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InterMob: A 24-month randomised controlled trial comparing the effectiveness of an intervention including behavioural change techniques and free transport versus an intervention including air pollution awareness-raising on car use reduction among regular car users living in Grenoble, France

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Abstract

Background. Frequent car use contributes to health and environmental issues such as air pollution, climate change and obesity. Active and sustainable mobility (bike, walk, public transport, car sharing) may address these issues. Different strategies have been implemented in past research, involving *hard* levers, aimed at modifying the economical or geographical context (e.g., free public transport), and *soft* levers, aimed at modifying psychological processes (e.g., personalised transport advice). However, few studies have combined both hard and soft levers. In addition, few have used robust methodologies (e.g., randomised controlled trials), followed behavioural changes in the long-term, and been anchored in behaviour change theories. InterMob aims to address these limits by implementing a 24-month randomised controlled trial including *hard* and *soft* levers. The objectives of InterMob are to a) evaluate the effectiveness of an experimental arm versus an active controlled arm, and b) identify the processes of mobility change.

Methods. Regular car users living in Grenoble ($N = 300$) will be recruited and randomised to one of the two arms. The experimental arm consists in a six-month intervention combining *hard* levers (free access to transport/bikes), and *soft* levers (e.g., personalised transport advice). The control arm consists in a six-month intervention aimed at raising awareness on air pollution and its health effects. Both arms will include eight evaluation weeks (spread out over 24 months) based on a GPS, an accelerometer, and a pollution sensor. Moreover, participants will complete mobility logbooks and surveys measuring psychological constructs, socio-economical, and socio-spatial characteristics.

Discussion. InterMob will assess the effectiveness of two interventions aimed at reducing car use within regular car users in the short-, mid- and long-term. Moreover, InterMob will allow to better understand the psychological processes of behaviour change, and the socio-economical and geographical conditions under which the intervention is

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65 efficient in reducing car use. Finally, the benefits of mobility change in terms of physical
66 activity, quality of life, and exposure to pollution will be quantified.

67 **Trial registration.** ClinicalTrials.gov: NCT05096000

68 **Keywords:** daily mobility, spatial organisation, psychology, car use, active mobility,
69 sustainable mobility, behaviour change, health, air pollution, RCT

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71 **InterMob: A 24-month randomised controlled trial comparing the effectiveness**
72 **of an intervention including behavioural change techniques and free transport versus an**
73 **intervention including air pollution awareness-raising on car use reduction among**
74 **regular car users living in Grenoble, France**

75 **Background**

76 Daily car use contributes to major health and environmental issues. Motorised
77 transport represents an important source of air pollution, noise and greenhouse gases
78 (CITEPA, 2020; van Schalkwyk & Mindell, 2018; WHO, 2018). Moreover, regular car users
79 present lower levels of physical activity (Chakrabarti & Shin, 2017), spend more time in
80 sedentary behaviours (Sugiyama et al., 2012), and have a higher risk of being obese or
81 overweight (Frank et al., 2004; Jacobson et al., 2011). In turn, air pollution, climate change
82 and physical inactivity represent important dangers to human health and life expectancy
83 (Fuller et al., 2022; Guthold et al., 2018; Kohl et al., 2012; Manisalidis et al., 2020).
84 Nevertheless, despite all the negative consequences of daily car use, the car remains the main
85 mode of transport in most countries (e.g., in France, 63% of daily trips are made by car,
86 SDES, 2020).

87 Active and sustainable mobility such as cycling, walking, public transport and
88 carpooling have in contrast positive effects on health and well-being. These modes of
89 transport are associated with higher levels of physical activity (Chaix et al., 2014, 2019;
90 Pucher et al., 2010; Rojas-Rueda et al., 2011), greater well-being (Martin et al., 2014), better
91 work performances (Ma & Ye, 2019), and a higher life expectancy (Cepeda et al., 2017). In
92 addition, these transport modes might represent an effective lever to tackle air pollution and
93 climate change (Bernard et al., 2021; Brand et al., 2021). Nevertheless, active and sustainable
94 mobility are less frequently used than the car for daily mobility (i.e., in France, 37% of daily
95 trips are made by using an active and sustainable mobility, SDES, 2020).

96 **1.1 Strategies for car use reduction, active and sustainable mobility promotion**

97 During the last years, many interventions have been developed to reduce car use and
98 promote active and sustainable mobility. They can be distinguished based on whether they
99 involve *hard* or *soft* levers (Bamberg et al., 2011).

100 *Hard* levers are strategies that target a change in the geographical and economic
101 context of individuals to encourage them to reduce car use and/or increase active mobility.
102 Hard-lever interventions include for example the implementation of low-emission zones (i.e.,
103 restricting the entry of polluting motorised transport into an established area), free public
104 transport, city tolls or new cycling and walking infrastructures (Gärling & Schuitema, 2007;
105 Kuss & Nicholas, 2022; Martin et al., 2012; Mölenberg et al., 2019). Results indicate that in
106 general, *hard* levers seem to increase the use of active and sustainable mobility and reduce car
107 use (e.g., implementing a payment for entering to the city centre reduces between 12 and 33%
108 of city-centre cars in European cities, Kuss & Nicholas, 2022; infrastructural interventions in
109 high-income countries increased in median relative, 22% of cycling behaviour compared to
110 the baseline, Mölenberg et al., 2019).

111 *Soft* levers are strategies that target a change in psychological factors associated with
112 mobility, such as individual's intention to use active modes of transport, self-efficacy and
113 attitudes towards active mobility, mobility habits, etc. In the behaviour change literature,
114 these levers refer to behaviour change techniques (Michie, Ashford, et al., 2011). In the field
115 of mobility, some examples of behaviour change interventions are those proposing
116 personalised transport advice, prompting mobility change goal setting and action planning,
117 furnishing maps, transport schedules and other written materials (for reviews, see Arnott et
118 al., 2014; Möser & Bamberg, 2008; Semenescu et al., 2020). The results concerning *soft*
119 levers are more heterogeneous. While a meta-analysis and some systematic reviews show a

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120 lack of rigorous studies to allow a conclusion about the effects of these interventions (e.g.,
121 Arnott et al., 2014; Graham-Rowe et al., 2011; Semenescu et al., 2020).

122 While past interventions have shown promising results, most of them share the same
123 limitations. First, few studies rely on “robust” methodologies such as randomised controlled
124 trials comparing the effects of an experimental intervention *vs.* a control intervention (e.g.,
125 Graham-Rowe et al., 2011 identified only 14 studies among 77 studies considered as being
126 “robust”). Second, few studies were anchored in behaviour change theories, and few describe
127 the behaviour change techniques that were used to elaborate the intervention (e.g., Aittasalo et
128 al., 2012; Fujii & Taniguchi, 2005; Mutrie et al., 2002). Third, most of the studies use only
129 self-reported measures and no *in situ* sensors to measure behaviour (except from some
130 exceptions like Aittasalo et al., 2019; Ben-Elia & Ettema, 2009). Fourth, few studies have
131 mid- and long-term follow-ups (three months after the intervention or more, e.g., Aittasalo et
132 al., 2012; Cellina et al., 2019; Hemmingsson et al., 2009; Mutrie et al., 2002; Thøgersen,
133 2009). Fifth, most studies focused on only one type of lever, either *hard* or *soft* (e.g., In their
134 meta-analysis, Semenescu et al., 2020 found only five interventions among 30 studies having
135 combined soft and hard levers). InterMob study aims to address all of these limits.

136 **1.2 InterMob Study**

137 InterMob is a study that is part of the interdisciplinary Mobil’Air project that seeks to
138 reduce air pollution in Grenoble, France (Mathy et al., 2020). More precisely, InterMob study
139 combines concepts and methods from geography, psychology, economics, and epidemiology,
140 with the aim to reduce car use and promote active and sustainable mobility in the Grenoble
141 metropolitan area. InterMob seeks to address the aforementioned limitations by being
142 anchored in behaviour change theories (see Figure 1). It also relies on a rigorous methodology
143 (a randomised controlled study comparing an experimental and a control group). In addition,
144 it proposes a longitudinal follow-up (eight weeks of measurement spread over 24 months), the

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145 experimental intervention contains *hard* and *soft* levers (e.g., free transport and behaviour
146 change techniques), and it combines *in situ* objective measures and self-reported
147 measurements, in order to collect data on mobility behaviours (e.g., through GPS sensors) as
148 well as on their correlates (e.g., through questionnaires assessing intentions, habits,
149 sociodemographic characteristics, etc.). Moreover, the content of the experimental group is
150 elaborated by mobilising evidence- and theory-based approaches. Indeed, interventions that
151 rely on a theoretical approach appear to be associated with larger effect sizes (Webb et al.,
152 2010) and more consistent effects (McEwan et al., 2019). The active control arm includes
153 sensibilisation to air pollution risks (*soft* lever). It targets attitudes, which have been identified
154 as a factor of behavioral intention (e.g., theory of planned behavior). Such behavior change
155 technique is expected to be less efficient in changing mobility behaviors than the techniques
156 included in the experimental arm, the latter targeting more directly the intention-behavior gap.

157 In conclusion, InterMob is a 24-months randomised controlled trial, parallel group,
158 two-arm, superiority trial with 1:1 allocation ratio.

159 The objectives of the study are to:

160 a) Evaluate the effectiveness of the InterMob intervention in reducing car use in the
161 short- and in the long-term (one, three, seven, twelve, and twenty-four months after the
162 beginning of the intervention).

163 b) Identify the mechanisms underlying mobility behaviours and behaviour change
164 (e.g., psychological constructs such as intentions, self-efficacy, habits).

165 c) Identify the moderators of mobility change (i.e., the conditions and contexts under
166 which the intervention is effective such as family context, degree of cyclability, trip chaining,
167 work situation, activities organisation in space and time).

168

169 **1.3 Procedure for elaborating, implementing, and evaluating a theory- and**
170 **evidence-base behavioural intervention**

171 To ensure the theory- and evidence-based character of the study, we followed a
172 framework summarising the methodologies and recommendations already used in health
173 psychology (Bartholomew et al., 2016; Desrichard et al., 2016; Hankonen & Hardeman, 2020;
174 Michie, van Stralen, et al., 2011) (see Figure 1).

