Hypertension in Overweight and Obese Primary Care Patients Is Highly Prevalent and Poorly Controlled

Peter Bramlage, David Pittrow, Hans-Ulrich Wittchen, Wilhelm Kirch, Steffen Boehler, Hendrik Lehnert, Michael Hoeﬂer, Thomas Unger, and Arya M. Sharma

Background: Although the relationship between body weight and blood pressure (BP) is well established, there is a lack of data regarding the impact of obesity on the prevalence of hypertension in primary care practice. The objective of this study was to assess the prevalence of hypertension and the diagnosis, treatment status, and control rates of hypertension in obese patients as compared to patients with normal weight.

Methods: A cross-sectional point prevalence study of 45,125 unselected consecutive primary care attendees was conducted in a representative nationwide sample of 1912 primary care physicians in Germany (HYDRA).

Results: Blood pressure levels were consistently higher in obese patients. Overall prevalence of hypertension (blood pressure \( \geq 140/90 \) mm Hg or on antihypertensive medication) in normal weight patients was 34.3\%, in overweight participants 60.6\%, in grade 1 obesity 72.9\%, in grade 2 obesity 77.1\%, and in grade 3 obesity 74.1\%. The odds ratio (OR) for good BP control (<140/90 mm Hg) in diagnosed and treated patients was 0.8 (95\% confidence interval [CI] 0.7–0.9) in overweight patients, 0.6 (95\% CI 0.6–0.7) in grade 1, 0.5 (95\% CI 0.4–0.6) in grade 2, and 0.7 (95\% CI 0.5–0.9) in grade 3 obese patients.

Conclusions: The increasing prevalence of hypertension in obese patients and the low control rates in overweight and obese patients document the challenge that hypertension control in obese patients imposes on the primary care physician. These results highlight the need for specific evidence-based guidelines for the pharmacologic management of obesity-related hypertension in primary practice.

Key Words: Control, treatment, diagnosis, hypertension, overweight, obesity.

Overweight and obesity are currently recognized as major public health issues in most areas of the world.\(^1\) For the U.S. population (National Health and Nutrition Examination Survey: 1999–2000), Flegal et al\(^2\) reported a prevalence of 64.5\% for overweight (body mass index [BMI] \( \geq 25 \) kg/m\(^2\)) and 30.5\% for obesity (BMI \( \geq 30 \) kg/m\(^2\)). In Germany, the prevalence of overweight and obesity in patients presenting in primary care practice is 60\% and 20\%, respectively.\(^3\) These figures represent a substantial increase in the prevalence of excess body weight compared with the 1990s and is in part responsible for the current increase in health care expenditures.\(^4\)

Among overweight and obese patients, the prevalence of hypertension has been reported to be around 50\% and to increase further with higher grades of obesity.\(^5\) On the other hand, almost 70\% of hypertensive patients have been reported to be overweight, with more than 30\% being obese.\(^6\) Previous population-based studies suggest that the probability of insufficient blood pressure (BP) control in obese patients is about 50\% higher than in hypertensive patients with normal weight.\(^7\) Yet, little is known about the prevalence and control of hypertension in overweight and obese primary care attendees.

The Hypertension and Diabetes Risk Screening and Awareness (HYDRA) study was a cross-sectional point prevalence study in 45,125 primary care attendees in Germany conducted during September 2001.\(^8\) In this article we present data on 1) BP levels of patients according...
to age and BMI, 2) the point prevalence of hypertension in overweight and obese patients, 3) the proportion of recognized, treated, and subsequently controlled hypertensive patients in the sample population, and 4) data on the use of antihypertensive treatment in primary care.

Methods

Study Design

The design and instruments of the HYDRA study have been presented in greater detail elsewhere. \(^8\), \(^9\) (see also http://www.hydra-studie.de). Briefly, the HYDRA study was based on a two-step epidemiologic design. In step one, a nationwide sample (n = 2466) of primary care doctors completed a prestudy questionnaire (n = 1912; response rate 79%) to describe personal and structural characteristics of each practice and to assess self-perceived qualifications and attitudes related to recognition, diagnosis, and care of primary care patients. The second step consisted of a target day assessment (half day, September 18 or 20, 2001) of all patients attending the doctors’ offices on that day. Patients were informed by posters and leaflets about participation of the respective practices in the study and that they were free to decline participation. Informed consent was obtained from all patients. A total of 45,125 consecutive primary care attendees, aged 16 years and older and eligible for the study, were enrolled irrespective of their reason for contacting the primary care physician.

