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## Cohort Profile Update

# Cohort Profile Update: The GAZEL Cohort Study

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### Abstract

The original GAZEL cohort was composed of 20 625 employees of the French national gas and electricity companies (15 011 male employees then aged 40 to 50 years and 5614 women between 35 and 50 years old) at its inception in 1989. A Cohort Profile article was published in 2007. By the end of 2013, participants were aged 60–75, and almost all of them retired during follow-up. Accordingly, the main focus of research in the past decade was devoted to the study of the persistent, long-term effects of occupational exposures after retirement; of the transition between professionally active life and retirement; and on determinants of early ageing. Accordingly, in addition to the health, behavioural and social data collected yearly since the beginning of the follow-up, new data were thus collected on cognitive complaints, cognitive and physical functioning, limitations in daily activities, time use and social relationships of retirees. This update presents the main findings of research within the GAZEL Cohort Study during the past 7 years.

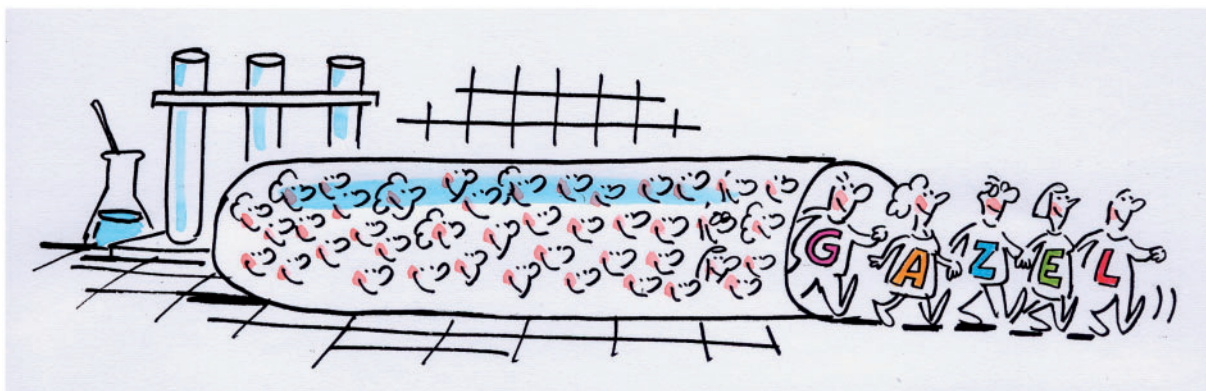
Any research group, in France or elsewhere, can submit a research proposal to work on the GAZEL cohort. To do this, interested researchers should contact one of the principal investigators of the GAZEL Cohort Study.

**Key words:** Population-based cohort, retirement, ageing, France

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### Key Messages

- The follow-up of the GAZEL Cohort Study extends now for more than 25 years and by the end of 2013 participants were aged 60–75 years, and almost all of them are retired.
- Accordingly the focus of research is now devoted to the study of the transition between professionally active life and retirement, on determinants of early ageing and of the persistence of long-term effects of occupational exposures.
- Occupational factors showed to exert long-term effects after retirement.
- Retirement seems highly beneficial for health and health-related behaviours, mainly due to the cessation of exposure to occupational risk factors.
- Long-term trajectory of several health conditions showed a less favourable evolution in socially disadvantaged groups.



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### What is the rationale for the new focus and new data collection?

The GAZEL Cohort Study was launched in January 1989 among *Électricité de France-Gaz de France* (EDF-GDF) workers. We described the original cohort in 2007,<sup>1</sup> and here we give a brief summary of its main features.

The company employed workers in all regions of France, from large cities to small villages; there was a wide socioeconomic range of occupational positions, including white- and blue-collar workers. The workforce was very stable due to employees' civil servant-like status; employees almost never leave the company and are not lost to follow-up even after retirement, since retirement benefits are paid by the company itself.

