Socioeconomic Inequalities in Hypertension Prevalence and Care
The IHAPAF Study

Régis de Gaudemaris, Thierry Lang, Gilles Chatellier, Lynda Larabi, Valérie Lauwers-Cancès, Anne Maître, Eloi Diène

Abstract—To analyze the health disparities relative to the prevalence of arterial hypertension and its therapeutic control in the active French population, in relation to occupational categories (OC), a population of 17,359 men and 12,267 women was assessed from January 1997 to April 1998. The initial phase was a cross-sectional analysis of a cohort study designed to assess the incidence of arterial hypertension in a French working population. Information was collected by the worksite physician during the annual examination. Blood pressure (BP) was measured using a validated automatic device. Among subjects with a BP ≥140/90 mm Hg, patients not treated with antihypertensive drugs were invited to have an additional BP measurement, 1 month later. Overall prevalence was 16.1% for men and 9.4% for women. Both prevalence and therapeutic control of high BP were related to OCs in this study. Prevalence of hypertension was higher and maintenance of therapeutic control lower among lower OCs. In contrast, awareness of high BP and the proportion of hypertensive subjects under current treatment were not related to OCs. Educational level and low OC were significantly related to prevalence of high BP after adjustment for obesity, excessive alcohol consumption, and sedentary lifestyle in women only. A poor BP control under treatment was related to high alcohol intake and low OC in men. In women only, however, low educational level was related to high prevalence of hypertension and poor BP control under antihypertensive treatment. Inequalities in hypertension prevalence persist, with prevalence being higher among lower OCs. Social disparities were not observed, however, in awareness of their condition among hypertensive subjects and among patients for receiving versus not receiving any treatment for hypertension. In contrast, BP control under antihypertensive treatment was lower among lower OCs. (Hypertension. 2002;39:1119-1125.)

Key Words: hypertension, arterial blood pressure population obesity socioeconomic factors body mass index alcohol epidemiology

Arterial hypertension is one of the important determinants of health inequalities of cardiovascular diseases, which have been observed to persist or increase in developed countries in the previous 20 years.1,2 Higher prevalence of hypertension and poorer therapeutic control of hypertension care have been noted in populations in the low social classes.3-5 Information regarding the continued presence and type of disparity (prevalence or therapeutic control) could provide guidance for the most efficient treatment activities for reducing the disparity. For example, differences in prevalence would stress the importance of primary prevention. Differences in therapeutic blood pressure control would emphasize the need for reinforcing secondary prevention. These questions are all the more important because insufficient therapeutic control of hypertension at the population level has been shown to be persistent.6

The causality chain between socioeconomic factors and blood pressure is complex. Hypertension is a well-known cardiovascular risk factor that depends on factors such as alcohol, obesity, and sedentary lifestyle. In turn, these risk factors have been shown to differ according to social status, in France and in other countries.7-9 Moreover, occupational factors, such as job strain at work, have been shown to be related to alcohol intake10,11 and obesity.8 Thus, when addressing social disparities in hypertension prevalence and control, adjusting on so-called “individual” behaviors and risk factors is not appropriate. As a matter of fact, social factors and individual behaviors are not mutually indepen-
dent. To understand the distribution of health behavior, theoretical models should include the role of social factors and social context. Eliminating the relationship between social factors and blood pressure after adjustment for personal behaviors does not mean that social factors are unrelated to blood pressure. It means that these latter factors may be considered as pathways through which hypertension is related to social factors.

The aim of this work was to analyze the prevalence of hypertension in a French working population, the level of therapeutic control, and the relationship between prevalence, control, and occupational categories, either directly or indirectly, through behavioral risk factors. Because of their important contribution to hypertension, particular attention was given to the contribution of obesity and alcohol consumption to hypertension disparities.