175 First, we reviewed the literature on the associations between air pollution, physical
176 inactivity, and mobility behaviours. Then, we undertook a literature review in psychology and
177 geography (e.g., De Witte et al., 2013; Ewing & Cervero, 2010; Lanzini & Khan, 2017; Van
178 Acker et al., 2010) on the factors underlying daily mobility behaviour. Third, we carried out
179 an interdisciplinary literature review to identify the strategies that have been successful in
180 reducing car use and increasing active and sustainable mobility (e.g., Arnott et al., 2014; Bird
181 et al., 2013; Martin et al., 2012; Semenescu et al., 2020). Fourth, we conceived a first version
182 of the InterMob intervention, and conducted a pilot study to test its feasibility. Finally, we
183 established the definitive version of InterMob that is detailed in this article. The present article
184 follows the SPIRIT 2013 Guidance for protocols of critical trials (Chan, Tetzlaff, Altman, et
185 al., 2013; Chan, Tetzlaff, Gotzsche, et al., 2013).

186 **2. Methods**

187 **2.1 Ethics and data protection**

188 The Figure 2 shows the details of the ethics and data protection process. First,
189 InterMob study received the ethic's approval from Grenoble Alpes Research Ethics
190 Committee (CERGA) in January 2019 (File CER Grenoble Alpes-Avis-2019-01-29-2).
191 Moreover, as part of the application to the Ethics Committee, we carried out a Privacy Impact
192 Assessment (PIA) to assess and avoid any potentially negative impacts of InterMob study on
193 participants' data privacy. This procedure involved setting a discussion group with the data

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194 protection officer of the University, the people in charge of the data infrastructure at the
195 university, and relevant representatives of the target population (members of a car-sharing
196 platform, a local energy and climate agency, and a member of a pedagogical program about
197 air pollution). During the discussion group, we talked about the potential implications of the
198 data-collection tools (e.g., GPS sensors, detailed surveys that include data on psychological
199 constructs as well as the geographic and socio-demographic context), and we detailed the
200 proposed procedures and elements to ensure the respect of the General Data Protection
201 Regulation (GDPR).

202 **2.2 Participants**

203 **2.2.1 Study Setting**

204 To detect the effects of InterMob study on car use reduction, recruitment will be
205 restricted to individuals living and working in the Grenoble metropolitan area (see Figure 3),
206 an urban area of south-eastern France (in the Alps) with a population size of approximately
207 600,000 people. The topography of this area is characterised by being flat in the valleys
208 (especially the Grenoble city) and surrounded by mountains (suburban areas). Car is the main
209 transport mode for daily trips (53% of daily trips in the Grenoble metropolitan area are made
210 by car, SMMAG, 2021).

211 **2.2.2 Eligibility criteria**

212 To take part in the InterMob study, participants will need to meet the following
213 criteria:

- 214 • Being 18 years and older at the time of the eligibility interview;
- 215 • Living, working, studying, in the Grenoble metropolitan area;
- 216 • Having a car or motorbike as the main transport mode during the week (excluding the
217 weekends);
- 218 • Travelling at least three days a week (excluding the weekends) by car or motorbike;

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- 219 • Motivated to reducing car use for daily trips, or having already started this reduction (i.e.,
220 being in the contemplation, preparation or action stages of change according to Prochaska
221 et al., 1994, 2008);
- 222 • Expecting to stay in the Grenoble metropolitan area for the duration of the study (24
223 months).

224 All the eligibility criteria have been established by considering theoretical and
225 practical aspects. For instance, theories in psychology suggest that participants who intend to
226 change their behaviours do not need the same behavioural techniques than those not having
227 such intention (e.g., Bamberg, 2013; Yang et al., 2010). More precisely, one of the main goals
228 of behaviour change approaches is to help people to overcome the intention-behaviour gap
229 (Sheeran & Webb, 2016).

230 **2.3 Participant timeline**

231 **2.3.1 Recruitment, allocation, and blinding**

232 The participants will be recruited through different sources: mailing lists from former
233 studies conducted by the research team (QAMECS-SHS and EMC² 2019-2020, local travel
234 surveys, surveys from other laboratories and projects), publicity in local events related to
235 transport or environment, publicity in community newspapers, intervention with the mobility
236 referents of companies in the Grenoble region and, social networks (e.g., Facebook, LinkedIn
237 and Instagram). The people that will be interested to participate in the InterMob study will fill
238 up an online form in order to be contacted by a member of the implementation team (the
239 information in this form includes the first name, a telephone number, an email address,
240 municipality of residence, sex, age, educational attainment and the availability for receiving a
241 phone call). The implementation team will call interested people to explain the study
242 procedure and to administer the eligibility questionnaire. A few days later, the implementation
243 team will call again the eligible people to ask if they accept to participate in the study. If a

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244 participant accepts, she/he will be randomly allocated to the experimental or active control
245 arm. For this allocation, a randomisation list for the whole study was created by blocks of six
246 before the beginning of the enrolment (i.e., it exists three possibilities to be in the
247 experimental arm and three possibilities to be in the active control arm) by a member of the
248 scientific team. The list was implemented in the management tool software developed by the
249 team with WebDev for the study. The management tool automatically assigns each eligible
250 participant to a group (the n-th participant is assigned to the group corresponding to the n-th
251 position of the list).

252 Concerning blinding, the implementation team (programme implementers) will not be
253 aware of group allocation at baseline (S0), but blinding will be impossible afterward, as the
254 programme implementers deliver different contents to each arm through face-to-face
255 interviews with participants. The researchers will not be aware of group allocation at any
256 time, and the researchers responsible for analysing the data will be blinded to the treatment
257 allocation. Double blinding will not be possible given that allocation concealment is
258 impossible for participants in such an intervention.

259 **2.3.2 Timeline of the Study**

260 Participants enrolled in the study will have a first two hours with a programme
261 implementer (“Session 0” or S0, see Figure 4). At the beginning of this meeting, the participant
262 reads and signs an informed consent form (cf. Supplementary materials). She/he fills up a first
263 questionnaire assessing her/his quality of life, biometrics, mobility behaviours, the weekly
264 duration of moderate-to-vigorous physical activity, socio-demographic information and
265 psychological constructs 1, 2 and 3, as well as a mobility logbook assessing her/his last week
266 mobility (for more details about the tools and surveys, see Table 1). Then, the implementation
267 team explains how to correctly carry the SensedocTM and MicroPenTM sensors (see Figure 5),
268 and the participant is instructed to start carrying them from the next seven days. At the end of

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269 the session, the sensors are collected by the programme implementer. Moreover, during this
270 session, the participants receive a daily survey on their telephones measuring psychological
271 constructs 4. Two weeks after S0, the participants have the first intervention appointment (S0+)
272 that will be described in the intervention subsection.

273 Approximately one month after the beginning of the study, participants have the second
274 meeting of the intervention (1 hour) and start a new session of measurement (S1). During this
275 session, they carry a Sensedoc™ and answer the same surveys as in S0. Approximately 3.5
276 months after the start of the study, the participants have the third session (S2) containing the
277 same elements as in S0 except for the pollution sensor. Then, about seven months after the start
278 of the study, the intervention is finished and immediately after the end of the intervention, the
279 participants have the fourth session (S3) during which they carry the Sensedoc™ and the
280 MicroPem™ and answer the same surveys as in S0. Around nine months after the start of the
281 study, participants start the fifth session (S4), they do not carry any sensors but fill up a mobility
282 logbook and answer the same as in S0. Twelve months after the start of the study, participants
283 start the sixth session (S5) with the same protocol as S4. Eighteen months after starting the
284 study, participants start the seventh session (S6) following the same protocol as S0. Finally, 24
285 months after starting the study, participants start the eighth session (S7) and follow the same
286 protocol as S4 and S5 (see Figure 4).

287 All the sessions are scheduled with our management tool by considering the availability
288 of the programme implementers. This internal tool is central to implement and chart all steps
289 of the intervention.

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292 **2.3.3 Retention of participants**

293 To limit the attrition risk, the implementation team will send a newsletter including
294 information about the study (e.g., recruitment ratios) and the research team (interviews,
295 recommended scientific articles) a few times a year. Moreover, participants taking part in
296 the study until the session 2 will be drawn to win a connected watch.

297 **2.3.4 Power Analysis and Sample Size**

298 Sample size is difficult to estimate when using multilevel modelling as in the present
299 study, given that sample size calculation is sensitive to the values of all the fixed and random
300 parameters included in the models. As such, we estimated the sample size based on the
301 expected effect size of the intervention at the end of the intervention only, which was an
302 expected difference of 17% of the trips made by car at the end of the intervention (Brockman
303 & Fox, 2011) between the experimental and the control group. With a significance level of
304 0.05 and a statistical power of 80%, the *a priori* power analysis conducted with G*Power
305 3.1.9.4 (Erdfelder et al., 2009; Faul et al., 2007) indicated that 150 participants per arm (a
306 total of 300 participants) are necessary for finding a difference of 17% between the
307 experimental and the control arms at the end of the intervention. We will therefore recruit
308 participants until exhaustion of our financial and human resources, with this ideal target of
309 150 participants per arm. Once recruitment is finished, we will compute the minimal
310 statistically detectable effect that can be observed based on the final number of participants
311 (Lakens, 2022).

312 **2.4 Interventions**

313 Eligible participants will be randomised in equal proportion to the experimental arm or
314 to the active control group. The duration of both interventions will be the six first months of
315 the 24-month study period (Figure 4). The detailed content of each arm will be described in
316 the next subsections.

317 2.4.1 Experimental Arm

318 The participants attributed to the experimental arm will receive a free six-month
319 transport pass and/or a six-month free access to a classic or electric bike (behavioural
320 technique classified as “12.5 Adding objects” according to Michie, Ashford, et al., 2011).
321 They will have two meetings with a programme implementer who will deliver behavioural
322 change techniques, including a discussion about the motivation to change (behavioural
323 techniques known as “motivational interviewing” and “5.2 salience of consequences”
324 according to Hardcastle et al., 2012; Michie, Ashford, et al., 2011), personalised transport
325 advice (behavioural technique classified as “4.1 Instructions on how to perform the
326 behaviour” according to Michie, Ashford, et al., 2011), a mobility change goal setting and
327 action planning (behavioural techniques classified as “1.1 Goal setting” and “1.4 Action
328 planning” according to Michie, Ashford, et al., 2011), and obstacles’ prevention (behavioural
329 technique classified as “1.2 Problem solving” according to Michie, Ashford, et al., 2011).