In 1989, the original cohort was composed of 20 625 participants (15 011 male employees aged 40 to 50 years and 5614 women between 35 and 50 years old). Follow-up is continuous and includes data collection on health status, lifestyle and socioeconomic and occupational factors from various sources. A mailed questionnaire is sent to the participants each year, and data are extracted regularly from the files of the personnel and medical departments of EDF-GDF and from national registers.

As the follow-up has extended over a longer period and the participants have grown older (mean age in 2014 is 68 and 71 for women and men, respectively), more than 2000 deaths have occurred among participants. The number of chronic diseases has also increased, allowing for more powerful studies. The past decade has also been the period of early ageing of cohort participants, and its consequences on health, such as frailty, physical limitations and cognitive impairments, have become more frequent. During follow-up, almost all participants retired, and this transition from work to retirement is accompanied by major changes in many domains that could be related to health.

Accordingly, the GAZEL Cohort Study has evolved in two main complementary directions: looking at the long-term effects of the occupational, social and lifestyle determinants of somatic and mental health conditions, and focusing increasingly on functional, physical and cognitive aspects of ageing. For both areas, new data have been collected.

### What will be the new areas of research?

Participants in the GAZEL Cohort Study have already been followed from middle age for over 25 years. This extended follow-up enables a life-course perspective on the evolution of different aspects of health, and it permits study of long-term consequences of various exposures and conditions that occurred during adulthood (earlier in life than in most cohorts of older adults). Early ageing is also a period of transition in life marked by major events such as retirement, relocation and changes in daily activities and social relationships. This is an opportunity to develop research on such changes and on their health effects. Accordingly, questions such as the health consequences of retirement, of major life events or social engagement, and the persistence of the effect of occupational-related factors after cessation of exposure, were investigated.

Regarding health outcomes, studies of chronic diseases took advantage of the increase in numbers of events and the resultant statistical power to investigate their association with a variety of exposures. The relationships between psychological factors and mental disorders and health, the evolution of health status over the life course, the relationships between sleep disturbances or cognitive complaints and mortality, as well as sickness absence as a predictor of main health outcomes occurring during working life or after retirement, were extensively studied.

The cognitive and physical functioning consequences of ageing are also a field of research which is developing



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quickly. Using a battery of cognitive and physical functioning tests which were administered to a sub-sample of GAZEL participants in 2002–04 and again in 2010, the long-term effects of alcohol drinking and occupational exposure to solvents were investigated.

In the future, as the follow-up will continue, research will develop along several dimensions of the study of ageing, and of chronic disease determinants and consequences. Thanks to the wealth of data collected over the past 25 years, physical, biological, psychological, environmental and social determinants of ageing and chronic diseases can be investigated in association with life-course variables such as sex, education, social origins, marital status, income, occupation, life events and living conditions. The health outcomes that can be examined as outcomes of those exposures are disability, morbidity, dependence, admission to hospitals or nursing homes, reduced quality of life and reduced survival. Several studies are already planned on topics such as lifestyle and health-related behaviour modifications while ageing, and determinants of social health inequalities in the elderly. Regarding determinants, occupational factors associated with healthy life expectancy will be investigated, as well as the determinants of frailty and its progression to dependence and dementia.

Research on some aspects of the pathophysiology of ageing, such as the relationships between high adiposity and dementia, or the association between metabolically healthy obesity and chronic conditions in ageing persons, will be carried out. Another field of interest is the evolution of some conditions over the life course; it is thus planned to study whether personality traits (hostility, neuroticism, trait anxiety) are stable or may change along the life course, and to analyse the predictive power of self-rated health in relation to specific causes of death. Another line of future research is the study of healthcare pathways among the elderly, and of the social and medical care of dependent older people.

