



**HAL**  
open science

## **Factors associated with participation in the organized cervical cancer screening program in the greater Paris area (France): An analysis among more than 200,000 women**

Céline Audiger, Thomas Bovagnet, Michel Deghaye, Aldis Kaufmanis, Caroline Pelisson, Audrey Bochaton, Gwenn Menvielle

### ► To cite this version:

Céline Audiger, Thomas Bovagnet, Michel Deghaye, Aldis Kaufmanis, Caroline Pelisson, et al.. Factors associated with participation in the organized cervical cancer screening program in the greater Paris area (France): An analysis among more than 200,000 women. *Preventive Medicine*, 2021, 153, pp.106831. 10.1016/j.ypmed.2021.106831 . hal-03376621

**HAL Id: hal-03376621**

**<https://hal.sorbonne-universite.fr/hal-03376621>**

Submitted on 13 Oct 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

1 **Title**

2 **Factors associated with participation in the organized cervical cancer screening program in the Greater**  
3 **Paris area (France): an analysis among more than 200,000 women.**

4 Céline Audiger<sup>ab</sup>, Thomas Bovagnet<sup>a</sup>, Michel Deghaye<sup>b</sup>, Aldis Kaufmanis<sup>b</sup>, Caroline Pelisson<sup>b</sup>, Audrey Bochaton<sup>c</sup>,  
5 Gwenn Menvielle<sup>a</sup>.

6 <sup>a</sup> Sorbonne Université, INSERM, Institut Pierre Louis d'épidémiologie et de Santé Publique (IPLESP UMRS  
7 1136), 27 rue Chaligny, F75012, Paris, France.

8 <sup>b</sup> Le Centre Régional de Coordination des Dépistages des cancers- Région Ile de France-, 8 place Adolphe  
9 Chérioux, 75015 Paris, France

10 <sup>c</sup> Université Paris Nanterre, UMR CNRS 7533 LADYSS, 200 Avenue de la République, 92000 Nanterre, France.

11

12 Corresponding author:

13 Céline Audiger

14 ORCID number : 0000-0001-8010-5651

15 [email: celine.audiger@gmail.com](mailto:celine.audiger@gmail.com)

16

17 Word counts abstract: 212

18 Word count article: 3534

19

20

21

22

23

24

25

26

27

28

29

30

31

32 **Abstract**

33 We aimed to identify the contextual factors associated with participation in the organized  
34 Cervical Cancer Screening (CCS) pilot program, which includes specific interventions to reach  
35 vulnerable women, in the Greater Paris region

36

37 Study population consisted of **231,712** women aged 25-65 years, who were not up to date to  
38 their smear test and had been invited to take part in the program from July 2014 to September  
39 2017. Using a multilevel mixed logistic regression with random effects, we investigated the  
40 effect of grassroots interventions targeting vulnerable women, healthcare provider accessibility,  
41 social environment and municipal policy-related factors.

42

43 The CCS rate was two times higher in women who had received their first invitation to the  
44 program during the study period (32·9%) compared to those who were already invited before  
45 the study period (15·3%). In both populations, there were no significant trends in participation  
46 with regards to the type of grassroots interventions, level of accessibility of healthcare services  
47 or municipal commitment to healthcare. Among women invited previously and aged above 35  
48 increased participation was seen in neighborhoods with low proportion of single women or in  
49 less deprived neighborhoods.

50 Our results identified groups of women who participated less in the organized CCS program  
51 and suggested that additional interventions targeting the barriers faced by vulnerable women,  
52 especially those aged 35-45 years old, are needed.

53

54

55 **Abbreviations**

56 CCS: cervical cancer screening

57

58

59 **Key words**

60 organized cervical cancer screening program, Greater Paris area, France, interventions to reach  
61 vulnerable women, healthcare accessibility.

62

## 63 **Abbreviations**

64 CC: cervical cancer

65 CCS: cervical cancer screening

66 GP: general practitioner

67 SEP: socio economic position

68 SMC: screening management center

69 VDM: Val-de-Marne

## 1. Introduction

70 Cervical smear tests have been shown to be an effective tool in fighting cervical cancer,  
71 decreasing both the incidence and mortality in several countries (Jansen et al., 2020; Peirson et  
72 al., 2013). There are large variations in the cervical cancer screening (CCS) policies  
73 implemented in different European countries, especially population-based organized programs  
74 versus opportunistic screening (Anttila et al., 2004). In France CCS was mainly opportunistic  
75 until 2020. However, an organized CCS pilot program was initiated in 2010 across 13  
76 administrative geographical areas, before extending it to the whole country in 2020. One of  
77 these regions was the Val de Marne (VDM), an urban metropolitan area located in the Greater  
78 Paris region, where the implementation of the organized CCS pilot program was managed by  
79 the VDM screening management centre (SMC).

80

81 The expected benefits of an organized CCS program are decreases in the incidence of cervical  
82 cancer (Bucchi et al., 2019), increases in the population coverage of CCS (Minozzi et al., 2015)  
83 and fewer disparities surrounding participation. Women with a low socioeconomic position  
84 (SEP) are less likely to participate in CCS (Menvielle et al., 2014; Seidel et al., 2009). Therefore,  
85 the SMC devoted an in-depth reflection to better reach the vulnerable women. As the literature  
86 suggests the best intervention to decrease social inequalities in health is a progressive graded  
87 approach with scale and intensity proportionate to the level of disadvantage (Bradley et al.,  
88 2004; Frohlich and Potvin, 2008), the SMC developed two types of grassroots interventions,  
89 which were primarily, but not exclusively, implemented in deprived neighborhoods. However,  
90 due to limited finances and human resources, not all deprived neighborhoods benefitted from  
91 these interventions. First, temporary large-scale CCS information events were set up (e.g.

92 market stalls). Secondly, empowerment interventions were developed in close collaboration  
93 with local associations working with vulnerable populations. These interventions were  
94 evidence-based; the literature attests that health promotion interventions involving the targeted  
95 community, mediated by people coming from the community and promoting empowerment are  
96 the most efficient in reducing health inequalities (Liu et al., 2012; Salmi et al., 2017). The aim  
97 for these empowerment interventions was to train women to act as “CCS relays” in their  
98 communities with the end goal of empowering women locally. In addition to this deep and  
99 proactive approach, other contextual factors may also influence the rate of CCS participation.  
100 This includes municipal commitment to healthcare (Haynes et al., 2014; Trompette et al.,  
101 2020)and healthcare accessibility-related factors (Akinyemiju et al., 2015; Ferdous et al., 2018;  
102 Vallée and Chauvin, 2012)such as lack of healthcare providers, heavy workloads among  
103 healthcare staff(Donnelly, 2006), delays in appointments (Black et al., 2011) and geographical  
104 distance (Akinyemiju et al., 2015). In other words, an intervention can be seen ‘an event in a  
105 system’(Cambon et al., 2019; Hawe et al., 2009) and its effectiveness depends on mechanisms  
106 at play within a given context (Pawson R, Tilley N, 1997)

107 Using a unique high-quality database with eight years of follow-up, this study aims to identify  
108 how the type of grassroots interventions, healthcare, social and municipal policy-related factors  
109 were associated with participation in the organized CCS program in the VDM.

110

## 111 **1. Materials and methods**

112 In France, the official recommendations are to perform a cervical smear test every 3 years, after  
113 two normal tests one year apart, from 25 to 65 years old. The organized CCS program targeted  
114 women who had not had a cervical smear test in the past three years. Women were invited by  
115 post to perform a cervical smear test. Upon receiving their letter of invitation, women had to  
116 book an appointment with a medical professional of their choice. To help them, the letter  
117 specified the different healthcare providers performing cervical smear tests: gynaecologists  
118 (who perform 90% of cervical smear tests in France), general practitioners (GPs) and midwives.  
119 Most of the time, women are required to pay the cost of the medical consultation and test before  
120 being refunded by health insurance providers. Nevertheless, it is important to keep in mind that  
121 in the VDM as everywhere in France, most gynaecologists charge out-of-pocket fees.

### 122 **2.1 Population**

123 The Val de Marne is an urban metropolitan area, comprised of 47 towns, located in the South-  
124 East of the Greater Paris region (1,378,151 inhabitants in 2016, population density of 5,624 per  
125 km<sup>2</sup>). In the VDM, the organized CCS program was initiated in 2010 with an interruption during  
126 2013. Once every three months, a list of all 25–65-year-old, female residents of the VDM, and  
127 the date of their previous smear test, was sent to the SMC by the VDM health insurance fund.  
128 The SMC then identified women who had not been screened over the past three years and sent  
129 them a personal invitation for screening by post. Recipients (or their next-of-kin) could then  
130 respond with the date of their most recent smear test or any reasons for non-participation (e.g.  
131 hysterectomy, history of CC, disability which rendered the test impossible, personal objection,  
132 death).

133

134 We selected data from all the women invited for screening by the organized CCS program from  
135 1<sup>st</sup> July 2014 to 30<sup>th</sup> of September 2017 (N=302,339). Exclusion criteria were the following:  
136 medical exemption (death, hysterectomy, history of CC, disability) (N=2918), letters returned  
137 to sender (N=20,328) and women's address not being geocoded (N=8124).

138

## 139 **2.2 Variables**

140 For each woman, their address, age, date of CCS invitation, and date of their subsequent  
141 cervical smear test (if any) were recorded from the health insurance database. Addresses were  
142 geolocalized and assigned to an IRIS (a municipal sub-division including about 2000 people).

143

144 A detailed description of all contextual variables is available in the supplementary material.  
145 Briefly, for each IRIS, called neighbourhood hereafter, we calculated the proportion of single  
146 women. When this proportion is low, it may serve as a proxy for marital status, a major  
147 determinant of participation in CCS with higher participation in partnered women (Luque et al.,  
148 2018). In addition, we developed an indicator for healthcare provider accessibility based on the  
149 geographical distribution of healthcare providers performing smear tests (gynaecologists,  
150 general practitioners, midwives) in each neighborhood and its adjacent neighborhoods.

