

# Health impact of motorised trips that could be replaced by walking

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**Background:** We aimed to quantify the number of women and men, in Catalonia, among those not achieving physical activity recommendations, making short motorized trips which could have been made on foot, and to estimate the annual economic benefit due to reducing mortality as a result of replacing one short, daily, motorized journey with walking. **Methods:** Cross-sectional study. Mobility data came from individuals >17 years who reported, in the 2006 Daily Mobility Survey, having travelled on the referred working day ( $N=80\,552$ ). The health economic assessment tool for walking (HEAT) from the World Health Organization (WHO) Regional Office for Europe was used to calculate the economic benefit. **Results:** Of those not meeting recommendations, 15.6% of men (95% CI 15.2–16.1) and 13.9% of women (95% CI 13.5–14.4) would go on to meet them if they were to replace at least one short motorized trip per day by walking. If applied to the entire population of Catalonia, this change would increase up to 326 557 men (95% CI 313 373–339 740) and up to 252 509 women (95% CI 240 855–264 163) who would achieve recommendations through walking rather than driving. According to HEAT estimations, this would suppose a saving of €124 216 000 (95% CI 120 182 000–128 250 000) in men and €84 927 000 (95% CI 81 774 000–88 079 000) in women, derived from the reduction in mortality gained from walking accumulated over one year. **Conclusion:** This study demonstrates the potential of trips on foot as a source of physical activity. It also points out that both benefits for the health of the population and a huge economic benefit could have been gained through active transportation interventions.

## Introduction

There is evidence that a sedentary lifestyle contributes to the decline in health at different levels<sup>1</sup> and that physical activity is essential to maintain good health.<sup>2,3</sup> Moreover, the World Health Organization (WHO), through the Global Strategy on Diet, Physical Activity and Health, concluded in 2004,<sup>4</sup> and confirmed in 2010, that at least 150 minutes of moderate-intensity aerobic physical activity undertaken throughout the week is sufficient in adults, aged 18–65 years.<sup>5</sup>

Walking as a means of transport is considered a moderate physical activity, suitable for achieving recommended activity levels. Despite its numerous reported health benefits<sup>6</sup> walking has mainly been studied as a leisure time activity, while most studies of mobility conducted in Spain or Europe have been undertaken by the transport sector,<sup>7–9</sup> with the aim of planning motorized transport.

However, in recent years strategies attempting to integrate active transport into daily life have gathered force in many countries, promoted by the global strategies developed by the WHO,<sup>10</sup> or the Centers for Disease Control and Prevention (CDC).<sup>11</sup> Promotion of the use of active transport is seen as a tool to combat the trend of increasing sedentarism in the population.<sup>12</sup> This has also been proposed by the new WHO Action Plan for the implementation of the European Strategy for the Prevention of Noncommunicable Diseases 2012/2016,<sup>13</sup> which identifies the promotion of active mobility as one of the supporting interventions for the prevention of noncommunicable diseases.

Due to the difficulty of promoting health through policies which are under the control of non-health sectors, an effort is being made in order to facilitate tools from the health sectors, which could provide methodological guidance to policy makers.<sup>14</sup> One recent

example comes within the framework of the Transport, Health and Environment Pan-European Programme (THE PEP), an intersectoral policy platform of European ministries of transport, health and the environment supported by the WHO and the United Nations Economic Commission for Europe, with the aim of promoting healthy and sustainable transport policies.<sup>15</sup> Within this context, the WHO developed the health economic assessment tool (HEAT) in order to facilitate the quantification of the economic savings resulting from the health benefits derived from cycling and walking.<sup>16</sup> As HEAT for walking provides economic arguments, it can be useful to highlight and quantify the health effects of interventions resulting in changes to walking and get support in many other sectors involved in policy decisions, notably in the domains of transport and urban planning.<sup>14,16</sup>

The objectives of the present study were to quantify the number of women and men making motorized trips, in Catalonia (Spain) in 2006, which could have been made on foot, among those who do not achieve physical activity recommendations, and to estimate through HEAT, the annual economic benefit due to reducing mortality as a result of walking coming from the substitution of at least one of those short motorized trips per day.