330 More precisely, during the first intervention appointment with the programme
331 implementer called “S0+” (1.5 hours), the participant and the programme implementer will
332 discuss about the motivations to change, they will work together on a personalised transport
333 advice considering the participant’s needs, constraints and preferences, the participant will set
334 some change goals and elaborate an action plan, and he/she will examine the possible
335 obstacles to change and how to prevent them. During the second meeting (1 hour, see
336 Figure 4), the programme implementer and the participant will assess and adapt the
337 previously established goals, they will work on an updated personalised transport advice (if
338 the participants ask for it), and on resolving any obstacles they met since the first meeting that
339 have not been resolved.

340 Following the first meeting of the intervention, participants will be prompt to fill up a
341 “goal notebook” during the six months of the intervention, by setting or reviewing their goals

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342 every two weeks, and by taking notes of the experienced obstacles. In addition, they will
343 receive weekly SMS during the first three months of the intervention, and bimonthly SMS
344 during the last three months of the intervention, to a) prompt goal setting and try to keep the
345 same contexts for the goals like the same trips or the same transport modes (behavioural
346 techniques classified as “1.7 Review outcome” and “8.2 Habit formation” according to
347 Michie, Ashford, et al., 2011) and b) prompt self-monitoring related to the consequences of
348 mobility change (e.g., a more important well-being; behavioural technique classified as “2.4
349 Self-monitoring of outcomes” according to Michie, Ashford, et al., 2011).

350 **2.4.2 Active Control Arm**

351 The participants in the active control arm will also have two meetings with a programme
352 implementer, of the same duration as in the experimental arm. During the first 1.5 hour meeting
353 “S0+”, the programme implementer and the participant will discuss about air pollution (i.e.,
354 definition of air pollution sources, population most impacted, air pollution levels in Grenoble,
355 health consequences of pollution and pollution peaks), about the association between air
356 pollution and mobility (i.e., participants and programme implementer discuss about the
357 exposure of car drivers and bike drivers to air pollution), and about the advantages of
358 commuting by car (behavioural technique classified as “5.2 Saliency of consequences”
359 according to Michie, Ashford, et al., 2011). During the second 1-hour meeting, the participant
360 and the programme implementer will discuss of the air quality of the last weeks and check if
361 there were some pollution peaks during the last weeks (behavioural technique classified as 5.2
362 Saliency of consequences, according to Michie, Ashford, et al., 2011).

363 Following the first meeting, participants will be prompted to fill up an “observation
364 notebook” during the six months of intervention, by taking notes of air quality and of every
365 announcement of pollution peak every two weeks. In addition, they will receive weekly SMS
366 during the first three months of the intervention, and bimonthly SMS during the last three

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367 months of the intervention, to prompt taking notes of a) air quality and b) any pollution peak
368 announced in the television/radio/telephone (see Table 2 for a summary of the interventions for
369 the experimental and active control arms).

370 **2.4.3 Adherence**

371 To measure the adherence to each intervention arm, the programme implementer will
372 take notes of the duration of each meeting and of every situation that could disrupt the
373 planned content of the intervention (e.g., participants that do not receive any personalised
374 transport advice). Moreover, one item in the deployed surveys will assess whether the
375 participant sets goals (i.e., Intention implementation towards active mobility survey, see
376 Table 1).

377 **2.5 Outcomes and data collection**

378 **2.5.1 Primary outcome and data collection methods**

379 The main outcome of InterMob study will be the reduction of car use measured by
380 kilometres travelled by car and the modal share of the car. This outcome will be calculated from
381 segmented and enhanced GPS tracks obtained from a sensor containing a triaxial accelerometer
382 and a continuous GPS tracking MAX-M8 Global Navigation Satellite System receiver from u-
383 blox (Sensedoc™ 2.0, see Figure 5), and by a mobility logbook (i.e., a paper notebook
384 collecting detailed information on the activities and trips made each day, such as departure and
385 arrival times, the address of the arrival point; the transportation mode, the number of people
386 making the trip with the participant). More precisely, The SenseDoc™ 2.0 acquires GPS data
387 each second et accelerometry with a frequency of 60hz.

388 **2.5.2 Secondary outcomes and data collection methods**

389 Secondary outcomes will include the following variables associated with mobility
390 behaviours: kilometres travelled by active and sustainable mobility, and the modal share of
391 active mobility, physical activity measured by the Sensedoc™ 2.0 sensor and the IPAQ (i.e.,

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392 International Physical Activity Questionnaire, Craig et al., 2003), exposure to air pollution (i.e.,
393 concentration of fine particles PM_{2.5} and oxidative potential) measured by an air pollution
394 sensor (MicroPem™), activity programme measured by the mobility logbook and, quality of
395 life measured by a survey (Ware et al., 1996) (see Figure 5).

396 **2.5.3 Mediators, moderators, and collection methods**

397 We will investigate whether the effects of the intervention on mobility-related outcomes
398 are mediated by several psychological constructs, including notably attitudes and self-efficacy
399 towards the car (Godin, 2012), active mobility habits (Gardner et al., 2012), motivational stages
400 of mobility change (Biehl et al., 2018) (see Table 1 for all the details), which will be collected
401 by online surveys, using the platform Sphinx iQ2 v 7.3.1.0 (this platform is located at the
402 university to ensure that the data remain in Europe as required by the European data protection
403 law). Self-control constructs, including subjective vitality (Ryan & Frederick, 1997),
404 temptation, conflict, and resistance (Hofmann et al., 2012), will be measured on a daily basis
405 during the data collection weeks, through online surveys on the platform Sphinx iQ2 v 7.3.1.0
406 as well.

407 We will also investigate if the efficacy of the intervention depends on several socio-
408 demographic and geographic variables, including the number of children, number of cars, trip
409 chaining, mobility biographies (Müggenburg et al., 2015), cyclability and density of home
410 address and destination address. They will be measured through the data collected by the online
411 surveys, on the platform Sphinx iQ2 v 7.3.1.0.

412 **2.5.4 Reach and Quality of the Implementation**

413 The reach of the intervention (i.e., the number of people contacted by the implementation
414 team, the number of eligible participants, and the enrolled participants) will be assessed by
415 collecting the data from the first contact to the enrolment of participants. Finally, the quality
416 of the implementation will be assessed by analysing a document filled up by the programme

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417 implementer at every appointment related to the intervention (i.e., a checklist for every task to
418 be done during the S0+ and S1 appointments).

419 **2.6 Data management and statistical methods**

420 **2.6.1 Data quality, management, storage, access and confidentiality**

421 In order to monitor the quality of the data, one member of the implementation team
422 and few members of the scientific team checks the correct completion of logbooks, online
423 questionnaires, and the presence of missing data collected by the sensors.

424 Data from the sensors (SensedocTM and MicroPemTM) are downloaded after each
425 session to an encrypted computer and stored on a secure and back-up online storage. Data
426 from the online surveys are downloaded twice a month on the same computer. Furthermore,
427 data from all devices (contact forms, sensors, mobility logbooks and online surveys) will be
428 structured and saved in two different blocks stored on distinct servers:

429 Block 1 will contain the contact file with the names, addresses and contact details of
430 participants for setting the appointments and sending/recovering material. This file will be in
431 the management tool, encrypted and kept separate from other data by the implementation
432 team coordinator. The correspondence table between the code of the participants and their
433 name will also remain in the management tool, a software as a service (SaaS) deployed on a
434 specific server of the university infrastructure accessible only by the implementation team.

435 Block 2 will contain all the collected data from surveys and sensors. They will be
436 stored locally, on the secured data centre of the university, with access restricted only to
437 InterMob faculty members and implementation team, in line with data protection law. The
438 raw data will be stored by the programme implementers. The data from the
439 GPS/accelerometer and pollution sensors will be downloaded at each return from the field.
440 The survey data, coming from the Sphinx platform, will be regularly uploaded to the storage
441 space. Only implementation team and informatician administrators will have read/write

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442 access. The scientific team will only have read access to raw data. Moreover, they have
443 folders with data pre-processing and processing with read/write access, not accessible to the
444 implementation team. Finally, another folder will be created for sharing with external
445 partners.

446 **2.6.2 Data monitoring, harms and auditing**

447 No data monitoring committee has been set up for this study because there is no strong
448 suspicion that the interventions can potentially harm the participants. Nevertheless, there is a
449 risk that some travel modes (e.g., cycling) might lead to traffic accidents. For this reason and
450 in order to protect the participants as much as possible, the helmets will be mandatory
451 throughout the study. At the psychological level, some participants may experience guilt if
452 they do not manage to reduce car use. In order to limit this risk, the team responsible for the
453 implementation insists on a non-guilty and valorising communication and coaching during
454 their face-to-face meetings with the participants (i.e., motivational interviewing). Moreover,
455 participants will be encouraged to share with the implementation team any adverse events
456 associated to mobility change. This information will be stored in a specific document by the
457 coordinator of the implementation of the study.

458 The coordinator of the implementation of the study and the coordinators of the project
459 have one meeting per week to audit the trial conduct.

460 **2.6.3 Ancillary and post-trial care**

461 No ancillary and post-trial care will be provided.

462 **2.6.4 Statistical methods**

463 **2.6.4.1 Analysing the effects of the intervention on primary and** 464 **secondary outcomes by using multilevel modelling**

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465 The analysis of the effectiveness of the intervention on the primary outcome
466 (reduction of car use, see section 2.5.1) and secondary outcomes (mobility-related variables
467 described in section 2.5.2) will be examined at the very short term (three months after the start
468 of the intervention: S2), the short term (seven months after the start of the intervention: S3),
469 the medium term (one year after the start of the intervention: S5) and the long term (18
470 months after the start of the intervention: S6). More precisely, we will test the differences in
471 car use reduction between the experimental arm and the active control arm, by using
472 multilevel modelling, which is appropriate when data are nested, as it is the case here with
473 several measurement times per participant (e.g., Boisgontier & Cheval, 2016). Moreover,
474 multilevel modelling offers the possibility to analyse incomplete data sets, which is
475 particularly relevant given the duration of the study, which makes likely the occurrence of
476 missing data (Judd et al., 2012). For this purpose, we will follow the steps recommended by
477 Field et al. (2012):

- 478 1) Prepare the data by differentiating between- and within-individual constructs.
- 479 2) Centre the within-individual variables by participant (i.e., “group centring”).
- 480 3) Create a first “constraint” model (a model containing all the random and fixed
481 variables of the final model) and a “null” model including only the “intercept”
482 equal to 1 and only one random variable associated with the identity of the
483 participant (i.e., $1 | Id$) to check the intraclass correlation coefficients (ICC).
- 484 4) Build the main model.
- 485 5) Evaluate the normal distribution of residuals, Cooks distance and influential cases.