151 For each IRIS and town, we obtained a social deprivation indicator based on the French  
152 deprivation index (Schuurman et al., 2007).

153 For every town, we also created a healthcare provider accessibility indicator by combining the  
154 potential spatial accessibility to gynaecologists and midwives. The potential spatial accessibility

155 is comprised of information on medical density, average distance between healthcare providers  
156 and patients and average number of patients seen by the healthcare providers each month. We  
157 also defined the type of grassroots interventions performed by the SMC by scanning their  
158 annual activity reports and categorised as either temporary large-scale CCS information events  
159 (e.g. market stalls, information related to CCS set up in local associations working with  
160 vulnerable women) and empowerment interventions (intervention in small committees  
161 developed in close collaboration with the local associations working with vulnerable women  
162 such as training women to act as relays in the community for CCS promotion). In sensitivity  
163 analyses, we refined this indicator by splitting temporary large-scale screening information  
164 events into sporadic or regular and by distinguishing empowerment interventions without or  
165 with a long cooperation with the associations. Finally, political context can also impact the  
166 efficiency of a public health intervention (Trompette et al., 2020). As no validated scale for  
167 municipal commitment to healthcare exists in France, we developed an ad-hoc indicator  
168 encompassing the dimensions identified as relevant from both the literature and discussions  
169 with experts such as density of health associations and specific arrangements around health  
170 policy.

171 Our outcome was having a cervical smear test in the year following the invitation, according to  
172 the official governmental guidelines (Barré et al., 2017). Therefore, women who had lived for  
173 less than one year in the VDM after the invitation for screening was sent were excluded from  
174 analyses (N 39,257).

175 To assess the stability of our results, we also conducted a sensitivity analysis without excluding  
176 these participants. We used a conservative approach assuming that women had not been  
177 screened when no data on CCS were available (these women may nevertheless have been  
178 screened in another region after leaving the VDM). In the rest of the paper, we will refer to  
179 women who were screened as having participated in the organized CCS program.

180 We identified three populations: long-term residents of the VDM who had already been invited  
181 to the organized CCS program before the study period (N=48,644), long-term residents of the  
182 VDM who received the first invitation to the organized CCS program during the study period  
183 (N=117,990) and newly arrived residents to the VDM (N=65,078). Long-term residents were  
184 identified as those who had any previous invitation or cervical smear test before the invitation  
185 for screening sent during our study period. Newly arrived residents were identified as women  
186 for whom the invitation during our study period was their very first record in the screening

187 management centre database. Women who had just turned 25 years-old were also included in  
188 the latter population.

189 Details on the data selection process are displayed in Figure 1.

### 190 **2.3 Analysis**

191 To account for the hierarchical structure of our data, we conducted a multilevel mixed logistic  
192 regression with random effects. We included individual characteristics as level one,  
193 neighbourhood characteristics as level two, and town characteristics as level three. The  
194 healthcare provider accessibility indicator was introduced at the town level in the main model  
195 and at the neighbourhood level in the sensitivity analysis because the town indicator included  
196 more detailed information (e.g. number of patients monthly seen).

197 Analyses were conducted in the three populations defined above.

198 New arrivals to the VDM were analysed as a specific group. As the health insurance fund is  
199 organized into administrative areas which do not share their information, the SMC has no  
200 visibility regarding newly-arrived women's screening or medical history. Thus, when a woman  
201 moves to the VDM, she systematically receives a personal invitation for screening. Therefore,  
202 this group includes women who performed a Pap smear less than three years ago and should  
203 not have been invited. Results are difficult to interpret and no stratified analysis was performed  
204 in this group.

205 As the determinants of CCS participation are likely to differ by age (Seidel et al., 2009), we  
206 carried out a stratified analysis by age among long-term residents. In addition, if any grassroots  
207 interventions were efficient (in particular empowerment interventions), their effects are likely  
208 to be accentuated among populations that would normally lack the resources (economic,  
209 psychological, cultural) to participate in CCS (Grillo et al., 2012). We therefore conducted  
210 analyses restricted to the most disadvantaged women, i.e. women living in the most deprived  
211 neighborhoods (lowest quintile) in the most deprived towns (lowest tertile).

212 All statistical analyses were performed with R (version 3.1).

213

## 214 **2. Results**

215 Women who had arrived recently to the VDM were younger and lived in neighborhoods with a  
216 higher proportion of single women than long-term residents (Table 1). Among long-term  
217 residents, women who had already been invited to take part in the organized CCS program  
218 generally lived in the most deprived neighborhoods, as opposed to women for whom this was



219 their first invitation. The CCS rate was two times higher for women receiving a first invitation  
220 (32·9%) compared to women invited previously (15·3%).

221

222 Participation increased as neighborhood deprivation decreased in all three populations and  
223 increased with decreasing age amongst newly arrived residents and long-term residents who  
224 had already been invited (Table 2). On the contrary, participation did not strongly differ by age  
225 amongst long-term residents who received their first invitation during the study period.

226 Overall, participation was not significantly associated with the type of grassroots interventions  
227 (in three or five categories (Suppl Table 1)), the level of municipal commitment to healthcare  
228 or the healthcare providers' accessibility (measured at the town or neighbourhood level (Suppl  
229 Table 2)). Nevertheless, among women who received their first invitation during the study  
230 period, a reduced participation was seen when temporary large-scale CCS information events  
231 were set up and in neighborhoods with high healthcare accessibility. We also noticed a tendency  
232 towards increased participation when there were healthcare professionals performing smear  
233 tests in the neighbourhood or its adjacent neighborhoods (Suppl Table 2). Similar results were  
234 found in analyses that included women who lived less than 12 months in the VDM (Suppl Table  
235 3).

236 Among women invited previously, women over 35 years old showed increased participation in  
237 neighborhoods with a lower proportion of single women or in most advantaged neighborhoods.  
238 However, for the latter, this association was weakened amongst older participants (Table 3).  
239 Medium healthcare accessibility was also associated with increased participation within the  
240 older age group. Among women who received their first invitation during the study period,  
241 those aged 35-45 years old again showed increased participation when living in neighborhoods  
242 with a lower proportion of single women or in most advantaged neighborhoods.

243 Among women living in the most deprived neighborhoods in the most deprived towns, no  
244 significant associations were observed between CCS participation and healthcare accessibility  
245 (both at the town and neighbourhood level) nor with municipal commitment to healthcare or  
246 the type of grassroots interventions (Suppl. Tables 4-5)

247

### 248 **3. Discussion**

249 We investigated the factors associated with participation in an organized CCS program that  
250 included specific interventions to reach vulnerable women and to promote women's  
251 empowerment. Our results provide detail on the real-life effectiveness of these interventions at

252 population level, over a long period of time, and add to the literature previously assessing the  
253 efficacy of interventions through randomised controlled trials (Smith et al., 2017).

254

255 Before discussing the results, several methodological limits should be mentioned. Our analysis  
256 was based on a large population-based sample comprising about 93% of the inhabitants of the  
257 VDM with exhaustive information on CCS participation. Some deprived groups could not be  
258 included in our database such as women without health insurance or residence permits.  
259 Nevertheless, we believe this limitation would not strongly affect our conclusions due to the  
260 very low proportion of the population it accounts for (<1%). In addition, our results were  
261 obtained in a very urban environment and therefore cannot be extrapolated to the entire French  
262 population. Finally, SEP was assessed using an ecological index. Although we cannot rule out  
263 any ecological bias, this index was available for a small geographical unit. The bias is hence  
264 likely to be minimized and this index partly reflects women's SEP (Schuurman et al., 2007).

265

266 One of the characteristics of the organized CCS program was to include grassroots interventions  
267 targeting vulnerable women: large-scale CCS information events or empowerment  
268 interventions. Surprisingly, we did not observe any association between any type of grassroots  
269 interventions and participation in CCS, except a negative association for temporary large-scale  
270 CCS information events. This negative association might be partly explained by a saturation of  
271 information that decreased the likelihood of participation among women more exposed to CCS  
272 prevention messages.

273 Several factors may explain the lack of association between participation and the intervention  
274 provided. The grassroots interventions indicator was built at the town level, with interventions  
275 almost exclusively reported in the SCM activities report at the town level whereas interventions  
276 took place in specific neighborhoods. In addition, it was impossible to account for territorial  
277 dynamics, quality of the relationship between stakeholders and stakeholder's involvement in a  
278 precise way (Cambon et al., 2019). However, no association was observed either when  
279 categorizing this indicator in a more refined way (into five categories), nor when restricting  
280 analyses to the population, which was the most likely to benefit from these interventions (most  
281 deprived neighborhoods in the most deprived towns). Even empowerment interventions had no  
282 effect on participation contrary to the previous findings (Nickel and von dem Knesebeck, 2020).  
283 This type of intervention is likely to take time before becoming efficient. However, our analyses

284 were based on data collected almost 8 years from the beginning of the pilot program. Our results  
285 thus suggest that, if existent, the impact of the grassroots interventions on participation was  
286 modest and present only at a very local level. We can also not rule out that these interventions  
287 did not overcome the financial barriers to CCS.

288

289 Similarly, level of municipal commitment to healthcare did not have any impact on participation  
290 in the organized CCS program. Although we used an ad-hoc indicator, this was based on both  
291 previous literature (Trompette et al., 2020) and discussions with experts, therefore providing a  
292 solid scientific basis. Nevertheless, a qualitative study may have provided a better  
293 understanding of the relationship between the different stakeholders, especially their  
294 involvement in public health politics (Cambon et al., 2019), in turn helping to refine the  
295 accuracy of this indicator.