## Methods

### *Design, information source and study population*

This is a cross-sectional study based on the 2006 Catalanian Daily Mobility Survey (EMQ2006) carried out by the Catalan regional government (Departament de Política Territorial y Obras Públicas de la Generalitat de Catalunya y Autoritat del Transport Metropolità). The study population includes all residents of Catalonia, aged >17 years in 2006.

## Data collection methods

The EMQ2006 employed a computer-assisted telephone interviewing (CATI) technique to interview a representative sample of the population of Catalonia, an autonomous region of Spain with ~7 million inhabitants. Data were collected using multistage stratified sampling covering the whole of Catalonia.

Thus, mobility data were collected for 106 091 individuals. We selected for our study those people aged >17 years who reported having made at least one trip on a work day ( $n = 80\,552$ ). For every trip they made the day before the interview, details were collected, for example, the day, reason, origin, destination, starting time and duration; this yielded data on 291 720 trips made on a working day in the 41 counties into which Catalonia is divided.

## Variables

The outcome variable used was 'Trips which could have been done on foot by a person' (none/some). We considered that trips made by car or motorcycle, which took  $\leq 5$  min, could have been made on foot. Moreover, we assumed that such trips could have been undertaken by walking for 20–30 min.<sup>9,17,18</sup> This study was performed in a context of high density urban zones, where 95% of the population is concentrated in 300 villages with a range of 2000 to 1.5 million inhabitants.<sup>19</sup>

The 'Time spent travelling on foot', by a person on a work day, in minutes, was used as an intermediate variable in order to determine the population in which the outcome was measured. This time was categorized in two ways: (i) zero, <30 minutes, from 30 to 59 and  $\geq 60$  or (ii) 'achievement of physical activity recommendations using walking as the means of transport (yes/no)'. We considered that one person achieves the physical activity recommendations if he/she walked at least 30 minutes on the workday referred in the survey.

The socio-economic variables used to describe the population in which the outcome was measured were: age, employment status (active worker, non-worker), vehicle availability (yes/no), size of municipality of residence (>1 000 000 inhabitants, >100 000, between 50 000 and 100 000, <50 000) and mode of transport (on foot, bicycle, public transport, motorcycle, car and truck or van). All variables referring to mode of transport were categorized as 'Made some trip using the given form of transport (yes/no)'. Sex was used as a stratifying variable.

## Statistical analysis

The prevalence of making trips on foot during a working day, and its corresponding 95% confidence intervals (95% CIs), were calculated stratifying by sex. A descriptive analysis was carried out of the time spent walking, calculating means and their corresponding 95% CIs.

The proportion of men and women who did not achieve recommended levels of physical activity through walking was described according to the socio-economic variables of the person making the trip and stratifying by sex. Bivariate and multivariate logistic regression analyses were carried out to determine the factors associated with not reaching recommended physical activity levels through walking by calculating odds ratios (ORs) and their corresponding 95% CI. A descriptive analysis of the mobility of those who did not meet recommended physical activity levels was performed. The proportion of using each form of transport during the working day was studied, stratifying by sex and age.

The number of men and women in Catalonia who could achieve the recommendations by replacing motorized trips of  $\leq 5$  min by trips on foot was calculated applying the proportions found in the travel survey to the entire population of Catalonia, using post-stratification weights. Finally, among those men and women, we used the HEAT for walking in order to calculate the financial saving derived from the reduction in mortality gained

from the level of walking accumulated over one year through the substitution of at least one daily motorized trip of  $\leq 5$  minutes duration with walking. In our study, we considered that in those individuals who did not walk at all, any increase in walking was newly induced and directly attributable to the substitution of a short motorized trip. On the contrary, in those who had already reported any walking, even though they did not reach the physical activity recommendations, we considered that only 50% of the new walking is attributable to that change as is suggested by HEAT in these cases, because some of the walking observed is probably a shift from previous walking activity. The other parameters used for HEAT calculation were: an amount of 150 minutes walked per week, considering 30 minutes walked per each workable day of the week; a mortality rate of 21 349 deaths/100 000 persons aged 20–74 years per year in Spain in 2008;<sup>16</sup> €1 300 000 as a value of statistical life,<sup>20</sup> derived with a methodology called 'willingness to pay' to avoid death in relation to the years this person can expect to live according to the statistical life expectancy, and a discounting rate of 5%, since benefits occurring in the future are generally considered less valuable than benefits occurring in the present.