Instruments

The prestudy questionnaire served to collect information on the participating physician’s profile. The patient questionnaire was used to collect data on a variety of variables including details on hypertension and diabetes history and treatment (if applicable). The doctor’s clinical appraisal included rating of the current presence of hypertension and diabetes using the Clinical Global Impression Scale (CGI: not present, borderline, mild/moderate, severe/extreme) \(^10\) and indicating co-morbidities out of 22 predefined somatic and mental disorders. Information on BP and biochemical data as well as the doctor’s assessment of diabetes or hypertension control was also collected. In addition systolic and diastolic BP was measured by the doctor by sphygmonanometry or automated, validated devices. It should be noted that this was a naturalistic study in routine care with no monitors carrying out quality assurance, and thus it is not feasible to quantify to what degree doctors complied with the rules. In particular, it is not possible to indicate whether doctors based their hypertension indication on one or more measurements.

Diagnostic Conventions

As in previous studies. \(^11\) hypertension was defined as measured BP equal to or greater than 140/90 mm Hg or receiving antihypertensive therapy. Detection levels were based on the doctor’s clinical diagnoses as reported and coded on the clinical appraisal form. The BMI was calculated from self-reported weight and height information taken from the patients questionnaire (body weight in kilograms/height in meters squared) and classified according to international conventions: overweight (25–29.9 kg/m\(^2\)), obesity (≥30 kg/m\(^2\)), obesity grade 1 (30–34.9 kg/m\(^2\)), grade 2 (35–39.9 kg/m\(^2\)), and grade 3 (≥40 kg/m\(^2\)). \(^6\)

Statistical Analyses

From the total HYDRA sample of 45,125 patients, 6252 were excluded due to missing values for weight and height (2185), underweight (BMI <18.5 kg/m\(^2\)) (841), missing CGI ratings for
diabetes (1467), or missing BP readings (1759). Thus, these point-prevalence estimates are based on a sample of 38,873 primary care attendees (Table 1). Cross-tables, frequency distributions, and descriptive statistics were used to compare the distributions of variables among all categories. Differences in binary outcomes like the presence of hypertension were quantified with odds ratios (ORs) from logistic regressions,\textsuperscript{12} while adjusting for age group, sex, and sex times age group, and by calculating robust confidence intervals for observations clustered within primary care settings.\textsuperscript{13} All analyses were conducted using the Stata 8 software package (StataCorp LP, College Station, TX).

Results

Mean BP Readings

Blood pressure levels by BMI and age group are plotted in Fig. 1. In the overall sample (treated and untreated hypertensive patients), systolic BP consistently increased with BMI and age. The same was true for all untreated patients except for the youngest age group, where BP levels in grade 3 obesity were lower than in grade 2 patients. In treated patients, systolic BP likewise increased with increasing age and BMI, although this relationship was attenuated by treatment. Similar trends were seen for diastolic BP and in both sexes (data not shown).

Prevalence of Hypertension in Overweight and Obese Patients

Table 1 shows the overall prevalence of hypertension by age groups, sex, and BMI. Overall prevalence of hypertension in normal weight patients was 34.3%, in overweight 60.6%, in grade 1 obesity 72.9%, in grade 2 obesity 77.1%, and in grade 3 obesity 74.1%. The prevalence of hypertension increased with higher BMI in all age groups, but this relationship was stronger in the younger age groups (Fig. 2). As with BP levels in the youngest age group, the prevalence of hypertension in the grade 3 obese patients was lower (37%) than in the grade 2 obese (51%). The same BP trends were seen in both sexes.

Using a more stringent BP cutoff of 130/80 mm Hg, as recommended for high-risk patients,\textsuperscript{14} prevalence of hypertension increased from 68% in patients with normal body weight (for whom the lower targets would not apply), to 87% for overweight (OR 2.1, 95% confidence interval [CI] 2.0–2.2), 92% for grade 1 obese (OR 3.9, 95% CI 3.6–4.3), 95.0% for grade 2 obese (OR 6.0, 95% CI 5.2–7.0), and 92% for grade 3 obese patients (OR 5.5, 95% CI 4.4–6.9).

Hypertension Diagnosis, Treatment, and Control

Fig. 3 shows the proportion of all primary care attendees who were hypertensive, were diagnosed as having hypertension by the physician, were treated, and were controlled (BP <140/<90 mm Hg). Although prevalence of hypertension increased with BMI class (falling off slightly in men with grade 3 obesity), the relative rates of detection and treatment likewise increased. However, ORs for good control were 0.8 (95% CI 0.7–0.9) in overweight patients compared with normal weight patients, OR 0.6 (95% CI 0.6–0.7) in grade 1, OR 0.5 (95% CI 0.4–0.6) in grade 2, and OR 0.7 (95% CI 0.5–0.9) in grade 3 obese patients.

Antihypertensive Medication

Fig. 4 illustrates the use of different drug classes for each BMI group among recognized hypertensive patients. There was a significant increase in the use of angiotensin-converting
enzyme inhibitors and diuretics with increasing BMI class (OR 1.9, 95% CI 1.5–2.4 for the use of angiotensin-converting enzyme inhibitors and OR 2.8, 95% CI 2.2–3.5 for diuretics in grade 3 obesity). The use of other drug classes was not related to BMI class.