### Who is in the cohort?

From the 20 625 participants at inception in 1989, 17 907 (4895 women and 13 012 men) were still participating to the cohort on 31 December 2013. Almost 10% have died (2028 deaths: 328 women, i.e. 5.8% of the initial women's group, and 1700 men, 11.3%), and 555 (2.6%) either never answered the annual questionnaire after 1989 or formally decided to stop their participation; 135 (0.6%) were lost to follow-up. Among those still participating, all men are now retired and only 131 women, who were younger as a group at inception, are still professionally active.

The GAZEL cohort is thus characterized by a very low loss to follow-up, as members of the cohort are tracked even if they do not complete their annual questionnaire. Active participation is also high: almost 75% of the questionnaires are returned every year (Figure 1). As different participants fail to respond each year, only the 2.6% of initial participants who resigned or never sent back any questionnaires during the 1989–2013 period are considered to be dropouts.

Several mortality studies showed, as expected, that those who died during follow-up had a poorer health status and were more frequently men, smokers and heavy drinkers at baseline; there was also a social mortality gradient from low-grade employees to executives, either blue- or white-collar workers.<sup>2–6</sup> Regarding attrition not due to death, the main associated factor was the occurrence of a severe disease.<sup>7</sup> Finally, those still remaining constitute a selected sample of the initial cohort; it is worth noting that the main factors associated with attrition during follow-up are the same as those associated with participation at inception.<sup>8</sup>

### What has been measured?

According to the focus on ageing, we collect new data on changes in personal and social functioning during the

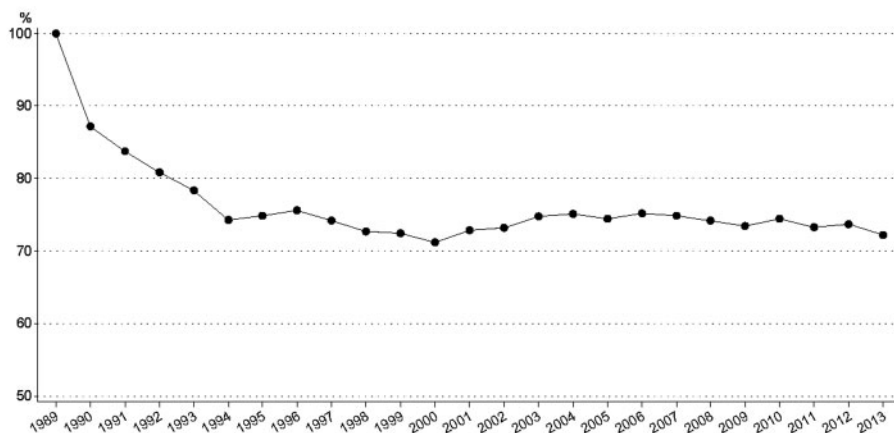


Figure 1. Annual response rate to mailed questionnaires.

annual follow-up. A set of questions about social activities was introduced in the 2005, 2009 and 2013 questionnaires, about informal caregiving in 2008 and a 24-h time use recall in 2013. Regarding the consequences of ageing on health, apart from the data on quality of life, morbidity and mortality that have been collected from the beginning of the cohort, we added some new items in the questionnaire. These include: cognitive complaints (every year since 2004); functional limitations using the IADL set of questions (Instrumental Activities of Daily Living)<sup>9</sup> in the 2007, 2011 and 2014 questionnaires; specific scales such as CASP (Control, Autonomy, Self-realisation and Pleasure<sup>10</sup>) in 2005, 2009 and 2013; and frailty yearly since 2012 (Stawbridge scale<sup>11</sup>).