All analyses were conducted using the STATA statistical package, version 11.2.

## Results

Of the total number of men and women who travelled on a working day, 40.4% (95% CI 39.8–41.0) and 57.4% (95% CI 56.8–57.9), respectively, made at least one trip on foot, men spending an average of 20.8 minutes, and women 25.8 minutes. In both sexes, the age groups who walked proportionately less were those aged 18–29 and 30–44 years (table 1).

On the other hand, 59.6% of men and 42.6% of women did not walk at all. When combined with those who, despite making a trip on foot, spent <30 minutes walking (17.6 and 25.1% among men and women, respectively), the result is that 77.2% of men and 67.7% of women aged >17 years in Catalonia, who made a trip, did not reach recommended daily physical activity levels using walking as transport (table 1).

In both sexes, we observe that men and women aged 18–29 years did not achieve physical activity recommendations to a higher proportion [85.5%, OR = 2.0 (1.8–2.4); 79.7%, OR = 1.6 (1.4–1.8), respectively]. Moreover, in both sexes, being employed and having access to a vehicle were both factors associated with not meeting recommendations through walking. Furthermore, the association increases with a decreasing size of municipality of residence, those living in towns of under 50 000 inhabitants

**Table 1** Men and women who travel on a working day and time spent walking

|                      | Persons who travel (N) | 0 min (%) | <30 min (%) | 30–59 (%) | >60 (%) | Mean <sup>a</sup> (min) | Mean <sup>b</sup> (min) |
|----------------------|------------------------|-----------|-------------|-----------|---------|-------------------------|-------------------------|
| <b>Men (years)</b>   |                        |           |             |           |         |                         |                         |
| 18–29                | 8789                   | 66.6      | 19.0        | 9.1       | 5.4     | 10.9                    | 32.5                    |
| 30–64                | 26 632                 | 65.2      | 16.7        | 8.2       | 9.9     | 15.9                    | 45.5                    |
| >65                  | 6601                   | 27.8      | 19.3        | 16.2      | 36.7    | 53.8                    | 74.6                    |
| Total                | 42 022                 | 59.6      | 17.6        | 9.6       | 13.1    | 20.8                    | 51.4                    |
| <b>Women (years)</b> |                        |           |             |           |         |                         |                         |
| 18–29                | 8370                   | 56.8      | 22.9        | 12.5      | 7.8     | 15.2                    | 35.1                    |
| 30–64                | 25 168                 | 44.2      | 24.2        | 15.9      | 15.6    | 25.0                    | 44.9                    |
| >65                  | 8065                   | 22.9      | 30.0        | 19.9      | 27.2    | 39.1                    | 50.8                    |
| Total                | 41 603                 | 42.6      | 25.1        | 16        | 16.2    | 25.8                    | 44.9                    |

a: Mean time spent walking by all the people interviewed, including those who did not walk

b: Mean time spent walking by all the people who walk, excluding those who did not walk

presenting the strongest association with not meeting recommendations, both in men [82.2%; OR = 1.7 (1.5–1.8)] and in women [72.7%; OR = 1.3 (1.2–1.4)] (table 2).

Given the high dependence on private transport of people not meeting the recommendations seen on table 3, we attempted to quantify those who made motorized trips that could have been made on foot, as well as the economic benefits gained from the level of walking derived from that substitution.

Of those not meeting recommendations, 15.6% of men (95% CI 15.2–16.1) and 13.9% of women (95% CI 13.5–14.4), could achieve recommended levels of physical activity by walking if they were to replace at least one motorized trip of 5 minutes duration or less by walking. This change would increase up to 326 557 the number of men (95% CI 313.373–339.740) and up to 252 509 the number of women (95% CI 240 855–264 163) in Catalonia who would in consequence achieve recommended daily levels of physical activity through walking as a means of transport. According to HEAT estimations, this change would suppose a financial saving of €124 216 000 (95% CI 120 182 000–128 250 000) derived from the reduction in men's mortality gained from the level of walking accumulated over one year through the replacement of at least one daily motorized trip of 5 minutes duration or less. This financial saving would be of €84 927 000 (95% CI 81 774 000–88 079 000) in the case of women (table 4).