296

297 In our study, accessibility to healthcare services had little influence on participation in the  
298 organized CCS program. We obtained similar results with both healthcare provider accessibility  
299 indicators at the neighbourhood and town level. However, we observed a positive association  
300 between high midwife/low gynaecological accessibility and participation in the organized CCS  
301 program among women aged over 55 who had been invited previously. The letter may have  
302 incited these women to go for a last smear test, leading them to look for a new healthcare  
303 professional, the midwife. In France, more and more gynaecologists are retiring, and most are  
304 not being replaced due to low medical demography. The recent role of midwives in  
305 gynaecological check-ups (since 2009) is often unknown to the general population, therefore  
306 women may have only discovered it when reading their invitation. In addition, we found that  
307 among the most deprived population, age was the single predictor for screening regardless of  
308 the healthcare provider accessibility indicator used, highlighting the need for targeting older  
309 women to increase CCS participation.

310 To better understand the role of healthcare on participation in the organized CCS program, it  
311 would be of interest to explore CCS care pathways (who performed the smear test and where).  
312 However, this information was unavailable. We may nevertheless presume that depending on  
313 their SEP (Lorant et al., 2002; van Ballegooijen et al., 2000) and mobility (Traoré et al., 2020;  
314 Vallée and Chauvin, 2012), women visit different type of health professionals in various places.  
315 More precisely, socioeconomically privileged women are more likely to have a smear test

316 performed by a gynecologist outside their place of residence whereas vulnerable women more  
317 often use municipal center close to their place of residence(Vallée and Chauvin, 2012).

318

319 The groups that were less likely to participate in opportunistic CCS, and therefore the most  
320 likely to be invited to the organized CCS program (older, single and women with low  
321 SEP)(Luque et al., 2018; Menvielle et al., 2014; Seidel et al., 2009), were also the least likely  
322 to participate in the program. This pattern was clear among women who had already been  
323 invited to the organized CCS program before our study period. These women had received at  
324 least two invitations since the beginning of the program in 2010 meaning that they had not been  
325 screened for a long time. Evidently, they do not participate in opportunistic CCS and the  
326 organized CCS program does not seem to empower them despite the implementation of  
327 empowerment interventions targeting vulnerable women.

328 However, the situation was different among women who received their first invitation to the  
329 organized CCS program during the study period. In this group no factors were associated with  
330 participation except in the 35-45-year age group where we observed a social gradient for CCS  
331 participation and higher rates of participation among women living in neighborhoods with  
332 lower proportions of single women. Both associations most probably reflected the combined  
333 effect of family commitments and economic barriers, which are likely to be greater in this age  
334 group for several reasons: the presence of more women with young dependent children and  
335 more single mothers, leading to increased financial barriers and more difficulties in finding  
336 someone to look after babies or toddlers during gynecological appointments. In addition, this  
337 first invitation to the organized CCS program may have acted as a reminder in particular for the  
338 youngest and the wealthiest women. In fact, these sexually active and socio-economically  
339 privileged women do not face financial barriers and are more likely to have regular  
340 gynecological check-ups.

341

342 Overall, our results provide valuable information on factors limiting participation in the  
343 organized CCS program. In our study conducted in an urban context, low healthcare  
344 accessibility did not appear to be a barrier for participation. Hence, the obstacles may lie  
345 elsewhere, such as a lack of knowledge about which healthcare providers perform smear tests  
346 in one's neighborhood. Financial barriers may also exist, as users are often required to pay the  
347 cost of medical consultations and tests before being refunded by their health insurance, with

348 possible out-of-pocket fees. In almost all cities in the VDM, there are places where women  
349 could get CCS free of charge and this information was communicated to women during the  
350 interventions led by the SMC, but it is often difficult to get an appointment. In addition, other  
351 barriers to CCS may exist such as limited health literacy(Kobayashi et al., 2014), cultural  
352 factors and the burden of daily life(Grillo et al., 2012). We may also presume from the SMC's  
353 experience that organisational problems regarding transport or childcare may be another  
354 important barrier, which was not addressed by empowerment interventions. All these barriers  
355 among vulnerable women are likely to limit the effectiveness of grassroots interventions.  
356 Methods directly bringing CCS to these women may help improve access to CCS (Arbyn et al.,  
357 2018). Developing mobile smear test facilities may be efficient. Indeed, a study conducted in  
358 France showed that mobile mammography units targeting underserved remote communities,  
359 could increase participation and decrease social and geographical inequalities in  
360 participation(Guillaume et al., 2017). HPV self-sampling (through vaginal swabs (Madzima et  
361 al., 2017)or urinary samples(Arbyn et al., 2018)) could also be considered as an additional  
362 strategy to increase CCS participation for hard-to-reach and vulnerable women(Des Marais et  
363 al., 2018; Lefeuvre et al., 2020). For women who are out of touch with the healthcare system,  
364 appropriate follow-ups in the instance of pathological results would nevertheless be a challenge  
365 without the extremely active involvement of healthcare professionals(Ducancelle et al., 2015) .  
366

#### 367 **4. Conclusion**

368 Overall, our study identified groups of women that participated less in the CCS organized  
369 program. Interventions targeting vulnerable women aged 35-45 years old should be developed  
370 to maintain these women in the CCS process, paying special attention on both the financial (e.g.  
371 removal of fees associated with screening) and logistic (e.g. medical visits outside working  
372 hours; medical visits accepting young children; performing CCS close to participants' place of  
373 residence) aspects of the care pathway. Moreover, HPV self-sampling strategies directed  
374 towards the most vulnerable population should be considered, as the majority of women testing  
375 negative would be given 5 years of reassurance.  
376

#### 377 **Acknowledgments**

378 This article is based on data from the CRCDC-Ile de France for the geographical area of the Val  
379 de Marne. We thank all those who helped us in getting information on cervical cancer screening  
380 in the Val de Marne.

- Akinyemiju, T.F., McDonald, J.A., Lantz, P.M., 2015. Health care access dimensions and cervical cancer screening in South Africa: analysis of the world health survey. *BMC Public Health* 15. <https://doi.org/10.1186/s12889-015-1686-5>
- Anttila, A., Ronco, G., Clifford, G., Bray, F., Hakama, M., Arbyn, M., Weiderpass, E., 2004. Cervical cancer screening programs and policies in 18 European countries. *Br. J. Cancer* 91, 935–941. <https://doi.org/10.1038/sj.bjc.6602069>
- Arbyn, M., Smith, S.B., Temin, S., Sultana, F., Castle, P., Collaboration on Self-Sampling and HPV Testing, 2018. Detecting cervical precancer and reaching underscreened women by using HPV testing on self samples: updated meta-analyses. *BMJ* 363, k4823. <https://doi.org/10.1136/bmj.k4823>
- Barré, S., Massetti, M., Leleu, H., De Bels, F., 2017. Organized screening for cervical cancer in France: a cost-effectiveness assessment. *BMJ Open* 7, e014626. <https://doi.org/10.1136/bmjopen-2016-014626>
- Black, A.T., McCulloch, A., Martin, R.E., Kan, L., 2011. Young women and cervical cancer screening: what barriers persist? *Can J Nurs Res* 43, 8–21.
- Bradley, C.J., Given, C.W., Roberts, C., 2004. Health Care Disparities and Cervical Cancer. *Am J Public Health* 94, 2098–2103. <https://doi.org/doi:10.2105/ajph.94.12.2098>
- Bucchi, L., Baldacchini, F., Mancini, S., Ravaioli, A., Giuliani, O., Vattiato, R., Falcini, F., Giorgi Rossi, P., Campari, C., Canuti, D., Di Felice, E., Sassoli de Bianchi, P., Ferretti, S., Bertozzi, N., Biggeri, A., Emilia-Romagna Region Workgroup for Cervical Screening Evaluation, 2019. Estimating the impact of an organized screening program on cervical cancer incidence: A 26-year study from northern Italy. *Int J Cancer* 144, 1017–1026. <https://doi.org/10.1002/ijc.31806>
- Cambon, L., Terral, P., Alla, F., 2019. From intervention to interventional system: towards greater theorization in population health intervention research. *BMC Public Health* 19. <https://doi.org/10.1186/s12889-019-6663-y>
- Des Marais, A.C., Zhao, Y., Hobbs, M.M., Sivaraman, V., Barclay, L., Brewer, N.T., Smith, J.S., 2018. Home Self-Collection by Mail to Test for Human Papillomavirus and Sexually Transmitted Infections. *Obstet Gynecol* 132, 1412–1420. <https://doi.org/10.1097/AOG.0000000000002964>
- Donnelly, T.T., 2006. The health-care practices of Vietnamese-Canadian women: cultural influences on breast and cervical cancer screening. *Can J Nurs Res* 38, 82–101.
- Ducancelle, A., Reiser, J., Pivert, A., Le Guillou-Guillemette, H., Le Duc-Banaszuk, A.S., Lunel-Fabiani, F., 2015. Home-based urinary HPV DNA testing in women who do not attend cervical cancer screening clinics. *Journal of Infection* 71, 377–384. <https://doi.org/10.1016/j.jinf.2015.05.001>
- Ferdous, M., Lee, S., Goopy, S., Yang, H., Rumana, N., Abedin, T., Turin, T.C., 2018. Barriers to cervical cancer screening faced by immigrant women in Canada: a systematic scoping review. *BMC Womens Health* 18. <https://doi.org/10.1186/s12905-018-0654-5>
- Frohlich, K., Potvin, L., 2008. The Inequality Paradox: The Population Approach and Vulnerable Populations. *American journal of public health* 98, 216–21. <https://doi.org/10.2105/AJPH.2007.114777>
- Guillaume, E., Launay, L., Dejardin, O., Bouvier, V., Guittet, L., Déan, P., Notari, A., Mil, R., Launoy, G., 2017. Could mobile mammography reduce social and geographic inequalities in breast cancer screening participation? *Preventive Medicine* 100. <https://doi.org/10.1016/j.ypmed.2017.04.006>
- Hawe, P., Shiell, A., Riley, T., 2009. Theorising interventions as events in systems. *Am J*