The use of drug combinations in patients with treated hypertension is illustrated in Fig. 5. While the frequency of the use of only 1 drug (normal weight 51.1%) decreased with increasing weight (35.1% for grade 3 obesity), the number of patients taking 2, 3, or ≥ 4 antihypertensive drugs increased substantially with increasing weight. The OR for the use of 4 drugs in grade 3 obesity was 5.3 (95% CI 3.1–8.9), for 3 drugs it was 3.2 (95% CI 2.1–4.9), and for 2 drugs it was 2.3 (95% CI 1.6–3.3) versus normal weight.

The use of β-blockers predicted good BP control (<140/90 mm Hg) compared with the use of diuretics. This was true for patients with normal weight (OR 1.4, 95% CI 1.1–1.8) as well as for patients who are overweight (OR 1.3, 95% CI 1.1–1.7) or obese (OR 1.3, 95% CI 1.1–1.5). In contrast, neither the use of calcium channel blockers, angiotensin-converting enzyme inhibitors, AT1-receptor blockers, α-blockers, nor the number of drugs used were predictors of BP control.

**Discussion**

This study, based on data derived from more than 45,125 primary care attendees, not only documents the high prevalence of hypertension in primary care practice, but also highlights the remarkable increase in the prevalence of hypertension associated with overweight and obesity observed in this setting. Thus, the already high prevalence of ~35% in the normal weight group more than doubled with grade 3 obesity. Importantly, this relationship between increased body weight and hypertension prevalence was most apparent among the younger age groups, with an almost fivefold increase in the 16- to 29-year olds and a nearly fourfold increase in the 30- to 44-year age group. In contrast, in the elderly (>65 years), the impact of BMI on hypertension prevalence and BP was rather modest (~10% increase). Overall, our data demonstrate that apart from age, BMI is a very important determinant of BP levels, hypertension prevalence, and BP control in primary practice.

Our observation on the importance of BMI as a determinant of hypertension in primary practice is consistent with the well-known positive relationship between increased body weight and higher BP. Similarly, the Third National Health and Nutrition Examination Survey (NHANES III) reported an increasing rate of hypertension with increasing BMI class. Thus, in NHANES, although the prevalence of hypertension was 23.5% for men with normal weight (23.3% for women), it was 34.2% (38.8%) for overweight, 49.0% (48.0%) for class 1 obesity, 65.5% (54.5%) for class 2 obesity, and 64.5% (63.2%) for class 3 obesity. Although the steep relationship between BMI and hypertension observed in NHANES is compatible with the observations in our study, the overall prevalence of hypertension at each level of BMI was substantially higher in the HYDRA study. These higher prevalence rates of hypertension are perhaps in line with the recent report by Wolf-Maier and colleagues, who described substantial differences in the prevalence of hypertension between the U.S. and German populations. Higher prevalence rates in our study probably also reflect the fact that our study was restricted to primary care attendees rather than the general population.

In our study, the strong relationship between increase in BMI and both systolic and diastolic BP was apparent both in treated and, albeit at substantially lower BP levels, in untreated patients. In contrast, although treatment failed to normalize BP in the majority of hypertensive patients, it apparently sufficed to markedly decrease the overall BP variance such that the
relationship between BMI and BP levels was virtually abolished. Nevertheless, increased BMI was a substantial risk factor for poor BP control, a finding that is well in line with previous observations. Furthermore, the number of patients on more than one antihypertensive drug increased from 49% in the normal weight group to 65% in grade 3 obese patients.

Interestingly, although overall control rates were rather low in all BMI groups, the use of β-blockers was a significant predictor of good control. The fact that this was also true for obese patients may reflect the previous finding that β-blockade is more effective in lowering BP in obese than in lean patients. On the other hand, there have been reservations on the use of these agents in obese patients based on their propensity to cause weight gain and to increase the incidence of diabetes. In fact, whether or not β-blockers should be first-line treatment for young patients with uncomplicated obesity-related hypertension remains a matter of debate, which should be addressed by current guidelines. In the HYDRA study, clear preference of antihypertensive drug classes in obese patients was only apparent for diuretics and angiotensin-converting enzyme inhibitors, with their use progressively increasing with higher BMI classes. Whether or not the choice of these agents is a reflection of their better efficacy or is dictated by better tolerability or specific indications for obesity-related co-morbidities remains unclear.