**Methods**

This study is based on the data from the initial cross-sectional phase of a cohort study designed to assess the incidence of arterial hypertension in the working French population. Worksite physicians were recruited on a voluntary basis. A national study offer was published offering participation in the study. One hundred company doctors replied and volunteered for participation. Because 53 physicians were calculated to be necessary to obtain a 30,000-subject sample size, 53 among the 100 physicians were randomly selected and recruited. The sample process was organized in such a way that the geographic locations of the physicians, and thus of the wage-earners, could be representative of metropolitan France (economic sectors, population density). In each of 5 administratively defined regions of France, a fraction of the volunteers was sampled so that the national sample could be representative of their national distribution. Physicians from all work places were included (eg, industry, services, transports), with the exception of the agricultural sector. They included all or a random fraction of the salaried workers (18 to 50 years of age) under their medical responsibility (400 to 800 per doctor). Because an annual medical examination is mandatory in all French worksites, the design of the cohort study was based on this annual visit to ensure a high follow-up rate. The volunteer physicians agreed to enroll a population of at least 800 wage earners. According to the initial agreement with each worksite physician, he or she enrolled either the entire or a random sample of the working population he or she was responsible for. Each subject gave informed consent to participate in the protocol. The collection of data received the approval of the National Committee on Informatics and Freedom (CNIL, committee created by law in 1978). Confidentiality and anonymity were warranted by the worksite physician who, as a physician, must protect the privacy of the patients. Data were then sent anonymously by the worksite physician to the data center.

**Data Collection**

Information was collected by the worksite physician during the annual examination. Blood pressure (BP) was measured using a validated automatic device (OMRON CP705, Dupont). A training session was organized for all worksite physicians to standardize BP measurements. Systolic BP (SBP) and diastolic BP (DBP) were measured at the 5th, 6th, and 7th minutes in the sitting position, using a cuff properly adapted to the arm size. The mean of these 3 measures was used to estimate BP during all visits. Hypertension was defined as BP $\geq 140/90$ mm Hg and/or current antihypertensive treatment. For patients not currently treated for hypertension, with a BP $\geq 140/90$ mm Hg on the first visit, a diagnosis of hypertension was established from the results of a second visit, 1 month after the first visit. The additional BP measurement session could be performed in 78.5% of the invited population. Using the second criterion, subjects were defined as hypertensive if their BP was $\geq 140/90$ mm Hg on each of 2 visits or if they were under current antihypertensive treatment at the first visit.

Height and weight were measured and the body mass index (BMI) was calculated as weight/height$^2$ (kg/m$^2$). Obesity was defined by a BMI $\geq 30$ kg/m$^2$. Information about tobacco and alcohol consumption, participation in sports activities, educational level, marital status, and health services consumption was obtained through subject interviews. Alcohol consumption (wine, beer, and liquors) was quantified in glasses/day and $\geq 4$ U/d was the limit used to define heavy drinkers. The quality, homogeneity, and completeness of the data were monitored by a coordinating center in Grenoble, France (L.L., R.deG.).

A standardized questionnaire on social and occupational data and cardiovascular risk factors was completed by the worksite physician for each subject. Occupation was divided into 4 categories: Group I, unskilled and skilled workers; Group II, employees, nonmanual unskilled workers (eg, clerks, shop assistants); Group III, intermediate occupations (eg, technicians, sales managers, health and education employees); and Group IV, upper level executives. The level of education was defined as the number of years of education after primary school: $\leq 6$ years, 7 to 11 years, and $>11$ years of education. Job security was assessed by the job contract: open-ended work contract, fixed-term contract, or temporary work contract. Living conditions were addressed according to 2 criteria: living single or not, and owning versus renting a house.

**Statistical Methods**

Qualitative variables were compared using the $\chi^2$ test and $\chi^2$ for trend. Quantitative variables were compared using variance analysis (ANOVA). Adjustments on age for qualitative variables were performed using the Mantel-Haenszel $\chi^2$. Logistic regression models were used for multivariate analysis of qualitative variables, such as prevalence and control of hypertension. All statistical analyses were done using the STATA statistical package (STATA Software, version 5.1, STATA Corporation).

**Results**

**Population Characteristics**

Among 29 656 subjects, 58.5% were men. The mean age was 38.8 years for both genders. A higher proportion of men than women were executives or skilled workers, whereas a higher proportion of women had a high level of education. Most of the subjects had long-term work contracts and the same proportion of men and women lived as couples, or owned their own housing (Table 1). The prevalence of cardiovascular risk factors, smoking, sedentary lifestyle, obesity, and excessive alcohol intake were related to occupational categories (OCs), for both men and women (Table 2). In women only, the prevalence of obesity was negatively related to the level of education: 6.5% of those with $>12$ years of education versus 16.8% of those with $<6$ years ($P<0.001$).

**Prevalence of Hypertension**

Overall prevalence was 16.1% for men and 9.4% for women. The prevalence of hypertension was significantly associated with OC and was highest among workers and lowest among upper-level executives for both genders (Table 2). The prevalence of hypertension was related to educational level only in women: $>11$ years of schooling, 4.3%; 7 to 11 years, 5.9%; and $<7$ years, 8.1% ($P<0.001$).