- Community Psychol 43, 267–276. <https://doi.org/10.1007/s10464-009-9229-9>
- Haynes, A., Brennan, S., Carter, S., O'Connor, D., Schneider, C.H., Turner, T., Gallego, G., the CIPHER team, 2014. Protocol for the process evaluation of a complex intervention designed to increase the use of research in health policy and program organisations (the SPIRIT study). *Implementation Science* 9, 113. <https://doi.org/10.1186/s13012-014-0113-0>
- Jansen, E.E.L., Zielonke, N., Gini, A., Anttila, A., Segnan, N., Vokó, Z., Ivanuš, U., McKee, M., de Koning, H.J., de Kok, I.M.C.M., EU-TOPIA consortium, 2020. Effect of organized cervical cancer screening on cervical cancer mortality in Europe: a systematic review. *Eur. J. Cancer* 127, 207–223. <https://doi.org/10.1016/j.ejca.2019.12.013>
- Kobayashi, L.C., Wardle, J., von Wagner, C., 2014. Limited health literacy is a barrier to colorectal cancer screening in England: evidence from the English Longitudinal Study of Ageing. *Prev Med* 61, 100–105. <https://doi.org/10.1016/j.ypmed.2013.11.012>
- Lefevre, C., Pivert, A., Guillou-Guillemette, H.L., Lunel-Fabiani, F., Veillon, P., Le Duc-Banaszuk, A.-S., Ducancelle, A., 2020. Urinary HPV DNA testing as a tool for cervical cancer screening in women who are reluctant to have a Pap smear in France. *J Infect* 81, 248–254. <https://doi.org/10.1016/j.jinf.2020.05.006>
- Liu, J., Davidson, E., Bhopal, R., White, M., Johnson, M., Netto, G., Deverill, M., Sheikh, A., 2012. Adapting health promotion interventions to meet the needs of ethnic minority groups: mixed-methods evidence synthesis. *Health Technol Assess* 16, 1–469. <https://doi.org/10.3310/hta16440>
- Lorant, V., Boland, B., Humblet, P., Deliège, D., 2002. Equity in prevention and health care. *J Epidemiol Community Health* 56, 510–516. <https://doi.org/10.1136/jech.56.7.510>
- Luque, J.S., Tarasenko, Y.N., Chen, C., 2018. Correlates of Cervical Cancer Screening Adherence Among Women in the U.S.: Findings from HINTS 2013–2014. *J Prim Prev* 39, 329–344. <https://doi.org/10.1007/s10935-018-0513-z>
- Menvielle, G., Richard, J.-B., Ringa, V., Dray-Spira, R., Beck, F., 2014. To what extent is women's economic situation associated with cancer screening uptake when nationwide screening exists? A study of breast and cervical cancer screening in France in 2010. *Cancer Causes Control* 25, 977–983. <https://doi.org/10.1007/s10552-014-0397-z>
- Minozzi, S., Armaroli, P., Espina, C., Villain, P., Wiseman, M., Schüz, J., Segnan, N., 2015. European Code against Cancer 4th Edition: Process of reviewing the scientific evidence and revising the recommendations. *Cancer Epidemiol* 39 Suppl 1, S11-19. <https://doi.org/10.1016/j.canep.2015.08.014>
- Nickel, S., von dem Knesebeck, O., 2020. Do multiple community-based interventions on health promotion tackle health inequalities? *Int J Equity Health* 19. <https://doi.org/10.1186/s12939-020-01271-8>
- Pawson R, Tilley N, 1997. *Realistic Evaluation* [WWW Document]. SAGE Publications Ltd. URL <https://uk.sagepub.com/en-gb/eur/realistic-evaluation/book205276> (accessed 1.7.21).
- Peirson, L., Fitzpatrick-Lewis, D., Ciliska, D., Warren, R., 2013. Screening for cervical cancer: a systematic review and meta-analysis. *Syst Rev* 2, 35. <https://doi.org/10.1186/2046-4053-2-35>
- Salmi, L.-R., Barsanti, S., Bourgueil, Y., Daponte, A., Piznal, E., Ménival, S., AIR Research Group, 2017. Interventions addressing health inequalities in European regions: the AIR project. *Health Promot Int* 32, 430–441. <https://doi.org/10.1093/heapro/dav101>
- Schuurman, N., Bell, N., Dunn, J.R., Oliver, L., 2007. Deprivation indices, population health and geography: an evaluation of the spatial effectiveness of indices at multiple scales.

- J Urban Health 84, 591–603. <https://doi.org/10.1007/s11524-007-9193-3>
- Seidel, D., Becker, N., Rohrmann, S., Nimptsch, K., Linseisen, J., 2009. Socio-demographic characteristics of participation in the opportunistic German cervical cancer screening program: results from the EPIC-Heidelberg cohort. *J. Cancer Res. Clin. Oncol.* 135, 533–541. <https://doi.org/10.1007/s00432-008-0485-0>
- Smith, S.G., Wardle, J., Atkin, W., Raine, R., McGregor, L.M., Vart, G., Morris, S., Duffy, S.W., Moss, S., Hackshaw, A., Halloran, S., Kralj-Hans, I., Howe, R., Snowball, J., Handley, G., Logan, R.F., Rainbow, S., Smith, S., Thomas, M., Counsell, N., von Wagner, C., 2017. Reducing the socioeconomic gradient in uptake of the NHS bowel cancer screening Program using a simplified supplementary information leaflet: a cluster-randomised trial. *BMC Cancer* 17, 543. <https://doi.org/10.1186/s12885-017-3512-1>
- Traoré, M., Vallée, J., Chauvin, P., 2020. Risk of late cervical cancer screening in the Paris region according to social deprivation and medical densities in daily visited neighborhoods. *Int J Health Geogr* 19, 18. <https://doi.org/10.1186/s12942-020-00212-6>
- Trompette, J., Kivits, J., Minary, L., Alla, F., 2020. Dimensions of the Complexity of Health Interventions: What Are We Talking About? A Review. *Int J Environ Res Public Health* 17. <https://doi.org/10.3390/ijerph17093069>
- Vallée, J., Chauvin, P., 2012. Investigating the effects of medical density on health-seeking behaviours using a multiscale approach to residential and activity spaces: results from a prospective cohort study in the Paris metropolitan area, France. *Int J Health Geogr* 11, 54. <https://doi.org/10.1186/1476-072X-11-54>
- van Ballegooijen, M., van den Akker-van Marle, E., Patnick, J., Lynge, E., Arbyn, M., Anttila, A., Ronco, G., Dik, J., Habbema, F., 2000. Overview of important cervical cancer screening process values in European Union (EU) countries, and tentative predictions of the corresponding effectiveness and cost-effectiveness. *Eur J Cancer* 36, 2177–2188. [https://doi.org/10.1016/s0959-8049\(00\)00330-0](https://doi.org/10.1016/s0959-8049(00)00330-0)

382

### 383 **Ethics approval and consent to participate**

384 This study was conducted in accordance with the Declaration of Helsinki.

385

### 386 **Consent to publish**

387 No individual person's data are used in this manuscript in any form, so no consent for  
388 publication was required.

389

### 390 **Data availability**

391 All data and material are available in this study.

392

### 393 **Funding information**

394 This study was supported by the Association Nationale de la Recherche et de la Technologie.

395

### 396 **Contributions**



397 CA and GM conceived the present idea and designed the plan of analysis.  
398 MD, AK, CP organized and supervised data collection.  
399 TB performed the data management. CA and TB carried out the analysis. AB supervised the  
400 analyses related to the geographical variables.  
401 CA interpreted the results and wrote the manuscript. GM supervised the statistical analysis, the  
402 interpretation of the data and the writing of the manuscript.  
403 All authors revised the manuscript and approved the final version of the manuscript.  
404  
405  
406

## Supplementary material: Description of the contextual variables introduced in the analyses

### Title

**Factors associated with participation in the organized cervical cancer screening program in the Greater Paris area (France): an analysis among more than 200000 women.**

Céline Audiger<sup>ab</sup>, Thomas Bovagnet<sup>a</sup>, Michel Deghaye<sup>b</sup>, Aldis Kaufmanis<sup>b</sup>, Caroline Pelisson<sup>b</sup>, Audrey Bochaton<sup>c</sup>, Gwenn Menvielle<sup>a</sup>.

<sup>a</sup> Sorbonne Université, INSERM, Institut Pierre Louis d'épidémiologie et de Santé Publique (IPLESP UMRS 1136), 27 rue Chaligny, F75012, Paris, France.

<sup>b</sup> Le Centre Régional de Coordination des Dépistages des cancers- Région Ile de France-, 8 place Adolphe Chérioux, 75015 Paris

<sup>c</sup> UPN, UFR SSA – Département de Géographie, UMR CNRS 7533 Ladyss, géographie, 200 Avenue de la République, 92000 Nanterre.

### Corresponding author:

Céline Audiger

ORCID number : 0000-0001-8010-5651

[email: celine.audiger@depistage-cancers-idf.fr](mailto:celine.audiger@depistage-cancers-idf.fr)

telephone: +33609449333

### Abbreviations

CCS : cervical cancer screening

SMC : Screening management center

VDM: Val de Marne

## **Neighbourhood level**

### Proportion of single women

Using data from the 2013 census, we obtained the proportion of single women that we categorized into three groups according to the tertiles of the VDM distribution.