## Discussion

This study reveals that about half of the men and women who travel on a working day in Catalonia do not make any of the journeys on foot. Moreover, it is noteworthy that only 22.7% of men and 32.2% of women >17 years achieve recommended levels of physical activity through walking. However, these percentages could be increased since one in every 10 men and women would go on to meet recommended physical activity levels if some of their short motorized journeys were made by walking instead. This change would suppose not only a great benefit for health but also a huge financial saving.

### Strengths and limitations

Apart from the large sample size, the EMQ2006 collects exhaustive data on all trips made during an entire day, and covering all forms

of transport used, even in trips lasting ≤5 minutes. This gives us an opportunity to determine the current population prevalence of making trips on foot, as well as to identify those motorized trips which could be replaced by walking, thus characterizing the most inactive population groups, and hence targets for intervention. Few studies have used mobility survey data from this perspective with the ultimate purpose of analysing active mobility. Moreover, the recent development of HEAT for walking allows us to apply an evidence-based and easy to use tool, in order to calculate the economic benefit of replacing those short motorised trips by walking, taking into account, in this case, mobility data derived from an exhaustive survey.

Despite its completeness, the EMQ2006 did not collect the time spent in each mode of transport in trips involving several modes. We assigned the total trip time to the first stage. However, these multistaged trips represented only 5% of all trips undertaken in Catalonia on a working day. Another limitation is that we have information about minutes walked referring to only one working day of the week. Despite not having sufficient information to extrapolate these results to cover the whole week, we believe that trips made on a working day are routine and would not vary too much from day to day during the week. We also do not have information referring to physical activities not related to transport. However, we do know that 90.7 and 93.3% of the men and women who made short motorized trips during the day and did not meet recommendations through walking, had not made any bicycle journeys, nor made any trips to go somewhere to engage in sport.

In addition, there is the limitation of not having data on distances in order to determine which motorized trips which could have been made by walking. Instead, we employed an approximation in time (5 minutes). However, given that this criterion only takes time into account, it is possible that we included some trips that were not in practice walkable because of physical barriers, or perhaps excluded some trips that were. In any case, it must be borne in mind that the choice of a means of transport is not solely based on questions of time and/or distance, but also by other aspects, such as accessibility, convenience or factors related with the setting.<sup>21,22</sup> Nevertheless, this study is performed in the context of high-density urban zones.

**Table 2** Men and women who travelled on a working day but did not reach the physical activity recommendations, and factors associated with not reaching the physical activity recommendations through walking among those who travel

|                                 | Men                      |  |                                    | Women                      |  |                                    |
|---------------------------------|--------------------------|--|------------------------------------|----------------------------|--|------------------------------------|
|                                 | Number of men who travel | Travel but did not reach recommendations |                                    | Number of women who travel | Travel but did not reach recommendations |                                    |
|                                 | N                        | %  | Multivariate analysis (OR [95%CI]) | N                          | %  | Multivariate analysis (OR [95%CI]) |
| Age of the interviewees (years) |                          |  |                                    |                            |  |                                    |
| 18–29                           | 8789                     | 85.5                                     | 2.0 (1.8–2.4)                      | 8370                       | 79.7                                     | 1.6 (1.4–1.8)                      |
| From 30 to 64 years             | 26 632                   | 81.9                                     | 1.3 (1.2–1.5)                      | 25 168                     | 68.5                                     | 1.0 (0.9–1.1)                      |
| More than 65 years              | 6601                     | 47.1                                     | 1.0                                | 8065                       | 53.0                                     | 1.0                                |
| Professional situation          |                          |  |                                    |                            |  |                                    |
| Employed                        | 27 898                   | 87.2                                     | 4.5 (4.1–4.9)                      | 20 789                     | 76.59                                    | 2.0 (1.9–2.2)                      |
| Unemployed                      | 15 821                   | 57.8                                     | 1.0                                | 22 205                     | 59.0                                     | 1.0                                |
| Vehicle availability            |                          |  |                                    |                            |  |                                    |
| Yes                             | 34 286                   | 81.1                                     | 2.0 (1.8–2.2)                      | 21 326                     | 76.6                                     | 1.8 (1.7–1.9)                      |
| No                              | 9183                     | 60.2                                     | 1.0                                | 21 521                     | 58.4                                     | 1.0                                |
| Size of municipality            |                          |  |                                    |                            |  |                                    |
| Barcelona(Capital City)         | 10 930                   | 71.8                                     | 1.0                                | 11 712                     | 64.6                                     | 1.0                                |
| More than 100 000 hab           | 10 281                   | 72.9                                     | 0.9 (0.8–1.1)                      | 10 053                     | 62.2                                     | 0.8 (0.8–0.9)                      |
| Between 50 000 and 100 000 hab  | 5590                     | 75.8                                     | 1.1 (0.9–1.2)                      | 5417                       | 65.6                                     | 0.9 (0.8–1.0)                      |
| Less than 50,000 hab            | 23 107                   | 82.2                                     | 1.7 (1.5–1.8)                      | 21 619                     | 72.7                                     | 1.3 (1.2–1.4)                      |
| Total                           | 49 906                   | 77.2                                     |                                    | 48 795                     | 67.7                                     |                                    |