Three models, using logistic regression analysis, were defined. In 2 models introducing age and OC, on the one hand, and age and educational level, on the other, prevalence of hypertension was found to be high among workers and
positively related with a short duration of schooling. In men, after introducing obesity, sedentarity, alcohol intake, smoking, and single living into the model, prevalence of hypertension was not related to OC. In contrast, BMI, sedentarity, alcohol intake, smoking, and single living in men were related to prevalence of hypertension (Table 3). In women, prevalence of hypertension was higher among unskilled and partially skilled workers, and those with a low educational level, a low leisure-time physical activity, and obesity.

Management of Hypertension

Awareness and Current Antihypertensive Treatment

Awareness of hypertension and the proportion of aware hypertensive subjects under current antihypertensive treatment were not significantly different among OCs for both men and women (Table 2).

Control of Blood Pressure Under Treatment

In both genders, the higher the OC, the higher the percentage of BP levels <140/90 mm Hg under treatment (Table 2). In contrast, no significant gradient according to educational level was observed. In multivariate analysis (Table 4), after adjustment for age and behavioral factors, being a skilled or unskilled worker was a significant risk factor for poor control of BP among men. Excessive alcohol intake was a very important factor for a poor BP control among male treated patients. In women, a poorer BP control was observed among unskilled workers and those with a low educational level.

Discussion

Both prevalence and therapeutic control of high BP were related to OCs in this study. Prevalence of hypertension was higher and therapeutic control lower among lower OCs. In contrast, awareness of high BP and the proportion of hypertensive subjects under current treatment were not related to OCs. Educational level and a low OC were related to prevalence of hypertension (Table 3). In women, prevalence of hypertension was higher among unskilled and partially skilled workers, and those with a low educational level, a low leisure-time physical activity, and obesity.

The results should not be generalized to the entire active French population without caution. The participation of the worksite physicians was obtained on a voluntary basis. However, all occupations were included, except for the agricultural sector, because in this occupational group, annual medical visits by an occupational physician are not required.
by law for all of the workers, as is the case in the other sectors. The estimates of prevalence of hypertension and therapeutic control shown in this study are probably better than in the entire French population because it was conducted in a work environment and was therefore influenced by the “healthy worker effect” and better access to preventive care. In addition, it does not include the over-65 age group (legal age for retirement) nor the unemployed, who do not benefit from a yearly visit to the worksite doctor’s office.

Although disparities in hypertension prevalence and control have been documented in many countries, to our knowledge, little information on trends in these matters has been reported. The results of this study show that, in France, disparities persist in the prevalence and control of high BP under treatment.

The higher prevalence of hypertension observed among workers is in line with previous reports in industrialized countries. Among recent reports, in a Dutch study the prevalence was higher among educated men. However, the population of the study was over 55 years old. In previous studies during the 80s in the Netherlands, and in women, the prevalence was higher among persons lower levels of education. This was also the case in another survey, in a younger population in the same country. The findings related to women are in keeping with previous reports in other countries: more women than men were in the lower occupational categories and health differences were more pronounced when educational level rather than occupational category is taken into account.

Similarly, job strain has been observed to be a risk factor for high blood pressure in men, but not in women. The role of obesity and high alcohol intake has to be emphasized and carefully discussed with regard to social inequalities in hypertension prevalence. Taking into account these 2 factors in a multivariate analysis results in masking the relationship that was observed between OCs and prevalence of hypertension. The strong relationship among alcohol, BMI, and hypertension on one hand, and the gradient observed between OCs in relation to obesity and alcohol...
intake, on the other hand, explain this result from a statistical point of view. The social gradient concerning alcohol intake and obesity has been observed in other countries. From an epidemiologic perspective, the interpretation should be that the gradient in alcohol and obesity might be one pathway through which social inequalities in BP levels may be dealt with. The relationship among social conditions, occupational factors, and obesity should, therefore, be explored further. Some results suggest a link between job strain and obesity. Coping strategies with stressful situations have also been suggested.

