Case description

The subject was a healthy 32-year-old Caucasian man living in the Tokyo metropolitan area, Japan. The Tokyo Metropolitan Employment Area consists of a continuous urban area patch with about 27 million habitants. Similar to about 9 million Tokyoites, the subject lived in one of the 23 special wards of Tokyo, which are located at the very heart of the metropolitan area. He worked in another of these 23 special wards. The subject declared having progressively switched from an active to sedentary lifestyle in the course of his twenties. He reported no regular physical activity in the 6-year period preceding the observation period. The subject has never been diagnosed with any chronic disease. He reported a BMI of 24.6kg/m^2, measured in December 2012. On April 2013, he bought a one-gear 27-inch utility bicycle (commonly called “mamachari”), featuring a lower top tube, shopping basket in the front and luggage rack at the back, and decided to systematically use it to travel within the Tokyo Metropolitan area. Each time it seemed possible relative to the distance, transported packages, and accompanying persons. He registered all the bicycle travels, which he would otherwise have completed using public transportations, in the GPS-based smartphone application Runkeeper from May 12th 2013, to March 31st 2014. He agreed to share this 11-month travel record. The Ethical Committee of the Ochanomizu University for Biomedical Research has approved the study protocol (ref: 2018-3). The subject gave his written consent to participate to the study. The subject stopped registering his travelling activities after a period of discontinuation due to the loss of his smartphone.

Data extraction and treatment

Each Runkeeper entry was systematically screened. Only bicycle (or “ride”) activities were explored further. For each travel, the starting and arrival dates, and times and locations were collected, and the estimated distance and average speed were computed. Apart from the usual commuting route, several recurrent itineraries were identified (home to commercial district, home to children’s school, workplace to community center, etc.). If the Runkeeper application appeared to have been unintentionally interrupted before the end of the travel (recorded activity ending at an unidentified location), or if the subject forgot to stop the application on arrival (timer still running), the entry was used to identify the type of travel, e.g., commute route or workplace to community center. However, the GPS segment and time metrics were considered corrupted. If the GPS data did not allow a clear identification of the travel, e.g., if the route stopped near the departure place, the entry was not considered for further treatment. In addition, missing travels were identified when the departure location of one activity did not match the arrival location of the previous registered event.

In an attempt to be as conservative as possible, missing travels and corrupted time data were replaced by the average duration of all similar travels completed in the same direction, plus one standard deviation. This data extrapolation procedure was not performed when no recurrent travelling route could be identified.

Estimation of pecuniary and time benefits

For each travel, a cost estimation of the same route travelled using public transportations was performed. First, a “low price” estimation was derived by selecting the cheapest route suggested by Google Map. If the latter included walking segments lasting more than 20 min, a second estimation was performed to match a more “natural use” of public transportations. For travels located on the “home-to-workplace” route, a cost adjustment procedure was performed to match the common usage of a commuter pass. These cost estimations were done for all identified bicycle travels. The sum of all “low price” estimations represents the minimal saving that can be expected by travelling actively for an 11-month period in the Tokyo metropolitan area. In order to reflect a more realistic expectation of pecuniary benefits, the previous calculation was also majored by incorporating the difference between “natural use” and “low price” estimations when relevant.

In addition, the duration of each identified bicycle travel was subtracted from the estimated duration of the fastest corresponding public transportation route suggested by Google Map. The sum of these differences represents a conservative estimation of time gain that is possibly achievable by travelling actively for a 11-month period in the Tokyo metropolitan area.

Each replacement of the missing data was verified a posteriori with the subject. This verification was conducted using his agenda. Extrapolated data were removed if there was any doubt regarding their validity/accuracy.

Physical fitness

The subject reported the results of two ergo-cyclometer ramp tests, which were performed in December 2012 and April 2014, at the same location. Thus, the body weight and maximal oxygen consumption data measured before and after the observation period were available.

Data quality

For the 11-month observation period, 659 entries were identified on the Runkeeper application. Among these, 133 duplicates were found, resulting in the identification of 526 actual activities. Additionally, 30 running leisure activities as well as 4 miscellaneous entries were discarded from the analysis. Finally, a total of 492 bicycle activities were considered for further screening. Seventy-five entries consisted of corrupted data, i.e., the travel could have been identified but time and distance data were not considered to be the actual values. Eighty-two missing travels were identified, bringing the total of activities to 574. All these 574 activities were used for the estimation of public transportation costs. In addition, the durations of 18 of the 157 corrupted or missing entries could not be extrapolated, and therefore, they were not used for the comparison between bicycle and public transportation durations.