In 2002–04 a subset of 5242 participants aged 55–65 years undertook the Mini Mental State Examination (MMSE)<sup>12</sup>, and Wechsler's coding subtest<sup>13</sup> as cognitive tests. In 2010 a health examination was performed, but for logistical reasons only 2143 participants (mean age: 65, SD: 2.8 years), who had been retired for 10 years on average, could participate. During this examination, physiological and biological parameters were measured: weight, height, waist-hip ratio, visual acuity, hearing, spirometry, electrocardiogram, blood pressure—basic biological parameters. Additionally, a more extensive set of cognitive and physical functioning tests was administered (MMSE,<sup>12</sup> Trail Making Test A – B,<sup>14</sup> Wechsler's coding subtest,<sup>13</sup> Digital Finger Tapping Test,<sup>15</sup> Word fluency, formal lexical and semantic evocation,<sup>16,17</sup> Grober and Busckhe's memory test,<sup>18,19</sup> Gait Speed Test,<sup>20</sup> Balance Test<sup>21</sup> and Hand Grip Test<sup>22</sup>).

Thanks to easier access to administrative databases in France,<sup>23</sup> since 2009 we have been able to link cohort participants to the French national database of claims for medical benefits and hospital discharges.

## What has it found? Key findings and key publications

Since 2007, when the original GAZEL Cohort Profile was published, many sub-studies which aim to examine specific research questions were conducted. Here we will summarize only the main findings regarding topics specifically related to the new research directions indicated above. Here, we have categorized research during these years according to four broad topics: long-term effects of occupational exposures; impact of retirement and other major life events; determinants and consequences of the evolution of different aspects of health over the life course; and social activities in early ageing. A full list of publications can be found on the GAZEL website.<sup>24</sup>

### Long-term effects of occupational exposures on premature ageing

One of the unique features of the GAZEL Cohort Study is its extensive collection of career-long data on biomechanical, psychosocial and chemical occupational exposures. We studied certain effects of these exposures over an extended follow-up, often years after the cessation of exposure (i.e. after retirement), and their consequences for premature ageing. Biomechanical factors were mainly studied in relation to musculoskeletal disorders, a major source of pain and functional impairment. Globally, the main finding was that even years after retirement, heavy exposure during the professional career to specific ergonomic constraints remained associated with musculoskeletal disorders. Thus, severe shoulder pain<sup>25</sup> was associated with prolonged prior exposure to arm elevation, severe knee pain with working in a kneeling or squatting position,<sup>26</sup> low back pain with driving, pushing, pulling,



carrying heavy loads, bending or twisting repeatedly<sup>27</sup> and Dupuytren's disease with manipulating a vibrating tool.<sup>28</sup> Moreover, it was shown that biomechanical strains during the professional career were the main factor associated with socioeconomic differences in low back pain, a frequent condition in early old age.<sup>29</sup> Negative effects on quality of life, assessed with CASP-19 (Control, Autonomy, Self-Realisation, Pleasure-19), were found in retired men and were associated with physical occupational exposures to ergonomic strain and physical danger.<sup>30</sup> Psychosocial factors at work, measured by the Job Content Questionnaire<sup>31</sup> and/or the Effort-Reward Imbalance Questionnaire,<sup>32</sup> also showed long-term effects among retirees on health functioning using the SF-36 (Short Form health survey-36) mental and physical component scores,<sup>33</sup> and on fatigue.<sup>34</sup> Biomechanical and psychosocial occupational exposures showed to be independent predictors of poor functional health, and combined exposure to both types of constraints appeared to have additive effects in retirees.<sup>35</sup> Regarding chemicals, occupational exposure to solvents during working life was associated with poor cognitive performance among retirees,<sup>36</sup> but this long-term effect was apparent only among the less educated, suggesting that higher cognitive reserve in the more educated group may have a protective effect.<sup>37</sup> When taking into consideration the timing and levels of exposure it appeared that the risk of cognitive impairment among moderately exposed workers attenuated with time, but that such an effect may not be fully true for those with higher exposure.<sup>38</sup> Interestingly, when alcohol drinking was used as the exposure, similar negative long-term cognitive effects were also only observed among the less educated.<sup>39</sup>