In our study, there are no differences in awareness and the percentage of persons under current antihypertensive treatment among the occupational groups. In contrast, the quality of BP control, as assessed by the percentage of treated subjects with a BP level below 140/90 mm Hg, is significantly different among groups, with higher BP control in the upper OCs. Two decades ago, differences among social categories existed in the awareness as well as the treatment of hypertension. This is in line with what has been observed in other populations; ie, the first priority in hypertension care has evolved from detection to adequate treatment of high BP. One should be cautious, however, in comparing percentages of hypertensive persons whose disease has been satisfactorily controlled by the antihypertensive treatment as long as the awareness and the percentage of treated subjects are not comparable. A selection process might occur during these successive steps, and the population of treated hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States. In contrast, the percentage of treated subjects among aware hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States. In contrast, the percentage of treated subjects among aware hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States. In contrast, the percentage of treated subjects among aware hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States. In contrast, the percentage of treated subjects among aware hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States. In contrast, the percentage of treated subjects among aware hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States. In contrast, the percentage of treated subjects among aware hypertensive subjects might eventually be different. For example, the proportion of hypertensive subjects under current treatment who have controlled BP levels is lower in France than in the United States.

### TABLE 3. Prevalence of Hypertension, Socioeconomic Status, and Health Behavior Variables

<table>
<thead>
<tr>
<th>Variables Introduced in the Models</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>95% Confidence Interval</td>
</tr>
<tr>
<td>Model with age and occupational category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.09</td>
<td>1.09–1.10</td>
</tr>
<tr>
<td>Unskilled and partially skilled workers</td>
<td>1.22</td>
<td>1.08–1.38</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>1.17</td>
<td>0.99–1.40</td>
</tr>
<tr>
<td>Intermediate occupations</td>
<td>1.06</td>
<td>0.98–1.22</td>
</tr>
<tr>
<td>Upper executive</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Model with age and years of schooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.09</td>
<td>1.09–1.10</td>
</tr>
<tr>
<td>≤6 years</td>
<td>1.14</td>
<td>0.98–1.33</td>
</tr>
<tr>
<td>7–11 years</td>
<td>1.22</td>
<td>1.08–1.38</td>
</tr>
<tr>
<td>&gt;11 years</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Model with age, occupational category, years of schooling, and health behavior*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.09</td>
<td>1.08–1.10</td>
</tr>
<tr>
<td>Unskilled and partially skilled workers</td>
<td>1.05</td>
<td>0.89–1.24</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>1.04</td>
<td>0.85–1.26</td>
</tr>
<tr>
<td>Intermediate occupations</td>
<td>0.94</td>
<td>0.80–1.10</td>
</tr>
<tr>
<td>Upper executive</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≤6 years of education</td>
<td>0.98</td>
<td>0.74–1.10</td>
</tr>
<tr>
<td>7–11 years of education</td>
<td>1.09</td>
<td>0.94–1.27</td>
</tr>
<tr>
<td>&gt;11 years of education</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Obesity, BMI≥30 kg/m²</td>
<td>3.58</td>
<td>3.17–4.05</td>
</tr>
<tr>
<td>Leisure time physical activity, &lt;2 h/wk</td>
<td>1.17</td>
<td>1.06–1.28</td>
</tr>
<tr>
<td>Alcohol consumption, ≥4 glasses/d</td>
<td>1.64</td>
<td>1.44–1.85</td>
</tr>
<tr>
<td>Current smoker</td>
<td>0.99</td>
<td>0.90–1.09</td>
</tr>
<tr>
<td>Living alone</td>
<td>1.25</td>
<td>1.12–1.39</td>
</tr>
</tbody>
</table>

*Forced procedure including occupational category, years of schooling, obesity, leisure time physical activity, alcohol, smoking, and the fact of living alone.
cases of uncontrolled hypertension in the United States involve persons who have access to care and regular contacts with a physician.\textsuperscript{26} Risk factors for poor BP control under antihypertensive treatment differ between men and women. In men, excessive alcohol intake is the main factor identified in this study. Increasing BP, while undergoing treatment, and decreasing compliance with treatment with increasing alcohol intake has been reported earlier in another working population.\textsuperscript{7} The mechanisms that relate poor BP control and high alcohol intake probably involve a low compliance in this group. A direct pathway between alcohol and drugs might, however, exist because animal studies suggest that successful antihypertensive treatment may not be achieved if alcohol misuse is evident.\textsuperscript{27} In women, a low level of stated leisure physical activity was a risk factor and a U-shaped relationship between educational level and BP control was observed. Women with an intermediate level of education had a higher rate of BP control than did women with either lower or higher levels of education. Although exercise has been shown to be associated with lower BP,\textsuperscript{11} this relationship might reflect a lifestyle more than the effect of exercise per se.