The categorization identified neighbourhoods with a low proportion of single women. Indeed women living in the first group (proportion of single women < 6.2%) are very likely to live with a partner. This indicator can thus be considered as a proxy of the marital status, an important determinant of participation in CCS with higher participation among partnered women (Luque et al., 2018).

### Social deprivation

We obtained a social deprivation indicator based on the 2013 census data, the French deprivation index. The index was classified into five categories according to the quintiles of the distribution in the whole Paris area.

### Healthcare provider accessibility

We collected the name of all healthcare providers working in the VDM who performed at least one Pap smear test during the year 2017 from the health insurance fund. The number of Pap smear tests monthly performed by each healthcare provider is unknown. We geolocated all healthcare providers and we attached them to a neighbourhood.

For each neighbourhood, we calculated the number of healthcare providers working in this neighbourhood and who performed at least one Pap smear during the year 2017. We then developed an ad-hoc indicator for healthcare provider accessibility in 4 categories:

- no healthcare provider inside the neighbourhood and its adjacent neighbourhoods
- no healthcare provider inside the neighbourhood but at least one in at least one adjacent neighbourhood
- one healthcare provider inside the neighbourhood
- more than one healthcare provider inside the neighbourhood.

## **Town level**

### Social deprivation

We obtained a social deprivation indicator based on the 2013 census data, the French deprivation index. The index was classified into three categories according to the tertiles of the distribution in the whole Paris area.

### Healthcare provider accessibility

Our healthcare provider accessibility indicator was based on a potential spatial accessibility indicator (Luo and Qi, 2009; Luo and Wang, 2003) built by a French governmental institution for various medical specialties and that accounts for several dimensions (medical density, average distance between healthcare providers and patients and average number of patients seen by the healthcare providers each month) (Barlet, n.d.). We selected the potential spatial accessibility indicator for two medical specialties which were relevant for CCS, namely gynaecologists and midwives.

For each town, we created two dummy variables indicating if the potential spatial accessibility for gynaecologists (resp. midwives) was below or above the VDM mean. We then combined these two dummy variables to define our healthcare provider accessibility indicator in three categories:

- Low: Below the VDM mean regarding the midwives and the gynaecologists potential spatial accessibility
- Medium: Above the VDM mean regarding midwives potential spatial accessibility and below the VDM regarding the gynaecologist potential spatial accessibility
- High: Above the VDM mean regarding the gynaecologist potential spatial accessibility whatever midwives potential spatial accessibility

The definition of this indicator was based on two observations. First, 90% of Pap smear test are performed by a gynaecologist in France. Second, in the VDM, if the potential spatial accessibility to gynaecologist is high in a town, the potential spatial accessibility to midwives is also high.

### Municipal commitment to healthcare

We developed an ad-hoc synthetic indicator to characterize the municipal commitment to healthcare. This indicator accounted for the following characteristics, that were selected based on the literature findings and discussions with experts. (Trompette et al., 2020)

- Density of health associations above the VDM mean. The associations are important local relay points and allow to spread CCS information more efficiently through the population.
- Municipal healthcare centre where women can get CCS free of charge.
- Local health agreement between the government and the town aiming at reducing health inequalities at local level. This agreement reflects the involvement of the town in health promotion.
- Organisation of workshops to apply the local health agreement. This reflects the political will to apply the agreement.
- Elected member in the municipal council in charge of health.
- Position of the elected member in charge of health in the municipal organisational chart

All these components were scored 0 if absent or 1 if present, except the position of the elected member in charge of health in the municipal organisation chart (0: no specific role, 1: advisor, 2: deputy).

We then computed a score by summing these six characteristics. Our indicator was then defined by categorising the score into 3 categories according to the VDM distribution: low(scored 0), medium (scored 1-3), high (scored 4-6).

We wanted to integrate the position of the elected member in charge of health in the municipal organisation chart, because there are driving forces in the decision-making process. The higher this position in the municipal organisation chart, the greater the power of this elected member will be: this person will be able to mobilise more money and human resources for this public health issue.

However, we were concerned about the weight of the elected member in charge of health in our indicator as it was taken into account twice (first for the presence of an elected member, second for the position in the municipal organisational chart). We therefore conducted a sensitivity analysis by scoring similarly towns without elected member in the municipal council in charge of health and towns with an elected member in the municipal council in charge of health but with no specific role. We found similar results.

### Grassroots interventions

The SCM implemented various grassroots interventions to reach the vulnerable women. These interventions were primarily organized in the most deprived neighbourhoods. First, the SCM organized temporary large-scale CCS information event such as stalls at the market. In addition, the SCM developed interventions which integrated communities and aimed at empowering women. More specifically, the SCM trained relay women to spread CCS information inside their communities. These empowerment interventions were evidence-based. The literature indeed suggests that interventions involving communities and promoting women empowerment are the most efficient in reducing health inequalities (Liu et al., 2012; Nickel and von dem Knesebeck, 2020; Salmi et al., 2017)

We defined an indicator for the type of grassroots interventions conducted by the VDM SMC in three categories:

- No intervention
- Temporary large-scale CCS information events (stalls at a market, information related to CCS set up in local associations working with vulnerable women)
- Empowerment interventions (intervention in small committees in close collaboration with the local associations working with vulnerable women such as training women to act as relays in the neighbourhood for CCS promotion)

We also defined a more refined indicator for the type grassroots interventions conducted by the VDM SMC in five categories:

- No intervention
- Temporary sporadic large-scale CCS information events (maximum one per year)
- Temporary regular large-scale CCS information events (more than one per year)
- Empowerment interventions without a long cooperation with the associations working with vulnerable women (less than 18 months)
- Empowerment interventions with a long cooperation with the associations working with vulnerable women (more than 18 months)

This more refined indicator accounted for the frequency of large-scale CCS information events and the length of cooperation with the associations working with vulnerable women, as we supposed that these two criteria could have an impact on CCS participation.

### **References**

- Barlet, M., n.d. N° 795 – Potential spatial accessibility : a new indicator for assessing the accessibility to General Practitioners [L'accessibilité potentielle localisée (APL) : une nouvelle mesure de l'accessibilité aux médecins généralistes libéraux] 8.
- Liu, J., Davidson, E., Bhopal, R., White, M., Johnson, M., Netto, G., Deverill, M., Sheikh, A., 2012. Adapting health promotion interventions to meet the needs of ethnic minority groups: mixed-methods evidence synthesis. *Health Technol Assess* 16, 1–469. <https://doi.org/10.3310/hta16440>
- Luo, W., Qi, Y., 2009. An enhanced two-step floating catchment area (E2SFCA) method for measuring spatial accessibility to primary care physicians. *Health Place* 15, 1100–1107. <https://doi.org/10.1016/j.healthplace.2009.06.002>
- Luo, W., Wang, F., 2003. Measures of Spatial Accessibility to Health Care in a GIS Environment: Synthesis and a Case Study in the Chicago Region. *Environ Plann B Plann Des* 30, 865–884. <https://doi.org/10.1068/b29120>

- Luque, J.S., Tarasenko, Y.N., Chen, C., 2018. Correlates of Cervical Cancer Screening Adherence Among Women in the U.S.: Findings from HINTS 2013-2014. *J Prim Prev* 39, 329–344. <https://doi.org/10.1007/s10935-018-0513-z>
- Nickel, S., von dem Knesebeck, O., 2020. Do multiple community-based interventions on health promotion tackle health inequalities? *Int J Equity Health* 19. <https://doi.org/10.1186/s12939-020-01271-8>
- Salmi, L.-R., Barsanti, S., Bourgueil, Y., Daponte, A., Piznal, E., Ménival, S., AIR Research Group, 2017. Interventions addressing health inequalities in European regions: the AIR project. *Health Promot Int* 32, 430–441. <https://doi.org/10.1093/heapro/dav101>
- Trompette, J., Kivits, J., Minary, L., Alla, F., 2020. Dimensions of the Complexity of Health Interventions: What Are We Talking About? A Review. *Int J Environ Res Public Health* 17. <https://doi.org/10.3390/ijerph17093069>

## Highlights

- Low healthcare provider accessibility did not appear as a barrier to participation in the organized CCS program
- Municipal health commitment did not have any impact on CCS participation.
- Promoting women's empowerment was not sufficient to improve participation in the organized CCS program
- Interventions targeting vulnerable women aged 35-45 years old should be developed.

## Conflicts of interest statement

Céline Audiger, Michel Deghayé, Aldis Kaufmanis, and Caroline Pelisson are working at the CRCDC-Ile de France

Table1: Characteristics of women aged 25-65 years old who were invited to the organized cervical cancer screening program of the VDM from the 1st July 2014 to the 1st October 2017 (n=231,712).