### Impact of retirement and other major life events

Taking advantage of repeated yearly measures, a series of studies investigated changes in health and health-related behaviours around retirement. For each of the negative health outcomes under study, retirement was associated with a dramatic decrease of prevalence. That was true for self-rated health,<sup>40</sup> sleep disturbances,<sup>41</sup> headache,<sup>42</sup> depression and fatigue.<sup>43</sup> However retirement has no impact on the prevalence of major chronic conditions, such as respiratory diseases, diabetes, cardiovascular disease or stroke.<sup>43</sup> Retirement was also associated with improvement in health-related behaviours: retirees increased their physical activity and lost weight<sup>44</sup> and had less risky driving behaviours.<sup>45</sup> Taken together, these findings strongly suggest that observed improvements are largely attributable to the cessation of exposure to diverse occupational risk factors.

Regarding alcohol consumption, there was a temporary increase in the year following retirement, generally followed by a return to previous levels.<sup>46</sup> Other stressful events, such as marriage or divorce, children leaving home or death of loved ones, may promote healthy or unhealthy alcohol consumption, some events temporarily and others with longer-term implications.<sup>47</sup>

### Determinants and consequences of the evolution of different aspects of health over the life course

Taking advantage of the extended follow-up of the cohort, several studies investigated the evolution of different health conditions over a long period of time. Analyses of the long-term trajectory of depression,<sup>48–49</sup> of sleep disturbances<sup>50</sup> and of obesity<sup>51</sup> showed a less favourable evolution in socially disadvantaged groups. Participants suffering from chronic diseases, such as diabetes, were more prone to sickness absence<sup>52</sup> and to prematurely cease employment as a result of a disability pension or early retirement.<sup>53</sup> Psychiatric diseases, musculoskeletal and circulatory disorders were also strong predictors of disability pension.<sup>54</sup>

### Social activities in early ageing

Research was also devoted to social engagement in the early old age, showing that voluntary social activities were associated with a lower prevalence of depressive symptoms.<sup>55</sup> Regarding informal caregiving, it was shown that regular caregivers with the highest burden scores reported worse physical and mental health status than did non-caregivers and that conversely, caregivers with the lowest burden scores of caregiving reported better perceived health status than did noncaregivers.<sup>56,57</sup>

### What are the strengths and weaknesses?

We believe that the main strengths of the GAZEL Cohort Study are: (i) the diversity of the sample population in terms of social hierarchy and white- and blue-collar workers, representing all regions of France and settings ranging from small villages to large cities; (ii) the quality and length of follow-up, given almost no loss to follow-up since participants are traced via their retirement benefits; (iii) cohort members who show a high willingness to participate in additional data collection; (iv) the prospective collection of data from different sources: self-reported, extracted from company and national registers, medical examinations and biology; (v) the large variety of health determinants (personal, lifestyle, social and occupational data) and outcomes (specific diseases, state of physical and mental health and quality of life) examined; and (vi) repeated

measures for most of the variables, collected continuously or through multiple waves.

The main weaknesses are: (i) the limited size of the cohort for non-frequent conditions (exposures and outcomes); (ii) the restriction to EDF-GDF employees: due to their civil servant-like status they enjoyed security of employment, and certain categories of the population (agricultural workers, self-employed, foreigners...) are not present in the cohort; (iii) lack of health examination at baseline.

### Can I get hold of the data? Where can I find out more?

Any research group, in France or elsewhere, can submit a research proposal to work on the GAZEL cohort. These projects are reviewed by a scientific committee, and those selected receive free access to the GAZEL data and participants. More than 50 research projects have been conducted on this cohort by research groups from different countries (Canada, Denmark, Finland, France, Germany, Sweden, UK, USA), many of them currently under way.

Submitting a research proposal involves filling out an application form stating the objectives of the study, the description of sample, the methods, the data needed and a timetable. French legal requirements must also be met. The first step would be to contact one of the principal investigators of the GAZEL Cohort Study (M.G. or M.Z.). Refer to the GAZEL website: [<http://www.gazel.inserm.fr/>] for further details on the study and the procedures for submitting a research proposal.

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