\textbf{Perspectives}

The results of this study show that disparities in hypertension prevalence and hypertension care persist, as is the case with inequalities in cardiovascular diseases.\textsuperscript{1,2} This underlines the importance of continuing to address these issues because a plateau had been observed in the United States around 1990 concerning the awareness, treatment, and control of hypertension,\textsuperscript{28} and at the same time, results concerning hypertension care were still poor in other countries.\textsuperscript{6,19,24} Concerning the prevalence of hypertension, our results suggest that, in addition to a policy directed toward the hypertensive persons, a mass strategy policy focusing on weight and alcohol issues might be helpful because persons in the lower OCs have been shown to be the more affected by obesity and excessive alcohol intake and the effectiveness of interventions or treatment has been repeatedly observed to be lower among these groups.\textsuperscript{3} From an intervention point of view, "behaviors" such as excessive drinking, eating, and being obese should be considered in their social context.\textsuperscript{12} More active concern about excessive alcohol drinking would be needed because prevention strategies on the worksite have been shown to be able to reduce significantly BP.

\begin{table}
\centering
\caption{Poor BP Control Under Current Antihypertensive Treatment, Socioeconomic Status, and Health Behavior}
\begin{tabular}{lllll}
\hline

Variables Introduced in the Models & \multicolumn{2}{c}{Men} & \multicolumn{2}{c}{Women} \\
\hline
Model with age and occupational category & Odds Ratio & 95\% Confidence Interval & Odds Ratio & 95\% Confidence Interval \\
Age & 1.04 & 1.02–1.06 & 1.03 & 1.01–1.06 \\
Unskilled and partially skilled workers & 1.78 & 1.23–2.58 & 1.02 & 0.55–1.86 \\
Skilled workers & 2.18 & 1.26–3.78 & 0.71 & 0.39–1.29 \\
Intermediate occupations & 1.48 & 0.99–2.21 & 0.68 & 0.35–1.30 \\
Upper executive & 1 & & 1 & \\
Model with age and educational level & & & & \\
Age & 1.03 & 1.01–1.05 & 1.03 & 1.01–1.05 \\
\leq 6 years of education & 1.36 & 0.85–2.18 & 1.1 & 0.67–1.98 \\
7–11 years of education & 1.07 & 0.78–1.60 & 0.79 & 0.47–1.32 \\
\geq 11 years & 1 & & 1 & \\
Model with age, occupational category, educational level, and health behavior* & & & & \\
Age & 1.03 & 1.01–1.05 & 1.03 & 1.01–1.05 \\
Unskilled and partially skilled workers & 1.90 & 1.02–2.99 & 1.40 & 1.03–1.92 \\
Skilled workers & 2.44 & 1.35–4.40 & 0.80 & 0.42–1.53 \\
Intermediate occupations & 1.70 & 1.08–2.68 & 1.02 & 0.51–2.00 \\
Upper executive & 1 & & 1 & \\
\leq 6 years of education & 0.78 & 0.44–1.44 & 1.32 & 1.01–1.72 \\
7–11 years of education & 0.68 & 0.42–1.11 & 0.94 & 0.50–1.77 \\
\geq 11 years of education & 1 & & 1 & \\
Obesity, BMI $\geq 30$ kg/m$^2$ & 1.27 & 0.93–1.74 & 1.08 & 0.78–1.49 \\
Leisure time physical activity, $\leq 2$ h/wk & 1.25 & 0.92–1.69 & 1.47 & 0.95–2.26 \\
Alcohol consumption, $\geq 4$ glasses/d & 1.50 & 1.03–2.20 & 0.63 & 0.13–2.91 \\
Current smoker & 0.92 & 0.68–1.24 & 0.89 & 0.59–1.36 \\
Living alone & 0.93 & 0.66–1.33 & 1.07 & 0.75–1.52 \\
\hline
\end{tabular}
\footnote{Forced procedure including occupational category, years of schooling, obesity, leisure time physical activity, alcohol, smoking, and the fact of living alone.}
\end{table}
levels.29 Because BP control among treated subjects appears to be a major challenge, more information is needed about the quality of the doctor-patient relationship, which might vary according to social class.30,31

Appendix

Epidemiology Group of the Société Française d’Hypertension Arterielle J.M. Mallion, P. Ducimetière, P.F. Plouin, J.P. Cambou


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References

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