486 The main model will include the following fixed effects: arm, time, and arm x time
487 interaction, with random intercepts for participants and random linear slopes for repeated
488 measures at the participant level.

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489 Moreover, the statistical analysis will follow intention-to-treat principles. This means
490 that once a participant has been randomly assigned to an arm (i.e., experimental or control),
491 his/her data will be included in the analysis (McCoy, 2017). More precisely, even if a
492 participant has not adhered to the intervention or has not finished the study, his/her data will
493 be included to all the analysis.

494 In addition, we will carry attrition analysis by comparing the characteristics of the
495 participants that drop out the study and the participants that completed the study (e.g.,
496 compliance with eligibility criteria, sociodemographic and geographical characteristics).

497 **2.6.4.2 Analysis of the mediators of the effects of the intervention**

498 To analyse the mechanisms explaining potential effects of the intervention on car use
499 reduction and mobility-related variables, the investigators will use multilevel mediation
500 models to test the mediating role of psychological constructs (e.g., intention toward active and
501 sustainable mobility, active mobility habits, self-efficacy towards active mobility) in the
502 intervention mobility-related variables relationships.

503 **2.6.4.3 Analysis of the moderators of the effects of the intervention**

504 To analyse the possible moderators of the effects of the intervention on car use
505 reduction and mobility-related variables, the investigators will assess in multilevel models the
506 statistical interactions between socio-demographic, geographic and psychological variables
507 (e.g., number of children, travelled distances, accessibility of home and work, self-control
508 variables) and the allocation to the experimental or control arm. This will allow identifying to
509 what extent geographical, socio-demographic, and psychological variables moderate the
510 effects of the intervention on car use reduction and mobility-related variables.

511 **3. Discussion**

512 InterMob study is a 24-month randomised controlled trial aiming to reduce car use of
513 car and motorbike regular drivers. For this purpose, InterMob will include a two-arm

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514 intervention of six months: an experimental arm that combines the use of behaviour change
515 techniques previously identified as being successful at changing mobility behaviour (e.g.,
516 personalised transport advice, goal setting, action planning) and free access to public transport
517 or/and to a bike; and an active control arm which will target raising awareness about the
518 consequences of air pollution and the link between air pollution and car use.

519 InterMob will aim to address the limitations of prior behaviour change interventions in
520 the field, including lack of theory-based intervention elaboration, long-term follow-ups, high-
521 quality methodologies (e.g., randomised controlled trial), and *in situ* measures (Arnott et al.,
522 2014; Dixon & Johnston, 2021; Hoffmann et al., 2014; Petrunoff et al., 2016; Yang et al.,
523 2010). By addressing these limitations, InterMob will allow deepening our knowledge of the
524 long-term effects of a theory-based intervention tested in a 2-arm randomised controlled trial
525 that combines *hard* and *soft* levers, with use of *in situ* measures of mobility and correlates.

526 Furthermore, we will aim to understand the psychological mechanisms that explain the
527 potential effects of the proposed intervention on mobility, as well as the moderating role of
528 geographical, socio-demographic, and psychological factors in this relationship, to better
529 understand the conditions under which the intervention is effective.

530 Finally, InterMob study will measure the effects of the intervention not only on
531 mobility change, but also on health-related outcomes such as physical activity and exposure to
532 air pollution. Therefore, the results of our study might imply supplementary arguments for
533 governments and politicians to promote car reduction and active and sustainable mobility, and
534 deepen what has been modelled in past studies (Bouscasse et al., 2022).

535 **4. List of Abbreviations**

536 GPS: Global Positioning System

537 **5. Declarations**

538 **5.1 Ethics approval and consent to participate**

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539 InterMob study was approved by Grenoble-Alpes Ethics Committee (File CER
540 Grenoble Alpes-Avis-2019-01-29-2) in January 2019. Moreover, each participant reads and
541 signs a detailed informed consent form (cf. Supplementary materials) if he/she agrees to
542 participate in InterMob study before starting the study.

543 **5.2 Consent for publication**

544 All listed authors consented the publication of the manuscript.

545 **5.3 Availability of data and material**

546 The anonymized and aggregated dataset and the codes used to analyse data will be
547 available after the end of the data analysis in the open science framework:

548 https://osf.io/9anpg/?view_only=3cba7f109a984abbbc4408fcfa0f8618 with the DOI
549 10.17605/OSF.IO/9ANPG.

550 **5.4 Competing interests**

551 Free public transport and free access to conventional or electric bicycles will be
552 financed by Grenoble-Alpes Métropole, SMMAG (Mixed Syndicate of Mobilities of
553 Grenoble area) and Région Auvergne-Rhône-Alpes that are key players in mobility, health,
554 and environmental issues.

555 **5.5 Funding**

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562 Grenoble-Alpes Metropole. The funding sources had no role in determining the design nor the
563 execution, analysis, or interpretation of the data.

564 **5.6 Authors' contributions**

565 CT-E drafted the manuscript under the supervision of AC and SD. All the authors critically
566 appraised the manuscript, worked on its content, and approved the final version for
567 submission. AC and SC contributed equally to the conception and coordination of this article.

568 **5.6.1 Composition, roles, and responsibilities in the project**

569 AC and SC are the scientific coordinators of the project. LL is the coordinator of the
570 implementation of the study. CT-E elaborated and formulated the details of the intervention
571 under the supervision of AC, SD, and SC. All authors developed the study concept,
572 contributed to improving the study design and data collection, and approved the final version
573 of this study.

574 **5.7 Acknowledgements**

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576 Alpes Region, the SMAAG and, the Grenoble-Alpes Metropole.

577 **6. Trial registration**

578 ClinicalTrials.gov: NCT05096000 on 27/10/2021 (retrospectively registered).

579 <https://clinicaltrials.gov/ct2/show/NCT05096000>

580 **7. Protocol version and protocol amendments**

581
582 This version of the protocol (2.0) is dated 1 June 2022. Any changes in the protocol

583 will be communicated and shared on ClinicalTrials.gov

584 <https://clinicaltrials.gov/ct2/show/NCT05096000>

585 **8. Dissemination policy**

586 The results of the study will be published in scientific journals and open science
587 platforms. In addition, the results of the study will be written up in a user-friendly style to be
588 sent to all participants and partners of the study after the end of the study.

589 **9. References**

590

A randomised controlled intervention to reduce car use

- 591 Aittasalo, M., Rinne, M., Pasanen, M., Kukkonen-Harjula, K., & Vasankari, T. (2012).
592 Promoting walking among office employees — evaluation of a randomized controlled
593 intervention with pedometers and e-mail messages. *BMC Public Health*, *12*(1), 403.
594 <https://doi.org/10.1186/1471-2458-12-403>
- 595 Aittasalo, M., Tiilikainen, J., Tokola, K., Suni, J., Sievänen, H., Vähä-Ypyä, H.,
596 Vasankari, T., Seimelä, T., Metsäpuro, P., Foster, C., & Titze, S. (2019). Socio-Ecological
597 Natural Experiment with Randomized Controlled Trial to Promote Active Commuting to
598 Work: Process Evaluation, Behavioral Impacts, and Changes in the Use and Quality of
599 Walking and Cycling Paths. *International Journal of Environmental Research and Public*
600 *Health*, *16*(9), 1661. <https://doi.org/10.3390/ijerph16091661>
- 601 Arnott, B., Rehackova, L., Errington, L., Sniehotta, F. F., Roberts, J., & Araujo-
602 Soares, V. (2014). Efficacy of behavioural interventions for transport behaviour change:
603 Systematic review, meta-analysis and intervention coding. *International Journal of*
604 *Behavioral Nutrition and Physical Activity*, *11*(1), 133. [https://doi.org/10.1186/s12966-014-](https://doi.org/10.1186/s12966-014-0133-9)
605 [0133-9](https://doi.org/10.1186/s12966-014-0133-9)
- 606 Bamberg, S. (2013). Applying the stage model of self-regulated behavioral change in a
607 car use reduction intervention. *Journal of Environmental Psychology*, *33*, 68-75.
608 <https://doi.org/10.1016/j.jenvp.2012.10.001>
- 609 Bamberg, S., Fujii, S., Friman, M., & Gärling, T. (2011). Behaviour theory and soft
610 transport policy measures. *Transport Policy*, *18*(1), 228-235.
611 <https://doi.org/10.1016/j.tranpol.2010.08.006>
- 612 Bartholomew, L. K., 1950-. (2011). *Planning health promotion programs: An*
613 *intervention mapping approach / L. Kay Bartholomew ... [Et al.]* (3rd ed.). San Francisco:
614 Jossey-Bass. http://data.rero.ch/01-R007006712/html?view=GE_V1