Note. Model adjusted by level of studies and number of person at the household

Finally, we point out that the time spent on each trip was self-reported by the interviewee, so that there could be a certain degree of recall bias, probably tending to underestimate the shortest trips.

Regarding to the limitations of applying HEAT calculations, it must be said that HEAT only takes into account mortality reduction when calculating the economic benefit of walking. Based on a meta-analysis of nine longitudinal studies,<sup>23</sup>

they considered a relative risk of all-cause mortality of 0.78 among people who walk 29 minutes/day. Although neither morbidity reduction nor the additional benefits in terms of reduced emissions or road injuries from the replaced car trips have been considered, this makes the benefit estimations to be more conservative. Moreover, when using the default mortality data, HEAT application only allows us to calculate economic savings, taking into account the 2008 mortality rate for Spain, even though our mobility data were collected in 2006.

**Table 3** Mode of transportation used by men and women who did not reach physical activity recommendations through walking on a working day

|                  | Men           |      |         |      | Women         |      |         |      |
|------------------|---------------|------|---------|------|---------------|------|---------|------|
|                  | 0 min walking |      | <30 min |      | 0 min walking |      | <30 min |      |
|                  | N             | %    | N       | %    | N             | %    | N       | %    |
| <b>18–29</b>     |               |      |         |      |               |      |         |      |
| Only walking     |               | 0    | 596     | 35.7 | 0             |      | 736     | 38.4 |
| Bike             | 164           | 2.8  | 60      | 3.6  | 49            | 1    | 33      | 1.7  |
| Public transport | 1084          | 18.6 | 285     | 17.1 | 1297          | 27.3 | 472     | 24.7 |
| Car              | 3684          | 62.9 | 688     | 41.2 | 2824          | 59.4 | 755     | 39.4 |
| Motorbike        | 710           | 12.1 | 117     | 7    | 294           | 6.1  | 72      | 3.7  |
| Truck/van        | 166           | 2.8  | 34      | 2    | 7             | 0.2  | 3       | 0    |
| <b>30–64</b>     |               |      |         |      |               |      |         |      |
| Only walking     |               | 0    | 1986    | 44.6 | 0             |      | 3243    | 53.1 |
| Bike             | 258           | 1.4  | 79      | 1.8  | 109           | 1    | 34      | 0.6  |
| Public transport | 1974          | 11.4 | 513     | 11.5 | 2632          | 23.7 | 915     | 15   |
| Car              | 12658         | 73.1 | 1772    | 39.7 | 7348          | 66   | 2002    | 32.8 |
| Motorbike        | 1340          | 7.7  | 109     | 4.7  | 302           | 2.7  | 116     | 1.9  |
| Truck/van        | 857           | 4.9  | 90      | 2    | 40            | 0.4  | 4       | 0    |
| <b>&gt;65</b>    |               |      |         |      |               |      |         |      |
| Only walking     |               | 0    | 867     | 68   | 0             |      | 1985    | 82   |
| Bike             | 32            | 1.7  | 10      | 0.7  | 8             | 0.4  | 4       | 0.2  |
| Public transport | 405           | 22   | 154     | 12   | 778           | 42.1 | 244     | 10.1 |
| Car              | 1183          | 64.4 | 249     | 19.5 | 752           | 40.7 | 206     | 8.5  |
| Motorbike        | 47            | 2.6  | 10      | 0.8  | 6             | 0.3  | 0       | 0    |
| Truck/van        | 50            | 2.8  | 1       | 0.8  | 21            | 1.1  | 5       | 0.2  |