	Long-term residents				Newly arrived residents	
	First invitation during the study period		Invited before the study period		N(%)	Screening rate (%) <sup>1</sup>
	N(%)	Screening rate (%) <sup>1</sup>	N(%)	Screening rate (%) <sup>1</sup>		
<b>INDIVIDUAL LEVEL</b>						
Age group (years)						
[25-35]	10,361 (21.3)	3239 (31.3)	14,361 (12.2)	2677(18.6)	40,277(61.9)	9596(23.8)
[35-45]	13,830 (28.4)	4777 (34.6)	27,968(23.7)	4897(17.5)	12,354(19.0)	3353(27.0)
[45-55]	12,459 (25.6)	4109 (33.0)	35,081(29.7)	5695(16.2)	7639(11.7)	1634(21.4)
[55-65]	11,994 (24.6)	3903 (32.5)	40,580(34.4)	4842(11.9)	4808(7.4)	829(17.3)
Missing	0 (0.0)	0.0 (0.0)	0 (0.0)	0(0.0)	0 (0.0)	0(0.0)
<b>NEIGHBOURHOOD LEVEL</b>						
Proportion of single women (%) (in tertiles) <sup>2</sup>						
[0-6.2]	11,674 (24.0)	3911 (33.5)	29,740 (25.2)	4737(15.9)	13578(20.9)	3074(22.6)
[6.2-10.8]	25,270 (52.0)	8320 (32.9)	61,515(52.1)	9304(15.1)	33,924 (52.1)	7941(23.4)
[10.8-100]	11,686 (24.0)	3789 (32.4)	26,693(22.6)	4065(15.2)	17,548(27.0)	4390(25.0)
Missing	14 (0.0)	8 (57.1)	14 (0.0)	5(35.7)	28(0.0)	7(25.0)
Deprivation (in quintiles) <sup>4</sup>						
Q1(most deprived)	9946 (20.4)	3175 (31.9)	31,761(26.9)	4726(14.9)	14,490(22.3)	3185(21.9)
Q2	11,316 (23.3)	3716 (32.9)	29,361(24.9)	4473(15.3)	16,340(25.1)	3657(22.4)
Q3	11,702 (24.1)	3890 (33.2)	25,777(21.8)	4032(15.6)	14,510(22.3)	3515(24.2)
Q4	10,380 (21.3)	3498 (33.7)	20,909(17.7)	3296(15.8)	12,729(19.6)	3160(24.8)
Q5 (least deprived)	5261 (10.8)	1734 (32.9)	10,093(8.6)	1574(15.6)	6882(10.6)	1866(27.1)
Missing	39 (0.1)	15 (38.5)	89(0.1)	10(11.2)	127(0.2)	29(22.8)
Healthcare providers performing smear test <sup>3</sup>						
None inside the neighborhood and in its adjacent neighborhoods	5631 (11.6)	1773 (31.5)	15,553(13.2)	2360(15.2)	7806(12.0)	1764(22.6)
None inside the neighborhood but at least one in at least one adjacent neighborhood	28,248 (58.1)	9417 (33.3)	68,828(58.3)	10546(15.3)	37,495(57.6)	8811(23.5)
One inside the neighborhood	6296 (12.9)	2056 (32.7)	14,076(11.9)	2140(15.2)	8053(12.4)	1941(24.1)
More than one inside the neighborhood	8469 (17.4)	2782 (32.8)	19,556(16.6)	3065(15.7)	11,724(18.0)	2896(24.7)
<b>TOWN LEVEL</b>						
Deprivation (in tertiles) <sup>4</sup>						
Low	21,925 (45.1)	7140 (32.6)	59,795(50.7)	9106(15.2)	32,171(49.5)	7215(22.4)
Medium	13,519 (27.8)	4473 (33.1)	32,107(27.2)	4970(15.5)	17,402(26.7)	4229(24.3)



High	13,186 (27.1)	4407 (33.4)	26,046(22.1)	4019(15.4)	15,477(23.8)	3961(25.6)
Missing	14 (0.0)	8(57.1)	42(0.0)	5(11.9)	28(0.0)	7(25.0)
<b>Healthcare provider accessibility 5</b>						
Low	15,471 (31.8)	5196 (33.6)	37,565(31.8)	5746(15.3)	18,394(28.3)	4324(23.5)
Medium	13,815 (28.5)	4575(33.1)	35,769(30.4)	5602(15.7)	20,222(31.1)	4748(23.5)
High	19,266 (39.7)	6249(32.4)	44,614(37.8)	6758(15.1)	26,434(40.6)	6333(23.9)
Missing	14 (0.0)	8(57.1)	42(0.0)	5(11.9)	28(0.0)	7(28.0)
<b>Municipal commitment to healthcare 6</b>						
Low	6730 (13.8)	2300 (34.2)	14,327(12.1)	2222(15.5)	7103(10.9)	1711(24.1)
Medium	18,702 (38.4)	6149 (32.9)	41,634(35.3)	6388(15.3)	24,195(37.2)	6077(25.1)
High	23,198 (47.7)	7571 (32.6)	61,987(52.6)	9496(15.3)	33,752(51.9)	7617(22.6)
Missing	14 (0.0)	8 (57.1)	42(0.0)	5(11.9)	28(0.0)	7(25.0)
<b>Type of grassroots interventions by the screening management centre</b>						
No intervention	9732 (20.0)	3336 (34.3)	21,105 (17.9)	3273(15.5)	11,000(16.9)	2719(24.7)
Temporary sporadic large-scale CCS information events	9927 (20.4)	3268 (32.9)	21,976 (18.6)	3420(15.6)	13,835(21.3)	3591(26.0)
Temporary regular large-scale CCS information events	6862 (14.1)	2087 (30.4)	18,852 (16.0)	2750(14.6)	10,487(16.1)	2279(21.7)
Empowerment interventions without a long cooperation with the associations working with vulnerable women (less than 18 months)	11,985 (24.6)	3962 (33.1)	28,454(24.1)	4429(15.6)	15847(24.4)	3756(23.7)
Empowerment interventions with a long cooperation with the associations working with vulnerable women (more than 18 months)	10,124 (20.8)	3367 (33.3)	27,561(23.4)	4234(15.4)	13881(21.3)	3060(22.1)
Missing	14 (0.0)	8 (57.1)	42(0.0)	5(11.9)	28(0.0)	7(25.0)

VDM: Val de Marne CCS: cervical cancer screening

1 Calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Healthcare professionals include gynecologists, general practitioners, midwives.

4 Based on the distribution in the whole Paris area

5 Low: below the VDM mean regarding the midwives and gynaecologists potential spatial accessibility; Medium: above the VDM mean regarding the midwives potential spatial accessibility and below the VDM mean regarding the gynecologists potential spatial accessibility; High: above the VDM mean regarding the gynaecologists potential spatial accessibility whatever the midwives accessibility.

6 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)

Table 2: Individual, neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM among long term and newly arrived residents, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017.

	Long-term residents		Newly arrived residents
	First invitation during the study period (n=48,644)	Invited before the study period (n=117,990)	(n=65,078)
	OR[95%CI]1	OR[95%CI]1	OR[95%CI]1
<b>INDIVIDUAL LEVEL</b>			
Age group (years)			
[25-35]	<b>0.95[0.89-1.00]</b>	<b>1.71[1.62-1.80]</b>	<b>1.51[1.39-1.63]</b>
[35-45]	<b>1.10[1.04-1.16]</b>	<b>1.57[1.51-1.64]</b>	<b>1.79[1.64-1.95]</b>
[45-55]	1.02[0.97-1.08]	<b>1.43[1.38-1.49]</b>	<b>1.31[1.19-1.44]</b>
[55-65]	1	1	1
<b>NEIGHBOURHOOD LEVEL</b>			
Proportion of single women (%) (in tertiles) 2			
[0-6.2]	1.04[0.97-1.11]	<b>1.10[1.04-1.16]</b>	0.94[0.88-1.01]
[6.2-10.8]	1.03[0.97-1.08]	1.02[0.97-1.07]	0.99[0.94-1.04]
[10.8-100]	1	1	1
Deprivation (in quintiles)3			
Q1(most deprived)	1	1	1
Q2	<b>1.06[1.00-1.13]</b>	<b>1.05[1.01-1.11]</b>	1.01[0.95-1.08]
Q3	<b>1.07[1.01-1.14]</b>	<b>1.12[1.06-1.18]</b>	<b>1.10[1.03-1.18]</b>
Q4	<b>1.09[1.02-1.17]</b>	<b>1.13[1.05-1.20]</b>	<b>1.10[1.02-1.18]</b>
Q5(least deprived)	1.08[0.99-1.17]	<b>1.13[1.05-1.22]</b>	<b>1.21[1.11-1.32]</b>
<b>TOWN LEVEL</b>			
Healthcare provider accessibility 4			
Low	1	1	1
Medium	0.99[0.93-1.06]	1.05[0.98-1.12]	0.98[0.91-1.05]
High	0.95[0.89-1.01]	0.99[0.93-1.05]	0.96[0.89-1.04]
Municipal commitment to healthcare 5			
Low	1	1	1
Medium	0.97[0.90-1.05]	1.01[0.93-1.08]	1.02[0.93-1.13]
High	0.96[0.89-1.04]	1.02[0.95-1.11]	0.97[0.87-1.07]
Type of grassroots interventions by the screening management centre			
No intervention	1	1	1
Temporary large-scale CCS information events	<b>0.92[0.85-0.99]</b>	0.99[0.92-1.07]	0.97[0.89-1.06]
Empowerment interventions	0.97[0.90-1.04]	1.00[0.93-1.07]	0.94[0.86-1.03]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Based on the distribution in the whole Paris area

4 Low: below the VDM mean regarding the midwives and gynaecologists potential spatial accessibility; Medium: above the VDM mean regarding the midwives potential spatial accessibility and below the VDM mean regarding the gynecologists potential spatial accessibility; High: above the VDM mean regarding the gynaecologists potential spatial accessibility whatever the midwives potential accessibility.

5 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)

Table 3: Neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM by age group among long-term residents, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017.