A randomised controlled intervention to reduce car use

- 615 Bartholomew, L. K., Markham, C., Ruiter, R. A., Fernández, M. E., Kok, G., &
616 Parcel, G. S. (2016). *Planning health promotion programs: An intervention mapping*
617 *approach, 2nd ed.* (4th éd., p. xxiv, 765). Jossey-Bass.
- 618 Ben-Elia, E., & Ettema, D. (2009). Carrots versus sticks: Rewarding commuters for
619 avoiding the rush-hour—a study of willingness to participate. *Transport Policy*, *16*(2), 68-76.
620 <https://doi.org/10.1016/j.tranpol.2009.03.005>
- 621 Bernard, P., Chevance, G., Kingsbury, C., Baillot, A., Romain, A.-J., Molinier, V.,
622 Gadais, T., & Dancause, K. N. (2021). Climate Change, Physical Activity and Sport: A
623 Systematic Review. *Sports Medicine*. <https://doi.org/10.1007/s40279-021-01439-4>
- 624 Biehl, A., Ermagun, A., & Stathopoulos, A. (2018). Modelling determinants of
625 walking and cycling adoption: A stage-of-change perspective. *Transportation Research Part*
626 *F: Traffic Psychology and Behaviour*, *58*, 452-470. <https://doi.org/10.1016/j.trf.2018.06.016>
- 627 Bird, E. L., Baker, G., Mutrie, N., Ogilvie, D., Sahlqvist, S., Powell, J., & iConnect
628 Consortium. (2013). Behavior change techniques used to promote walking and cycling: A
629 systematic review. *Health Psychology*, *32*(8), 829-838. <https://doi.org/10.1037/a0032078>
- 630 Boiché, J., Gourlan, M., Trouilloud, D., & Sarrazin, P. (2019). Development and
631 validation of the ‘Echelle de Motivation envers l’Activité Physique en contexte de Santé’ : A
632 motivation scale towards health-oriented physical activity in French. *Journal of Health*
633 *Psychology*, *24*(3), 386-396. <https://doi.org/10.1177/1359105316676626>
- 634 Boisgontier, M. P., & Cheval, B. (2016). The anova to mixed model transition.
635 *Neuroscience & Biobehavioral Reviews*, *68*, 1004-1005.
636 <https://doi.org/10.1016/j.neubiorev.2016.05.034>
- 637 Bouscasse, H., Gabet, S., Kerneis, G., Provent, A., Rieux, C., Salem, N. B., Dupont,
638 H., Troude, F., Mathy, S., & Slama, R. (2022). Designing local air pollution policies focusing
639 on mobility and heating to avoid a targeted number of pollution-related deaths: Forward and

A randomised controlled intervention to reduce car use

640 backward approaches combining air pollution modeling, health impact assessment and cost-
641 benefit analysis. *Environment International*, 159, 107030.

642 <https://doi.org/10.1016/j.envint.2021.107030>

643 Brand, C., Dons, E., Anaya-Boig, E., Avila-Palencia, I., Clark, A., de Nazelle, A.,
644 Gascon, M., Gaupp-Berghausen, M., Gerike, R., Götschi, T., Iacorossi, F., Kahlmeier, S.,
645 Laeremans, M., Nieuwenhuijsen, M. J., Pablo Orjuela, J., Racioppi, F., Raser, E., Rojas-
646 Rueda, D., Standaert, A., ... Int Panis, L. (2021). The climate change mitigation effects of
647 daily active travel in cities. *Transportation Research Part D: Transport and Environment*, 93,
648 102764. <https://doi.org/10.1016/j.trd.2021.102764>

649 Brockman, R., & Fox, K. R. (2011). Physical activity by stealth? The potential health
650 benefits of a workplace transport plan. *Public Health*, 125(4), 210-216.

651 <https://doi.org/10.1016/j.puhe.2011.01.005>

652 Buhler, T. (2012). *Eléments pour la prise en compte de l'habitude dans les pratiques*
653 *de déplacements urbains par* [PhD Thesis, Institut National des Sciences Appliquées de
654 Lyon]. <http://theses.insa-lyon.fr/publication/2012ISAL0087/these.pdf>

655 Cellina, F., Bucher, D., Mangili, F., Veiga Simão, J., Rudel, R., & Raubal, M. (2019).
656 A Large Scale, App-Based Behaviour Change Experiment Persuading Sustainable Mobility
657 Patterns : Methods, Results and Lessons Learnt. *Sustainability*, 11(9), 2674.

658 <https://doi.org/10.3390/su11092674>

659 Cepeda, M., Schoufour, J., Freak-Poli, R., Koolhaas, C. M., Dhana, K., Bramer, W.
660 M., & Franco, O. H. (2017). Levels of ambient air pollution according to mode of transport: A
661 systematic review. *The Lancet Public Health*, 2(1), e23-e34. [https://doi.org/10.1016/S2468-](https://doi.org/10.1016/S2468-2667(16)30021-4)
662 [2667\(16\)30021-4](https://doi.org/10.1016/S2468-2667(16)30021-4)

663 Chaix, B., Benmarhnia, T., Kestens, Y., Brondeel, R., Perchoux, C., Gerber, P., &
664 Duncan, D. T. (2019). Combining sensor tracking with a GPS-based mobility survey to better

665 measure physical activity in trips: Public transport generates walking. *International Journal of*
666 *Behavioral Nutrition and Physical Activity*, 16(1), 84. [https://doi.org/10.1186/s12966-019-](https://doi.org/10.1186/s12966-019-0841-2)
667 0841-2

668 Chaix, B., Kestens, Y., Duncan, S., Merrien, C., Thierry, B., Pannier, B., Brondeel, R.,
669 Lewin, A., Karusisi, N., Perchoux, C., Thomas, F., & Méline, J. (2014). *Active transportation*
670 *and public transportation use to achieve physical activity recommendations? A combined*
671 *GPS, accelerometer, and mobility survey study*. 11.

672 Chakrabarti, S., & Shin, E. J. (2017). Automobile dependence and physical inactivity :
673 Insights from the California Household Travel Survey. *Journal of Transport & Health*, 6,
674 262-271. <https://doi.org/10.1016/j.jth.2017.05.002>

675 Chan, A.-W., Tetzlaff, J. M., Altman, D. G., Laupacis, A., Gøtzsche, P. C., Krleža-
676 Jerić, K., Hróbjartsson, A., Mann, H., Dickersin, K., Berlin, J. A., Doré, C. J., Parulekar, W.
677 R., Summerskill, W. S. M., Groves, T., Schulz, K. F., Sox, H. C., Rockhold, F. W., Rennie,
678 D., & Moher, D. (2013). SPIRIT 2013 Statement: Defining Standard Protocol Items for
679 Clinical Trials. *Annals of Internal Medicine*, 158(3), 200. [https://doi.org/10.7326/0003-4819-](https://doi.org/10.7326/0003-4819-158-3-201302050-00583)
680 158-3-201302050-00583

681 Chan, A.-W., Tetzlaff, J. M., Gøtzsche, P. C., Altman, D. G., Mann, H., Berlin, J. A.,
682 Dickersin, K., Hróbjartsson, A., Schulz, K. F., Parulekar, W. R., Krleža-Jeric, K., Laupacis,
683 A., & Moher, D. (2013). SPIRIT 2013 explanation and elaboration: Guidance for protocols of
684 clinical trials. *BMJ*, 346(jan08 15), e7586-e7586. <https://doi.org/10.1136/bmj.e7586>

685 CITEPA. (2020). *Gaz à effet de serre et polluants atmosphériques. Bilans des*
686 *émissions en France de 1990 à 2018* (p. 1-459). CITEPA. <https://www.citepa.org/fr/secten/>

687 Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth,
688 B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical

A randomised controlled intervention to reduce car use

- 689 activity questionnaire: 12-Country reliability and validity. *Medicine and Science in Sports and*
690 *Exercise*, 35(8), 1381-1395. <https://doi.org/10.1249/01.MSS.0000078924.61453.FB>
- 691 De Witte, A., Hollevoet, J., Dobruszkes, F., Hubert, M., & Macharis, C. (2013).
692 Linking modal choice to motility: A comprehensive review. *Transportation Research Part A:*
693 *Policy and Practice*, 49, 329-341. <https://doi.org/10.1016/j.tra.2013.01.009>
- 694 Desrichard, O., Moussaoui, L., & Cantarella, M. (2016). *GIMME--5: Geneva*
695 *Intervention Mapping: Model and Evaluation -5*.
- 696 Erdfelder, E., Faul, F., Buchner, A., & Lang, A. G. (2009). Statistical power analyses
697 using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research*
698 *Methods*, 41(4), 1149-1160. <https://doi.org/10.3758/BRM.41.4.1149>
- 699 Ettema, D., Gärling, T., Eriksson, L., Friman, M., Olsson, L. E., & Fujii, S. (2011).
700 Satisfaction with travel and subjective well-being: Development and test of a measurement
701 tool. *Transportation Research Part F: Traffic Psychology and Behaviour*, 14(3), 167-175.
702 <https://doi.org/10.1016/j.trf.2010.11.002>
- 703 Ewing, R., & Cervero, R. (2010). Travel and the Built Environment: A Meta-Analysis.
704 *Journal of the American Planning Association*, 76(3), 265-294.
705 <https://doi.org/10.1080/01944361003766766>
- 706 Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible
707 statistical power analysis program for the social, behavioral, and biomedical sciences.
708 *Behavior Research Methods*, 39(2), 175-191. <https://doi.org/10.3758/BF03193146>
- 709 Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. SAGE.
710 <https://doi.org/10.5860/CHOICE.50-2114>
- 711 Frank, L. D., Andresen, M. A., & Schmid, T. L. (2004). Obesity relationships with
712 community design, physical activity, and time spent in cars. *American Journal of Preventive*
713 *Medicine*, 27(2), 87-96. <https://doi.org/10.1016/j.amepre.2004.04.011>

A randomised controlled intervention to reduce car use

- 714 Fujii, S., & Taniguchi, A. (2005). Reducing family car-use by providing travel advice
715 or requesting behavioral plans: An experimental analysis of travel feedback programs.
716 *Transportation Research Part D: Transport and Environment*, 10(5), 385-393.
717 <https://doi.org/10.1016/j.trd.2005.04.010>
- 718 Fuller, R., Landrigan, P. J., Balakrishnan, K., Bathan, G., Bose-O'Reilly, S., Brauer,
719 M., Caravanos, J., Chiles, T., Cohen, A., Corra, L., Cropper, M., Ferraro, G., Hanna, J.,
720 Hanrahan, D., Hu, H., Hunter, D., Janata, G., Kupka, R., Lanphear, B., ... Yan, C. (2022).
721 Pollution and health: A progress update. *The Lancet Planetary Health*, S2542519622000900.
722 [https://doi.org/10.1016/S2542-5196\(22\)00090-0](https://doi.org/10.1016/S2542-5196(22)00090-0)
- 723 Gardner, B., Abraham, C., Lally, P., & de Bruijn, G.-J. (2012). Towards parsimony in
724 habit measurement: Testing the convergent and predictive validity of an automaticity subscale
725 of the Self-Report Habit Index. *International Journal of Behavioral Nutrition and Physical*
726 *Activity*, 9(1), 102. <https://doi.org/10.1186/1479-5868-9-102>
- 727 Gärling, T., & Schuitema, G. (2007). Travel Demand Management Targeting Reduced
728 Private Car Use: Effectiveness, Public Acceptability and Political Feasibility. *Journal of*
729 *Social Issues*, 63(1), 139-153. <https://doi.org/10.1111/j.1540-4560.2007.00500.x>
- 730 Godin, G. (2012). *Les comportements dans le domaine de la santé : Comprendre pour*
731 *mieux intervenir*. Presses de l'Université de Montréal.
732 <https://doi.org/10.4000/books.pum.8822>
- 733 Graham-Rowe, E., Skippon, S., Gardner, B., & Abraham, C. (2011). Can we reduce
734 car use and, if so, how? A review of available evidence. *Transportation Research Part A:*
735 *Policy and Practice*, 45(5), 401-418. <https://doi.org/10.1016/j.tra.2011.02.001>
- 736 Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in
737 insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based

A randomised controlled intervention to reduce car use

738 surveys with 1.9 million participants. *The Lancet Global Health*, 6(10), e1077-e1086.