Note. The percentages do not necessary add up 100 because a person could have travelled by several means of transport

**Table 4** The estimated number of men and women in Catalonia who could achieve physical activity recommendations by replacing motorized trips of >5 minutes by trips on foot, and the estimated total million EUROS accumulated over one year and its 95% CI, due to reduced mortality as a result of walking coming from the substitution of at least one short motorized trip

|              | People who made short motorized trips (%) <sup>a</sup> |           | Number of people who could achieve recommendations <sup>b</sup> |                 | Number of deaths per year that are prevented by this level of walking <sup>c</sup> |               | Total benefits accumulated over 1 year in EUROS <sup>d</sup> |                         |
|--------------|--|-----------|---|-----------------|--|---------------|--|-------------------------|
|              | %  | 95% CI    | N   | 95% CI          | N  | 95% CI        | N  | 95% CI                  |
| <b>Men</b>   |  |           |   |                 |  |               |  |                         |
| 0 min        | 17.3   | 16.8–17.9 | 279 061   | 269 840–288 282 | 99.90  | 96.68–103.13  | 123 690 000  | 119 700 000–127 680 000 |
| <30 min      | 10   | 9.2–10.8  | 47 496  | 43 533–51 458   | 8.50   | 7.79–9.21     | 526 000  | 482 000–570 000         |
| <b>Women</b> |  |           |   |                 |  |               |  |                         |
| 0 min        | 16.6   | 16.0–17.2 | 189 927   | 182 732–197 121 | 68.03  | 65.53–70.54   | 84 233 000   | 81 130 000–87 336 000   |
| <30 min      | 9.3  | 8.7–10.0  | 62 582  | 58 123–67 042   | 11.20  | 10.41–12.00   | 694 000  | 644 000–743 000         |
| <b>Total</b> |  |           |   |                 |  |               |  |                         |
| Men          | 15.6   | 15.2–16.1 | 326 557   | 313 373–339 740 | 108.40   | 104.47–112.34 | 124 216 000  | 120 182 000–128 250 000 |
| Women        | 13.9   | 13.5–14.4 | 252 509   | 240 855–264 163 | 79.23  | 75.94–82.54   | 84 927 000   | 81 774 000–88 079 000   |

Note. Parameters for HEAT calculations: minutes walked per week:150; mortality rate for Spain 2008: 213.49 deaths per 100 000 persons/year; value of statistical life: 1 300 000; discounting rate: 5%

a: Percentage of men and women who did not reach physical activity recommendations but made at least one motorized trip of 5 minutes or less duration

b: Estimated number of men and women in Catalonia who could achieve the recommendations by replacing motorized trips of 5 minutes or less by trips on foot

c: Estimated number of deaths per year that are prevented by this level of walking calculated by HEAT

d: The current value in EUROS of the total benefits accumulated over one year calculated by HEAT

### Comparison with other studies

As far as we are aware, no other study has tried to determine through a mobility survey how many people achieve recommended physical activity levels by using walking as a means of transport, how many people could achieve them by replacing short motorized trips by walking, and what is the economic benefit of that change.

There were no great differences between our results and other Spanish studies, which describe the proportion of people achieving recommended physical activity levels through other forms of activity different to walking for transportation (62.9 and 78.9% of men and women aged 18–65<sup>24</sup> years). Most studies describing socio-demographic characteristics of inactive people are focused on leisure time activities. Such studies report that sedentarism is greater in women and that it increases with age up to 65 years.<sup>25,26</sup> However, by studying physical activity through walking for transportation, we observe that women and those aged >65 years walk proportionately more, and a higher proportion of them achieve recommended levels. It is thus clear, as previous evidence on mobility suggests, that men and women travel in different ways. Although higher levels of walking for transportation in women could help to increase their global levels of physical activity, it must also be considered that sometimes those could be due to less access to motor vehicles or to restricted mobility because of familiar and domestic responsibilities. Both studies on leisure time and our own study describe that residents of the smaller towns face more barriers to engaging in physical activity,<sup>27</sup> due to fewer infrastructures, their lower quality or difficulties in access. Thus, policies in small municipalities should also become a key point



for future interventions. It points out the need to involve other sectors, in addition to the health sector, such as local transport and mobility departments.