	First invitation during the study period (n=48,644)				Invited before the study period (n=117,990)			
	[25-35]	[35-45]	[45-55]	[55-65]	[25-35]	[35-45]	[45-55]	[55-65]
	OR[95% CI]1	OR[95% CI]1	OR[95% CI]1	OR[95% CI]1	OR[95% CI]1	OR[95% CI]1	OR[95% CI]1	OR[95% CI]1
<b>NEIGHBOURHOOD LEVEL</b>								
Proportion of single women (%) (in tertiles) 2								
[0-6.2]	0.92[0.80-1.06]	<b>1.14[1.01-1.29]</b>	1.04[0.92-1.18]	1.01[0.89-1.15]	<b>0.87[0.75-1.00]</b>	<b>1.13[1.02-1.26]</b>	<b>1.18[1.07-1.31]</b>	<b>1.12[1.01-1.23]</b>
[6.2-10.8]	<b>0.89[0.79-1.00]</b>	1.08[0.98-1.19]	1.02[0.92-1.13]	1.08[0.98-1.20]	0.97[0.87-1.09]	1.03[0.95-1.13]	1.05[0.97-1.14]	0.98[0.90-1.06]
[10.8-100]	1	1	1	1	1	1	1	1
Deprivation (in quintiles)3								
Q1(most deprived)	1	1	1	1	1	1	1	1
Q2	1.11[0.97-1.26]	<b>1.16[1.03-1.30]</b>	1.01[0.90-1.30]	0.99[0.87-1.12]	1.01[0.89-1.14]	1.06[0.97-1.16]	1.08[0.99-1.18]	1.05[0.96-1.15]
Q3	1.02[0.89-1.17]	<b>1.18[1.05-1.32]</b>	1.02[0.90-1.15]	1.04[0.91-1.18]	1.05[0.92-1.20]	<b>1.13[1.03-1.25]</b>	<b>1.14[1.04-1.25]</b>	<b>1.10[1.00-1.20]</b>
Q4	1.04[0.89-1.21]	<b>1.29[1.14-1.47]</b>	0.99[0.87-1.12]	1.01[0.88-1.16]	1.02[0.87-1.19]	<b>1.16[1.04-1.29]</b>	<b>1.21[1.09-1.35]</b>	1.09[0.98-1.21]
Q5(least deprived)	1.07[0.88-1.31]	<b>1.38[1.18-1.62]</b>	1.00[0.86-1.17]	0.90[0.76-1.06]	1.16[0.94-1.43]	<b>1.27[1.10-1.45]</b>	1.12[0.97-1.28]	1.05[0.92-1.20]
<b>TOWN LEVEL</b>								
Healthcare provider accessibility 4								
Low	1	1	1	1	1	1	1	1
Medium	<b>0.83[0.72-0.94]</b>	0.99[0.89-1.09]	1.10[0.99-1.22]	1.02[0.91-1.13]	0.96[0.83-1.11]	1.02[0.92-1.12]	1.09[0.97-1.23]	<b>1.10[1.01-1.19]</b>
High	0.92[0.81-1.04]	0.90[0.82-0.99]	1.01[0.91-1.11]	0.97[0.87-1.07]	0.89[0.77-1.01]	1.01[0.92-1.10]	1.07[0.96-1.18]	1.00[0.93-1.09]
Municipal commitment to healthcare 5								
Low	1	1	1	1	1	1	1	1
Medium	0.88[0.75-1.03]	0.93[0.83-1.06]	1.01[0.89-1.14]	1.06[0.93-1.20]	0.93[0.78-1.11]	1.02[0.91-1.15]	0.99[0.87-1.12]	1.03[0.93-1.15]
High	0.88[0.74-1.04]	0.92[0.81-1.05]	1.00[0.88-1.15]	1.02[0.89-1.17]	0.87[0.73-1.05]	1.07[0.95-1.21]	0.99[0.87-1.13]	1.08[0.97-1.21]
Type of grassroots interventions by the screening management centre								
No intervention	1	1	1	1	1	1	1	1
Tempory large-scale CCS information events	<b>0.86[0.75-1.00]</b>	0.98[0.88-1.09]	<b>0.88[0.78-0.98]</b>	0.92[0.82-1.03]	0.92[0.78-1.08]	0.99[0.89-1.10]	0.99[0.87-1.12]	1.01[0.92-1.11]
Empowerment interventions	1.03[0.89-1.19]	0.99[0.89-1.10]	0.95[0.85-1.06]	0.93[0.83-1.05]	0.90[0.77-1.06]	1.09[0.98-1.20]	1.04[0.92-1.18]	0.95[0.86-1.04]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Based on the distribution in the whole Paris area

4 Low: below the VDM mean regarding the midwives and gynaecologists potential spatial accessibility; Medium: above the VDM mean regarding the midwives potential spatial accessibility and below the VDM mean regarding the gynecologists potential spatial accessibility; High: above the VDM mean regarding the gynaecologists potential spatial accessibility whatever the midwives potential accessibility.

5 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)

Supplementary Table1: Individual, neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM among long-term residents with grassroots interventions by the screening management centre categorized in 5 categories, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017.

	First invitation during the study period (n=48,644)	Invited before the study period (n=117,990)
	OR[95% CI]1	OR[95% CI]1
<b>INDIVIDUAL LEVEL</b>		
Age group (years)		
[25-35]	<b>0.95[0.89-1.00]</b>	<b>1.71[1.62-1.80]</b>
[35-45]	<b>1.10[1.04-1.16]</b>	<b>1.57[1.51-1.64]</b>
[45-55]	1.02[0.97-1.08]	<b>1.43[1.37-1.49]</b>
[55-65]	1	1
<b>NEIGHBOURHOOD LEVEL</b>		
Proportion of single women (%) (in tertiles) 2		
[0-6.2]	1.04[0.97-1.11]	<b>1.10[1.04-1.16]</b>
[6.2-10.8]	1.03[0.98-1.08]	1.02[0.97-1.07]
[10.8-100]	1	1
Deprivation (in quintiles) 3		
Q1(most deprived)	1	1
Q2	<b>1.07[1.00-1.13]</b>	<b>1.06[1.01-1.11]</b>
Q3	<b>1.07[1.01-1.14]</b>	<b>1.12[1.06-1.18]</b>
Q4	<b>1.09[1.02-1.17]</b>	<b>1.13[1.07-1.20]</b>
Q5(least deprived)	1.08[0.99-1.17]	<b>1.13[1.05-1.22]</b>
<b>TOWN LEVEL</b>		
Healthcare provider accessibility 4		
Low	1	1
Medium	0.99[0.93-1.05]	1.05[0.98-1.12]
High	<b>0.95[0.89-1.00]</b>	0.99[0.93-1.05]
Municipal commitment to healthcare 5		

Low	1	1
Medium	0.98[0.91-1.05]	1.01[0.94-1.09]
High	0.99[0.91-1.07]	1.04[0.96-1.13]
<b>Type of grassroots actions by the screening management centre</b>		
No intervention	1	1
Tempory sporadic large-scale CCS information events	0.95[0.89-1.02]	1.02[0.94-1.10]
Tempory regular large-scale CCS information events	<b>0.85[0.78-0.93]</b>	0.94[0.85-1.03]
Empowerment interventions without a long cooperation with the associations working with vulnerable women (less than 18 months)	0.96[0.89-1.03]	0.99[0.91-1.07]
Empowerment interventions with a long cooperation with the associations working with vulnerable women (more than 18 months)	0.96[0.89-1.04]	0.99[0.91-1.08]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Based on the distribution in the whole Paris area

4 Low: below the VDM mean regarding the midwives and gynaecologists potential spatial accessibility; Medium: above the VDM mean regarding the midwives potential spatial accessibility and below the VDM mean regarding the gynecologists potential spatial accessibility; High: above the VDM mean regarding the gynaecologists potential spatial accessibility whatever the midwives potential accessibility.

5 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)

Supplementary Table2: Individual, neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM among long-term residents with assessment of the healthcare provider indicator at the neighbourhood level, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017.

	First invitation during the study period (n=48,644) OR[95% CI]1	Invited before the study period (n=117,990) OR[95% CI]1
<b>INDIVIDUAL LEVEL</b>		
<b>Age group (years)</b>		
[25-35]	<b>0.95[0.90-1.00]</b>	<b>1.71[1.62-1.80]</b>
[35-45]	<b>1.10[1.04-1.16]</b>	<b>1.57[1.51-1.64]</b>
[45-55]	<b>1.02[0.97-1.08]</b>	<b>1.43[1.38-1.49]</b>
[55-65]	1	1
<b>NEIGHBORHOOD LEVEL</b>		
<b>Proportion of single women (%) (in tertiles) 2</b>		
[0-6.2]	1.04[0.98-1.11]	<b>1.10[1.05-1.17]</b>
[6.2-10.8]	1.03[0.97-1.08]	1.03[0.98-1.07]
[10.8-100]	1	1
<b>Deprivation (in quintiles) 3</b>		
Q1(most deprived)	1	1
Q2	1.05[0.99-1.12]	<b>1.06[1.01-1.11]</b>
Q3	<b>1.07[1.00-1.14]</b>	<b>1.12[1.06-1.18]</b>
Q4	<b>1.10[1.02-1.18]</b>	<b>1.13[1.07-1.20]</b>
Q5(least deprived)	<b>1.07[0.98-1.16]</b>	<b>1.13[1.04-1.22]</b>
<b>Healthcare providers performing smear test 4</b>		
None inside the neighbourhood and in its adjacent neighbourhoods	1	1
None inside the neighbourhood but at least one in at least one adjacent neighbourhood	<b>1.07[1.01-1.15]</b>	1.00[0.95-1.06]
One inside the neighbourhood	1.04[0.96-1.13]	0.99[0.92-1.06]
More than one inside the neighbourhood	1.05[0.98-1.14]	1.03[0.97-1.10]
<b>TOWN LEVEL</b>		
<b>Municipal commitment to healthcare 5</b>		
Low	1	1
Medium	0.95[0.88-1.03]	1.01[0.93-1.09]
High	0.96[0.89-1.04]	1.03[0.95-1.12]
<b>Type of grassroots interventions by the screening management centre</b>		
No intervention	1	1
Tempory large-scale CCS information events	<b>0.91[0.84-0.98]</b>	1.00[0.93-1.08]
Empowerment interventions	0.95[0.88-1.03]	1.00[0.93-1.08]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Based on the distribution in the whole Paris area

4 Healthcare providers include gynaecologists, general practitioners, midwives.

5 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)





Supplementary Table 3 : Individual, neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM among long-term residents including women with a follow-up shorter than 12 months\*, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017(n=182,951).