739 [https://doi.org/10.1016/S2214-109X\(18\)30357-7](https://doi.org/10.1016/S2214-109X(18)30357-7)

740 Hankonen, N., & Hardeman, W. (2020). Developing Behavior Change Interventions.

741 In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen, & T. Lintunen (Éds.), *The*
742 *Handbook of Behavior Change* (1^{re} éd., p. 300-317). Cambridge University Press.

743 <https://doi.org/10.1017/9781108677318.021>

744 Hardcastle, S., Blake, N., & Hagger, M. S. (2012). The effectiveness of a motivational
745 interviewing primary-care based intervention on physical activity and predictors of change in
746 a disadvantaged community. *Journal of Behavioral Medicine*, 35(3), 318-333.

747 <https://doi.org/10.1007/s10865-012-9417-1>

748 Hemmingsson, E., Uddén, J., Neovius, M., Ekelund, U., & Rössner, S. (2009).

749 Increased physical activity in abdominally obese women through support for changed
750 commuting habits: A randomized clinical trial. *International Journal of Obesity*, 33(6),

751 645-652. <https://doi.org/10.1038/ijo.2009.77>

752 Hofmann, W., Baumeister, R. F., Förster, G., & Vohs, K. D. (2012). Everyday
753 temptations: An experience sampling study of desire, conflict, and self-control. *Journal of*
754 *Personality and Social Psychology*, 102(6), 1318-1335. <https://doi.org/10.1037/a0026545>

755 Jacobson, S. H., King, D. M., & Yuan, R. (2011). A note on the relationship between
756 obesity and driving. *Transport Policy*, 18(5), 772-776.

757 <https://doi.org/10.1016/j.tranpol.2011.03.008>

758 Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor
759 in social psychology: A new and comprehensive solution to a pervasive but largely ignored
760 problem. *Journal of Personality and Social Psychology*, 103(1), 54-69.

761 <https://doi.org/10.1037/a0028347>

A randomised controlled intervention to reduce car use

- 762 Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G.,
763 & Kahlmeier, S. (2012). The pandemic of physical inactivity: Global action for public health.
764 *The Lancet*, 380(9838), 294-305. [https://doi.org/10.1016/S0140-6736\(12\)60898-8](https://doi.org/10.1016/S0140-6736(12)60898-8)
- 765 Kuss, P., & Nicholas, K. A. (2022). A dozen effective interventions to reduce car use
766 in European cities: Lessons learned from a meta-analysis and transition management. *Case*
767 *Studies on Transport Policy*, S2213624X22000281.
768 <https://doi.org/10.1016/j.cstp.2022.02.001>
- 769 Lakens, D. (2022). Sample Size Justification. *Collabra: Psychology*, 8(1), 33267.
- 770 Lalot, F., Quiazade, A., Falomir-Pichastor, J. M., & Gollwitzer, P. M. (2019). When
771 does self-identity predict intention to act green? A self-completion account relying on past
772 behaviour and majority-minority support for pro-environmental values. *Journal of*
773 *Environmental Psychology*, 61, 79-92. <https://doi.org/10.1016/j.jenvp.2019.01.002>
- 774 Lanzini, P., & Khan, S. A. (2017). Shedding light on the psychological and behavioral
775 determinants of travel mode choice: A meta-analysis. *Transportation Research Part F:*
776 *Traffic Psychology and Behaviour*, 48, 13-27. <https://doi.org/10.1016/j.trf.2017.04.020>
- 777 Ma, L., & Ye, R. (2019). Does daily commuting behavior matter to employee
778 productivity? *Journal of Transport Geography*, 76, 130-141.
779 <https://doi.org/10.1016/j.jtrangeo.2019.03.008>
- 780 Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020).
781 Environmental and Health Impacts of Air Pollution: A Review. *Frontiers in Public Health*, 8,
782 14. <https://doi.org/10.3389/fpubh.2020.00014>
- 783 Martin, A., Goryakin, Y., & Suhrcke, M. (2014). Does active commuting improve
784 psychological wellbeing? Longitudinal evidence from eighteen waves of the British
785 Household Panel Survey. *Preventive Medicine*, 69, 296-303.
786 <https://doi.org/10.1016/j.ypmed.2014.08.023>

- 787 Martin, A., Suhrcke, M., & Ogilvie, D. (2012). Financial Incentives to Promote Active
788 Travel. *American Journal of Preventive Medicine*, 43(6), e45-e57.
789 <https://doi.org/10.1016/j.amepre.2012.09.001>
- 790 Mathy, S., Bouscasse, H., Chardonnel, S., Chalabaëv, A., Gabet, S., Treibich, C., &
791 Slama, R. (2020). Protocol of an Interdisciplinary and Multidimensional Assessment of
792 Pollution Reduction Measures in Urban Areas: MobilAir Project. In W. Buchholz, A.
793 Markandya, D. Rübhelke, & S. Vögele (Éds.), *Ancillary Benefits of Climate Policy* (p.
794 325-345). Springer International Publishing. https://doi.org/10.1007/978-3-030-30978-7_18
- 795 McCoy, E. (2017). Understanding the Intention-to-treat Principle in Randomized
796 Controlled Trials. *Western Journal of Emergency Medicine*, 18(6), 1075-1078.
797 <https://doi.org/10.5811/westjem.2017.8.35985>
- 798 McEwan, D., Beauchamp, M. R., Kouvousis, C., Ray, C. M., Wyrrough, A., & Rhodes,
799 R. E. (2019). Examining the active ingredients of physical activity interventions underpinned
800 by theory versus no stated theory: A meta-analysis. *Health Psychology Review*, 13(1), 1-17.
801 <https://doi.org/10.1080/17437199.2018.1547120>
- 802 Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D.
803 P. (2011). A refined taxonomy of behaviour change techniques to help people change their
804 physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychology &*
805 *Health*, 26(11), 1479-1498. <https://doi.org/10.1080/08870446.2010.540664>
- 806 Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A
807 new method for characterising and designing behaviour change interventions. *Implementation*
808 *Science*, 6(1), 1-11. <https://doi.org/10.1186/1748-5908-6-42>
- 809 Mölenberg, F. J. M., Panter, J., Burdorf, A., & van Lenthe, F. J. (2019). A systematic
810 review of the effect of infrastructural interventions to promote cycling: Strengthening causal

A randomised controlled intervention to reduce car use

811 inference from observational data. *International Journal of Behavioral Nutrition and Physical*
812 *Activity*, 16(1), 93. <https://doi.org/10.1186/s12966-019-0850-1>

813 Möser, G., & Bamberg, S. (2008). The effectiveness of soft transport policy measures:
814 A critical assessment and meta-analysis of empirical evidence. *Journal of Environmental*
815 *Psychology*, 28(1), 10-26. <https://doi.org/10.1016/j.jenvp.2007.09.001>

816 Müggenburg, H., Busch-Geertsema, A., & Lanzendorf, M. (2015). Mobility
817 biographies: A review of achievements and challenges of the mobility biographies approach
818 and a framework for further research. *Journal of Transport Geography*, 46, 151-163.
819 <https://doi.org/10.1016/j.jtrangeo.2015.06.004>

820 Mutrie, N., Carney, C., Blamey, A., Crawford, F., Aitchison, T., & Whitelaw, A.
821 (2002). « Walk in to Work Out »: A randomised controlled trial of a self help intervention to
822 promote active commuting. *Journal of Epidemiology & Community Health*, 56(6), 407-412.
823 <https://doi.org/10.1136/jech.56.6.407>

824 Nexøe, J., Kragstrup, J., & Søgaaard, J. (1999). Decision on influenza vaccination
825 among the elderly: A questionnaire study based on the Health Belief Model and the
826 Multidimensional Locus of Control Theory. *Scandinavian Journal of Primary Health Care*,
827 17(2), 105-110. <https://doi.org/10.1080/028134399750002737>

828 Petrunoff, N., Rissel, C., & Wen, L. M. (2016). The effect of active travel
829 interventions conducted in work settings on driving to work: A systematic review. *Journal of*
830 *Transport & Health*, 3(1), 61-76. <https://doi.org/10.1016/j.jth.2015.12.001>

831 Prochaska, J. O., Redding, C. A., & Evers, K. E. (2008). The transtheoretical model
832 and stages of change. In *Health behavior and health education: Theory, research, and*
833 *practice, 4th ed.* (p. 97-121). Jossey-Bass.

834 Prochaska, J. O., Velicer, W. F., Rossi, J. S., Goldstein, M. G., Marcus, B. H.,
835 Rakowski, W., Fiore, C., Harlow, L. L., Redding, C. A., Rosenbloom, D., & Rossi, S. R.