Regarding motorized trips, which could have been made on foot, there are no established criteria, nor have we found any other studies attempting to quantify such trips through a mobility survey. One European project, WALCYNG,<sup>9</sup> conducted in several countries, with the aim of promoting walking or cycling instead of driving for short trips, considers trips of no more than >1–2 km as being possible to make on foot. As data on distances were not available, we considered as possible to make on foot those trips which took  $\leq 5$  min when made by a car or motorcycle. We consider that in this time, a vehicle can cover distances of  $\sim 1$ –2 km (on average, and depending on road/traffic conditions). This is coherent, taking into account both the criteria of project WALCYNG and of Shepard *et al.*,<sup>17</sup> who consider that a distance of 1.9 km can be covered on foot in  $\sim 22$  min. Similarly, Frank *et al.*<sup>18</sup> report that walking 2 km daily would be the equivalent of achieving the recommendations of 30 minutes of moderate activity.

Although there are examples of how the HEAT tool has begun to be used by practitioners in many European countries,<sup>14</sup> there are still not many articles in the literature which use HEAT, maybe because its walking application was only released in May 2011. We found two European studies that put HEAT into practice.<sup>28,29</sup> However, both are focused on bicycling, and although mobility data are taken into account, estimations are made to calculate bicycle use.

It is necessary to continue putting HEAT into practice in other studies, introducing as many mobility data as possible. Moreover, in future studies, it would be interesting to assess the impact on health of replacing short motorized trips by walking, taking into account the joint impact of the increase in the population's physical activity levels, reduction in emission of pollutant gases deriving from motorized transport<sup>30</sup> and the reduction in the exposure to risk of injury due to traffic accidents,<sup>31</sup> as has already begun to be studied in the context of bicycle trips.<sup>16,32</sup>

Although interventions advocating changes to the behaviour of sedentary and motivated subgroups have been described as one of the most effective ways to promote walking,<sup>33</sup> they must be put in place in combination with many other policies or interventions related to other determinants of active travel.<sup>33–35</sup> For this reason, it should be implemented at the same time as interventions aimed at improving infrastructures and creating more walkable environments such as pavements or green areas;<sup>22,36</sup> measures aimed at improving road safety and promoting traffic calming interventions such as the creation of pedestrian areas or reduction of traffic speed;<sup>37–39</sup> or interventions that provide alternatives to the car such as improving public transport services and accessibility.<sup>40</sup>

## Conclusions and implications

This study demonstrates the potential of trips on foot as a source of physical activity when attempting to combat current sedentarism. Many motorized trips could be made on foot due to their shortness, thus introducing physical activity into the population's daily activities. This would have a considerable impact on the health of the population, and also particularly among those who currently do not achieve physical activity recommendations. Moreover, this study points out that a huge economic benefit could be gained through active transportation interventions, and that factors, such as gender, age, professional situation or place of residence must be taken into account when designing future policies or interventions in order to facilitate replacing private transport with physically active means of transport.

## Acknowledgements

We thank Mayte Capdet from the Autoritat del Transport Metropolità (Barcelona) and Josep Maria Aragay from Universitat de Barcelona (UB) for providing the data, and Nick Cavill for his helpful suggestions. This article forms part of the doctoral dissertation of Marta Olabarria Saenz de Viguera at the *Universitat Pompeu Fabra* de Barcelona.

*Conflicts of interest:* None declared.

## Key points

- One in 10 men and women would go on to meet recommended physical activity levels if they made one of their daily short motorised journeys on foot instead.
- A huge annual economic benefit has been revealed through the HEAT tool as coming from the replacement of at least one motorized trip with a journey on foot, among those people who do not currently achieve recommended levels of physical activity through walking.
- Our findings reinforce the potential of walking for transportation as a physical activity source and reveal the huge economic benefit that could be gained through the design and promotion of interventions encouraging active transport.

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