	First invitation during the study period		Invited before the study period	
	N(%)	OR[95% CI]1	N(%)	OR[95% CI]1
	54,192(29.6)		128,759(70.4)	
<b>INDIVIDUAL LEVEL</b>				
Age group (years)				
[25-35]	12,463(23.0)	<b>0.88[0.83-0.93]</b>	16,978(13.2)	<b>1.62[1.55-1.71]</b>
[35-45]	16,115(29.7)	<b>1.06[1.00-1.11]</b>	32,013(24.9)	<b>1.52[1.46-1.59]</b>
[45-55]	13,218(24.4)	1.02[0.96-1.07]	37,063(28.8)	<b>1.44[1.38-1.50]</b>
[55-65]	12,396(22.9)	1	42,705(33.1)	1
<b>NEIGHBOURHOOD LEVEL</b>				
Proportion of single women (%) (in tertiles) 2				
[0-6.2]	12,875(23.8)	1.05[0.99-1.12]	32,202(25.0)	<b>1.10[1.04-1.16]</b>
[6.2-10.8]	28,199(52.0)	1.03[0.98-1.09]	67,187(52.2)	1.03[0.98-1.07]
[10.8-100]	13,101(24.2)	1	29,325(22.8)	1
Deprivation (in quintiles) 3				
Q1(most deprived)	11,079(20.4)	1	34,283(26.6)	1
Q2	12,623(23.3)	<b>1.06[1.00-1.12]</b>	32,079(24.9)	1.04[0.99-1.09]
Q3	13,019(24.0)	<b>1.07[1.01-1.14]</b>	28,181(21.9)	<b>1.10[1.05-1.16]</b>
Q4	11,534(21.3)	<b>1.08[1.01-1.16]</b>	22,946(17.8)	<b>1.10[1.04-1.16]</b>
Q5(least deprived)	5890(10.9)	1.05[0.96-1.14]	11,177(8.8)	<b>1.10[1.02-1.18]</b>
<b>TOWN LEVEL</b>				
Healthcare provider accessibility 4				
Low	17,306(32.0)	1	41,101(31.9)	1
Medium	15,404(28.5)	0.99[0.93-1.06]	38,967(30.3)	1.04[0.98-1.12]
High	21,373(39.5)	0.94[0.89-1.00]	48,535(37.7)	0.98[0.92-1.05]
Municipal commitment to healthcare 5				
Low	7450(13.8)	1	15,581(12.1)	1
Medium	20,914(38.6)	0.97[0.90-1.04]	45,567(35.4)	1.00[0.93-1.08]
High	25,811(47.6)	0.96[0.89-1.04]	67,566(52.5)	1.01[0.94-1.10]
Type of grassroots interventions by the screening management centre				
No intervention	10,765(19.9)	1	22,929(17.8)	1
Temporary large-scale CCS information events	18,842(34.8)	<b>0.92[0.85-0.98]</b>	44,834(34.8)	0.99[0.92-1.06]
Empowerment interventions	24,585(45.3)	0.97[0.90-1.04]	60951(47.4)	0.98[0.92-1.06]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

\* we used a conservative approach and assumed that women did not screen when no data on CCS was available

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Based on the distribution in the whole Paris area

4 Low: below the VDM mean regarding the midwives and gynaecologists potential spatial accessibility; Medium: above the VDM mean regarding the midwives potential spatial accessibility and below the VDM mean regarding the gynecologists potential spatial accessibility; High: above the VDM mean regarding the gynaecologists potential spatial accessibility whatever the midwives potential accessibility.

5 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)

Supplementary Table 4 : Individual, neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM among long-term residents living in the most deprived neighbourhoods and in the most deprived towns\*, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017(n=24,681).

	First invitation during the study period (n=5899)		Invited previously the study period (n=18,782)	
	N(%)	OR[95% CI]1	N(%)	OR[95% CI]1
<b>INDIVIDUAL LEVEL</b>				
Age group (years)				
[25-35]	1487(25.2)	0.83[0.71-0.97]	2559(13.6)	<b>1.68[1.48-1.91]</b>
[35-45]	1727(29.3)	0.90[0.77-1.05]	4631(24.6)	<b>1.51[1.35-1.68]</b>
[45-55]	1387(23.5)	0.97[0.83-1.14]	5652(30.1)	<b>1.41[1.27-1.57]</b>
[55-65]	1298(22.0)	1	5940(31.6)	1
<b>NEIGHBOURHOOD LEVEL</b>				
Proportion of single women (%) (in tertiles) 2				
[0-6.2]	402(6.8)	1.05[0.82-1.34]	7603(6.0)	1.07[0.89-1.29]
[6.2-10.8]	2308(39.2)	1.08[0.86-1.37]	1133(40.5)	1.02[0.85-1.21]
[10.8-100]	3189(54.0)	1	10,046(53.5)	1
<b>TOWN LEVEL</b>				
Healthcare provider accessibility 3				
Low	2924(49.6)	1	9234(49.2)	1
Medium	2026(34.4)	0.89[0.77-1.03]	6723(35.8)	0.98[0.88-1.09]
High	945(16.0)	1.04[0.87-1.24]	2815(15.0)	1.00[0.88-1.14]
Municipal commitment to healthcare 4				
Low	256(4.3)	1	766(4.0)	1
Medium	672(11.4)	0.63[0.38-1.05]	2493(13.4)	1.22[0.87-1.73]
High	4971(84.3)	0.70[0.44-1.12]	15,523(82.6)	1.24[0.90-1.73]
Type of grassroots interventions by the screening management centre				
No intervention	433(7.3)	1	1297(6.9)	1
Temporary large-scale CCS information events	1303(22.1)	0.76[0.45-1.28]	4118(21.9)	1.34[0.94-1.92]
Empowerment interventions	4163(70.6)	0.86[0.59-1.26]	13,367(71.2)	1.06[0.82-1.37]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

\*This corresponds to the most deprived quintiles regarding the neighbourhood and the most deprived tertiles regarding the town

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Low: below the VDM mean regarding the midwives and gynaecologists potential spatial accessibility; Medium: above the VDM mean regarding the midwives potential spatial accessibility and below the VDM mean regarding the gynecologists potential spatial accessibility; High: above the VDM mean regarding the gynaecologists potential spatial accessibility whatever the midwives potential accessibility.

4 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center)



Supplementary Table 5: Individual, neighbourhood and town characteristics associated with participation in the organized cervical cancer screening program of the VDM among long-term residents living in the most deprived neighbourhoods in the most deprived towns\*, with the assessment of the health care providers indicator at the neighbourhood level, multilevel logistic regression model, women invited from the 1st July 2014 to the 1st October 2017(n=24,681).

	First invitation		Invited before	
	during the study period (n=5899)		the study period (n=18,782)	
	N (%)	OR[95% CI]1	N (%)	OR[95% CI]1
<b>INDIVIDUAL LEVEL</b>				
<b>Age group (years)</b>				
[25-35]	1487(25.2)	0.83[0.71-0.97]	2559(13.6)	<b>1.68[1.48-1.91]</b>
[35-45]	1727(29.3)	0.90[0.77-1.04]	4631(24.6)	<b>1.51[1.35-1.68]</b>
[45-55]	1387(23.5)	0.96[0.82-1.13]	5652(30.1)	<b>1.41[1.27-1.57]</b>
[55-65]	1298(22.0)	1	5940(31.6)	1
<b>NEIGHBOURHOOD LEVEL</b>				
<b>Proportion of single women (%) (in tertiles) 2</b>				
[0-6.2]	402(6.8)	1.01[0.79-1.29]	7603(6.0)	1.05[0.88-1.26]
[6.2-10.8]	2308(39.2)	1.03[0.81-1.31]	1133(40.5)	0.98[0.82-1.17]
[10.8-100]	3189(54.0)	1	10,046(53.5)	1
<b>Healthcare providers performing smear test 3</b>				
None inside the neighbourhood and in its adjacent neighbourhoods	1216(20.6)	1	3958(21.1)	1
None inside the neighbourhood but at least one in at least one adjacent neighbourhood	3653(61.9)	1.08[0.93-1.26]	11,675(62.2)	1.06[0.96-1.18]
One inside the neighbourhood	401(6.8)	1.13[0.87-1.47]	1250(6.6)	1.15[0.96-1.39]
More than one inside the neighbourhood	629(10.7)	1.05[0.84-1.31]	1899(10.1)	1.12[0.96-1.32]
<b>TOWN LEVEL</b>				
<b>Municipal commitment to healthcare 4</b>				
Low	256(4.3)	1	766(4.0)	1
Medium	672(11.4)	0.69[0.42-1.14]	2493(13.4)	1.26[0.90-1.77]
High	4971(84.3)	0.86[0.55-1.34]	15,523(82.6)	1.33[0.98-1.81]
<b>Type of grassroots interventions by the screening management centre</b>				
No intervention	433(7.3)	1	1297(6.9)	1
Temporary large-scale CCS information events	1303(22.1)	0.71[0.44-1.16]	4118(21.9)	1.31[0.95-1.81]
Empowerment interventions	4163(70.6)	0.74[0.51-1.06]	13,367(71.2)	0.99[0.78-1.26]

VDM: Val de Marne OR: Odds ratio CI: Confidence interval CCS: cervical cancer screening

\*This corresponds to the most deprived quintiles regarding the neighbourhood and the most deprived tertiles regarding the town

1 Adjusted ORs calculated one year after the personal invitation for screening was sent

2 Based on the VDM distribution

3 Healthcare providers include gynaecologists, general practitioners, midwives.

4 Adhoc synthetic indicator including the density of health associations and the existence of specific institutional arrangements around health policy (local health agreement, elected member in charge of health, municipal health care center).







Title figure 1: Flow diagram to detail the selection of the 3 populations

