 km/hour suggestive of ‘walking with the bicycle’ or ‘standing still waiting’ were excluded from analyses. An average mean trip speed was computed for each participant. Next, these speeds were averaged over all trips for that participant, which resulted in a mean speed. To investigate if helmet wearing had an effect on speed, average speed changes between pre-trial and trial period were compared. The mean speeds were analysed using repeated measures ANOVA with helmet (helmet and no helmet) as within subject variable and gender as between-subject variables.