A randomised controlled intervention to reduce car use

- 836 (1994). Stages of change and decisional balance for 12 problem behaviors. *Health*
 837 *Psychology, 13*(1), 39-46. <https://doi.org/10.1037/0278-6133.13.1.39>
- 838 Pucher, J., Buehler, R., Bassett, D. R., & Dannenberg, A. L. (2010). Walking and
 839 Cycling to Health: A Comparative Analysis of City, State, and International Data. *American*
 840 *Journal of Public Health, 100*(10), 1986-1992. <https://doi.org/10.2105/AJPH.2009.189324>
- 841 Rojas-Rueda, D., de Nazelle, A., Tainio, M., & Nieuwenhuijsen, M. J. (2011). The
 842 health risks and benefits of cycling in urban environments compared with car use: Health
 843 impact assessment study. *BMJ, 343*(aug04 2), d4521-d4521.
 844 <https://doi.org/10.1136/bmj.d4521>
- 845 Ryan, R. M., & Frederick, C. (1997). On Energy, Personality, and Health: Subjective
 846 Vitality as a Dynamic Reflection of Well-Being. *Journal of Personality, 65*(3), 529-565.
 847 <https://doi.org/10.1111/j.1467-6494.1997.tb00326.x>
- 848 SDES. (2020). *Comment les Français se déplacent-ils en 2019 ? Résultats de*
 849 *l'enquête mobilité des personnes | Données et études statistiques*. SDES.
 850 [https://www.statistiques.developpement-durable.gouv.fr/comment-les-francais-se-deplacent-](https://www.statistiques.developpement-durable.gouv.fr/comment-les-francais-se-deplacent-ils-en-2019-resultats-de-lenquete-mobilite-des-personnes)
 851 [ils-en-2019-resultats-de-lenquete-mobilite-des-personnes](https://www.statistiques.developpement-durable.gouv.fr/comment-les-francais-se-deplacent-ils-en-2019-resultats-de-lenquete-mobilite-des-personnes)
- 852 Semenescu, A., Gavreliuc, A., & Sârbescu, P. (2020). 30 Years of soft interventions to
 853 reduce car use – A systematic review and meta-analysis. *Transportation Research Part D:*
 854 *Transport and Environment, 85*, 102397. <https://doi.org/10.1016/j.trd.2020.102397>
- 855 Sheeran, P., & Webb, T. L. (2016). The Intention-Behavior Gap: The Intention-
 856 Behavior Gap. *Social and Personality Psychology Compass, 10*(9), 503-518.
 857 <https://doi.org/10.1111/spc3.12265>
- 858 SMMAG. (2021). *L'enquête mobilité Grande Région Grenobloise : Premiers*
 859 *résultats*. SMMA. [https://www.aurg.fr/article/280/2205-mobilite-des-habitants-du-bassin-](https://www.aurg.fr/article/280/2205-mobilite-des-habitants-du-bassin-grenoblois-les-premiers-resultats-de-la-grande-enquete-emc2.htm)
 860 [grenoblois-les-premiers-resultats-de-la-grande-enquete-emc2.htm](https://www.aurg.fr/article/280/2205-mobilite-des-habitants-du-bassin-grenoblois-les-premiers-resultats-de-la-grande-enquete-emc2.htm)

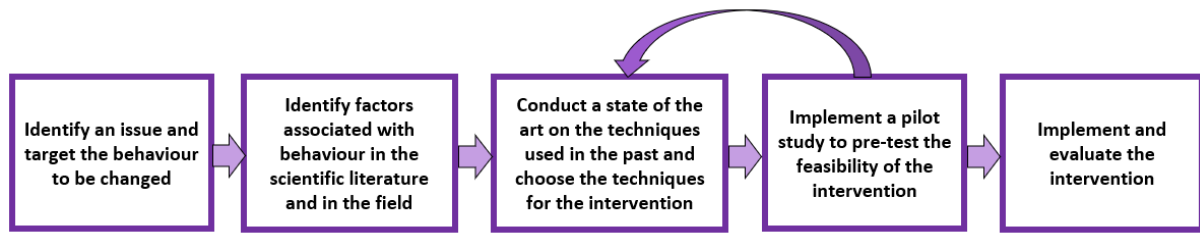
A randomised controlled intervention to reduce car use

- 861 Sugiyama, T., Merom, D., van der Ploeg, H. P., Corpuz, G., Bauman, A., & Owen, N.
862 (2012). Prolonged sitting in cars: Prevalence, socio-demographic variations, and trends.
863 *Preventive Medicine*, 55(4), 315-318. <https://doi.org/10.1016/j.ypmed.2012.07.026>
- 864 Thøgersen, J. (2009). Promoting public transport as a subscription service: Effects of a
865 free month travel card. *Transport Policy*, 16(6), 335-343.
866 <https://doi.org/10.1016/j.tranpol.2009.10.008>
- 867 Van Acker, V., Van Wee, B., & Witlox, F. (2010). When Transport Geography Meets
868 Social Psychology: Toward a Conceptual Model of Travel Behaviour. *Transport Reviews*,
869 30(2), 219-240. <https://doi.org/10.1080/01441640902943453>
- 870 van Schalkwyk, M. C. I., & Mindell, J. S. (2018). Current issues in the impacts of
871 transport on health. *British Medical Bulletin*, 125(1), 67-77.
872 <https://doi.org/10.1093/bmb/ldx048>
- 873 Ware, J. E., Kosinski, M., & Keller, S. D. (1996). A 12-Item Short-Form Health
874 Survey: Construction of Scales and Preliminary Tests of Reliability and Validity. *Medical*
875 *Care*, 34(3), 220-233. JSTOR.
- 876 Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the Internet to
877 Promote Health Behavior Change: A Systematic Review and Meta-analysis of the Impact of
878 Theoretical Basis, Use of Behavior Change Techniques, and Mode of Delivery on Efficacy.
879 *Journal of Medical Internet Research*, 12(1), e1376. <https://doi.org/10.2196/jmir.1376>
- 880 WHO. (2018). *Ambient (outdoor) air pollution*. World Health Organization.
881 [https://www.who.int/fr/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/fr/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- 882 Yang, L., Sahlqvist, S., McMinn, A., Griffin, S. J., & Ogilvie, D. (2010). Interventions
883 to promote cycling: Systematic review. *BMJ*, 341(oct18 2), c5293.
884 <https://doi.org/10.1136/bmj.c5293>
- 885

886

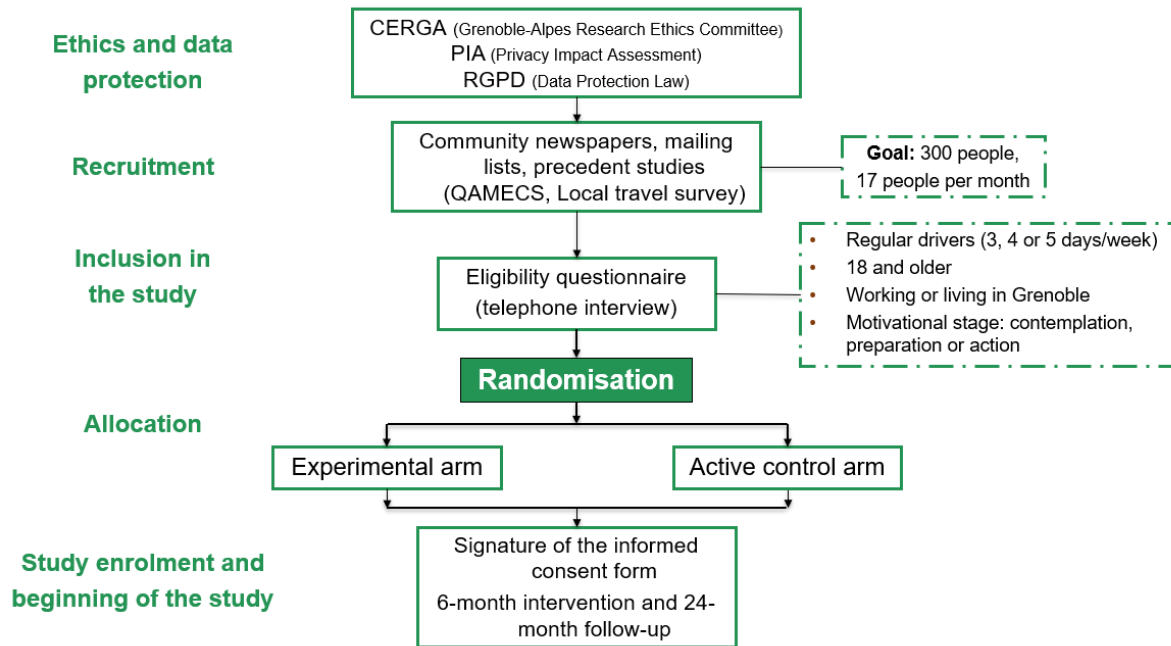
Figures

887



888 *Figure 1.* Followed steps for the elaboration, implementation and evaluation of InterMob (the
889 proposed methodology summarises the methodologies proposed by Bartholomew et al., 2016;
890 Bartholomew, 2011; Desrichard et al., 2016; Michie, van Stralen, et al., 2011).

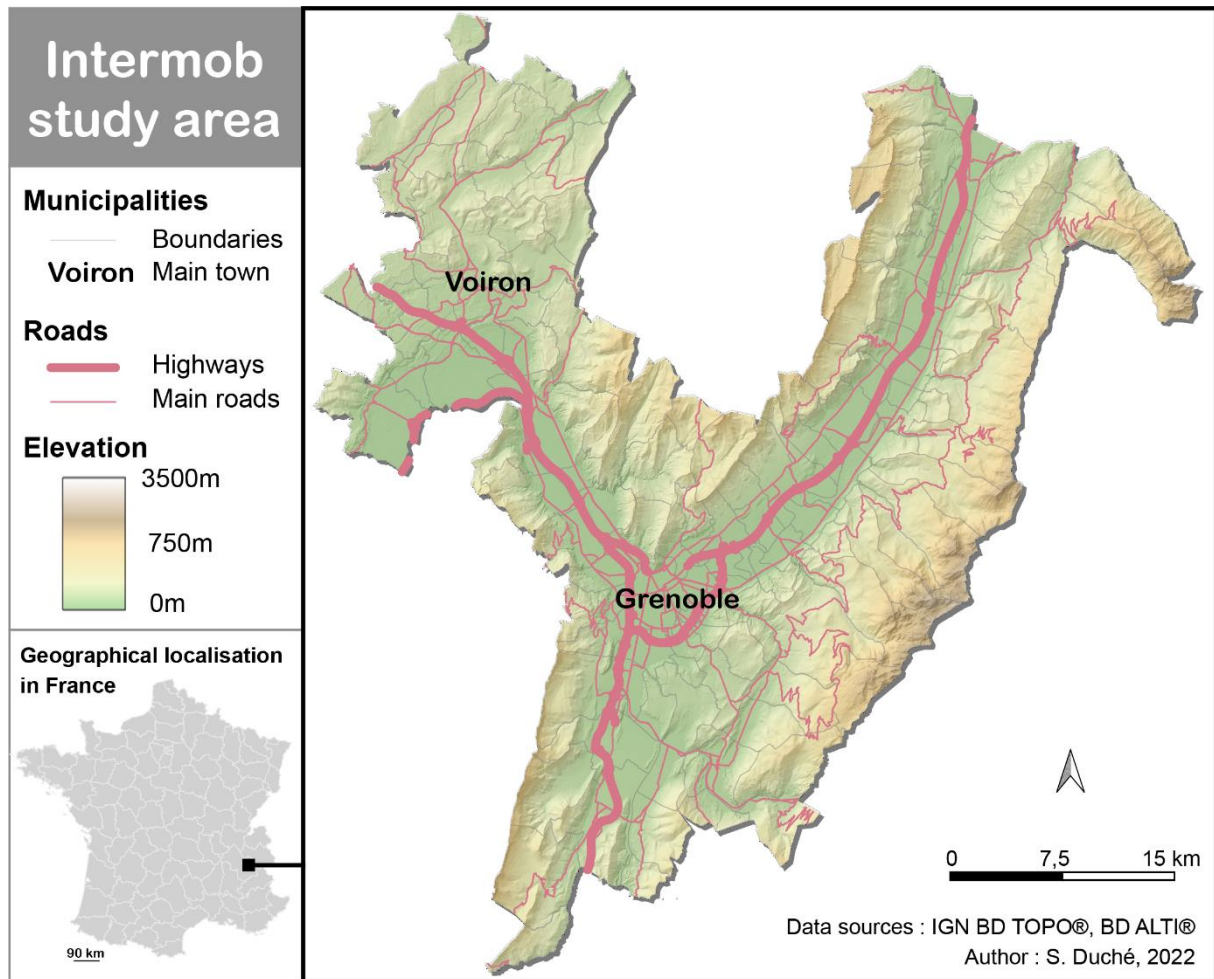
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892 *Figure 2.* Procedure of the InterMob study since the ethics and data protection procedures to

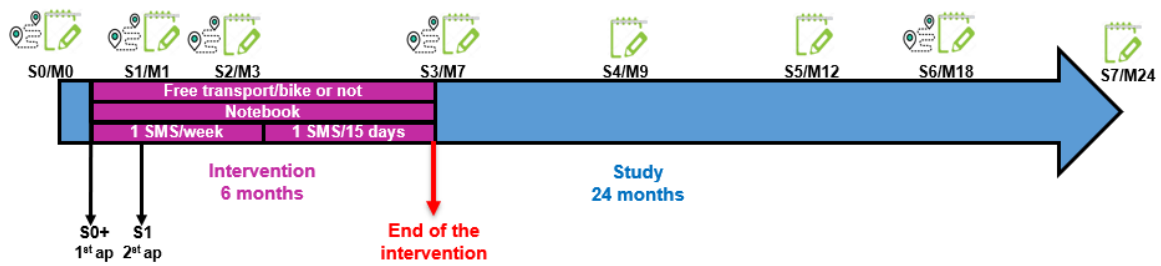
893 the study enrolment and beginning of the study.





894

895 *Figure 3. Map of Intermob study area.*

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896

897 *Figure 4.* Calendar of the intervention and the measurements. S = Session (seven-day
 898 measurement), M = Month, ap= appointment being part of the intervention.  represents
 899 seven days of carrying a Sensedoc and a MicroPem (the air pollution sensor is only carried
 900 during the sessions 0, 3 and 6),  represents seven days of filling up a mobility logbook,
 901 answering a long survey (one time) and a short daily survey.

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902

903 *Figure 5.* Data collection sensors. In the left side, Sensedoc™ sensor (Accelerometer and GPS)

904 which should be worn in a belt around the waist. In the middle, MicroPem™ (pollution sensor)

905 which should be worn in a bag or purse with the pipe as close to the airway as possible. In the

906 right side, the MicroPem™ and the Sensedoc™.

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907

Tables

908 Table 1. Summary of the outcomes, tools and time measurements.

Outcome	Tool	Time measurement										
		R	S0	S0+	S1	S2	S3	S4	S5	S6	S7	
Principal outcome												
Car use reduction (kilometers and modal share)	Sensedoc and/or mobility logbook		✓ ^{abc}		✓ ^{abc}	✓ ^{abc}	✓ ^{abc}		✓ ^{bc}	✓ ^{bc}	✓ ^{ab}	✓ ^{bc}
Secondary outcomes												
Use of active and sustainable mobility (kilometers and modal share)	Sensedoc and/or mobility logbook		✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c
Minutes of moderate and vigorous physical activity	Sensedoc and/or IPAQ (Craig et al., 2003)		✓ ^a		✓ ^a	✓ ^a	✓ ^a	✓	✓	✓ ^a	✓	
Exposure to air pollution	MicroPem		✓				✓			✓		
Carbon footprint related to transport	Calculation based on the travelled kilometers and the mode of transport		✓ ^c		✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c
Quality of life	Survey SF-12 (Ware et al., 1996)		✓			✓	✓		✓	✓	✓	
Biometrics	Biometrics survey (size and weight)		✓ ^c		✓ ^c	✓ ^c	✓ ^c			✓ ^c		
Activity programme	Mobility logbook		✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c	✓ ^c
Mobility diagnosis	Survey		✓									
Accessibility by public transport and bicycle	Calculation of spatial information through a survey		✓ ^c									
Cyclability	Calculation of spatial information through a survey		✓ ^c									
Socio-demographic information survey	Survey		✓									
Socio-demographic follow-up survey	Survey				✓	✓	✓	✓	✓	✓	✓	✓
Psychological constructs survey part 1			✓				✓	✓	✓	✓	✓	✓
Stage of mobility change	Adapted survey (Biehl et al., 2018)		✓				✓	✓	✓	✓	✓	✓

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Associated mobility habits	Adaptated survey (Buhler, 2012)	✓	✓	✓	✓	✓	✓	✓	✓
Green identity	Survey (Lalot et al., 2019)	✓	✓	✓	✓	✓	✓	✓	✓
Psychological constructs survey part 2		✓	✓	✓	✓	✓	✓	✓	✓
Mobility habits	Adapted survey (Gardner et al., 2012)	✓	✓	✓	✓	✓	✓	✓	✓
Intention towards mobility	Adapted survey (Godin, 2012)	✓	✓	✓	✓	✓	✓	✓	✓
Mobility self-efficacy	Adapted survey (Godin, 2012)	✓	✓	✓	✓	✓	✓	✓	✓
Intention implementation towards active mobility	Adapted survey (Godin, 2012)	✓	✓	✓	✓	✓	✓	✓	✓
Mobility attitudes	Adapted survey	✓	✓	✓	✓	✓	✓	✓	✓
Perceived risks of COVID-19	(Nexøe et al., 1999)	✓	✓	✓	✓	✓	✓	✓	✓
Mobility subjectives norms	Adapted survey (Godin, 2012)	✓	✓	✓	✓	✓	✓	✓	✓
	Adapted survey	✓	✓	✓	✓	✓	✓	✓	✓
Psychological constructs survey part 3		✓							
Satisfaction with travel	Adapted survey (Ettema et al., 2011)								
Mobility motivation	Adapted survey (Boiché et al., 2019)								
Psychological constructs survey part 4		✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b
Subjective vitality	Adapted survey (Ryan & Frederick, 1997)	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b
Tentation and conflict	Adapted survey (Hofmann et al., 2012)	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b	✓ ^b
Reach of the intervention	Ratio of contacted people, eligible and enrolled people	✓ ^c							
Quality of the implementation	Checklist for every intervention meeting (answered by the programme implementer)		✓ ^c	✓ ^c					

909 **Note.** By default, the outcomes were measured by using a survey that was filled in at the beginning of the session. S= Seven-day measurement
 910 session (except from S0+ that indicated the first intervention meeting), R= Recruitment and enrolment periods. ^a indicates that the outcome was
 911 measured with a sensor, ^b indicates that the outcome was measured on a daily basis, ^c indicates that the outcome was calculated by a member of
 912 the research team based on other data.

Table 2. Summary of the elements of the experimental and the active control arms.

Element	Experimental arm	Active control arm
Material incentive	6 months of free transport and/or 6 months of free access to a classic or an electric bike	
2 appointments with a programme implementer	First appointment: Discussion about the motivations to reduce car use, co-construction of a personalised mobility advice, mobility change goals setting, development of an action plan, prevention of obstacles to change mobility behaviour. Second appointment: Evaluation and adaptation of change goals and resolution of obstacles	First appointment: Concept of air pollution, in-depth questions on pollution (sources of air pollution, health consequences, pollution levels in Grenoble metropolitan area), discussion about the association between air pollution and car use and discussion about the benefits and advantages of the frequent use of the car Second appointment: Evaluation and discussion of the air quality and the identified pollution peaks
Notebook to be filled up	Goals notebook: 1. Setting new goals or adapting goals every two weeks 2. Taking notes of the experienced obstacles and looking for solutions	Observation notebook: 1. Taking note of the air pollution every two weeks 2. Taking note of the announced air pollution peaks (if any)
2 kinds of SMS (1 SMS per week during the first 3 months and 1 SMS bimonthly during the last six months)	1. Prompting the Setting and the Adaptation of goals, action planning and, habit formation 2. Self-monitoring of positive consequences of mobility change (e.g., better physical state, feeling of well-being)	1. Taking notes of the air pollution indices and comments 2. Taking notes of the announced air pollution peaks and comments