Poor control of obesity hypertension may be related to its complex pathophysiologic effects on renal function and morphology. Obesity increases renal sodium reabsorption and impairs pressure natriuresis by activation of the reninangiotensin and sympathetic nervous systems and by altered intrarenal physical forces. Chronic obesity also causes marked structural changes in the kidneys that eventually lead to a loss of nephron function, further increasing arterial pressure. Recent evidence suggests that some of these alterations may be attributable to adipocyte-derived factors (termed adipokines) that can directly affect metabolism, neurohumoral vascular control, and renal function. It is, therefore, perhaps not surprising that in this survey, diuretics and blockers of the renin-angiotensin system were more likely to be used in obese patients than other drug classes.

There are several limitations to our study. First, BMI was calculated based on the data provided in the patient questionnaire. Self-reported weight and height are nevertheless highly correlated with measured weight and height, with a small systematic error generally resulting in an overestimation of height and an underestimation of weight, resulting in an underestimation of BMI. Therefore, the true prevalence of overweight and obesity may be even higher than reported in our study. Also, BP readings were obtained only once on the study day after 3 min of rest. Although this may not suffice to fully characterize BP levels in a given patient, it has been shown that one time BP testing is feasible and gives reliable estimates in large patient cohorts. Furthermore, we were able to assess the validity of the one time measure by asking doctors to provide a second measure from the chart (median time, 2 months before the study). These measures were available in two-thirds of the reported cases and the mean BP of these measurements was almost identical to the data reported here. Finally, BP readings before the diagnosis of hypertension were not evaluated. Thus, the magnitude of BP reduction, an important factor in evaluating the success of therapy, could not be determined. A patient whose BP was lowered from 210/110 mm Hg to 150/90 mm Hg was classified identically as a patient whose BP was reduced only from 150/95 mm Hg to 142/92 mm Hg, although the morbidity and mortality risk of the former patient would have been lowered to a considerable extent. Thus, evaluating only whether a given patient was below the recommended threshold, most likely underestimates the benefit of BP therapy for a given patient.
In conclusion, our study not only documents the high prevalence of obesity and hypertension in primary practice, but also emphasizes the steep relationship between these two entities in younger patients. The striking lack of control was even more pronounced in the obese groups with obesity being a significant predictor of poor control, despite the greater use of combination therapy. Preferential use of drugs in obese patients was only apparent for diuretics and angiotensin-converting enzyme inhibitors, although the use of β-blockers was a significant predictor of good BP control in all groups. Whether or not these findings reflect better efficacy of these drugs in obese patients or their use is dictated by other factors remains to be studied.

Perspectives

Despite the well-recognized relationship between increased body weight and BP, there is a remarkable paucity of data on the prevalence of obesity and its relationship to hypertension in medical practice. Our data emphasize not only the magnitude of this relationship but also show that obesity is a predictor of poor control. The results of our study also highlight the need for evidence-based guidelines on the pharmacologic management of obesity-related hypertension.

| Table 1. Prevalence of hypertension (≥140 or ≥90 mm Hg), and/or receiving hypertensive medication |
|---------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Age/Gender | Normal BMI 18.5-24.9 | Overweight BMI 25-29.9 | Obesity grade 1 BMI 30-34.9 | Obesity grade 2 BMI 35-39.9 | Obesity grade 3 BMI ≥ 40 | N % | OR* | 95% CI |
| 16-24y | 164 | 12.4 | 126 | 27.0 | 2.1 | 1.7-2.9 | 42 | 41.2 | 2.0 | 1.6-2.4 | 21 | 77.8 | 0.2 | 2.6-144.0 | 5 | 45.5 | 0.0 | 0.4-50.3 |
| Women | 136 | 5.8 | 55 | 11.0 | 1.5 | 1.2-2.1 | 22 | 21.6 | 2.2 | 1.7-2.5 | 16 | 35.6 | 0.1 | 2.9-12.6 | 0 | 52.2 | 0.0 | 1.0-17.9 |
| Total | 300 | 6.6 | 181 | 10.1 | 1.8 | 1.5-2.2 | 64 | 39.6 | 2.0 | 1.7-2.4 | 37 | 51.4 | 0.1 | 3.9-14.4 | 10 | 37.1 | 0.2 | 2.3-16.6 |
| 30-44y | 302 | 12.9 | 510 | 37.0 | 1.8 | 1.5-2.2 | 237 | 54.5 | 0.1 | 1.2-2.3 | 50 | 66.7 | 0.2 | 1.5-3.0 | 28 | 65.7 | 0.1 | 0.9-9.7 |
| Women | 233 | 54.5 | 457 | 31.0 | 1.9 | 1.5-2.3 | 215 | 40.1 | 0.3 | 1.7-4.1 | 34 | 49.7 | 0.2 | 1.4-7.7 | 10 | 50.0 | 0.3 | 3.7-11.3 |
| Total | 536 | 65.3 | 957 | 68.0 | 1.9 | 1.5-2.3 | 452 | 40.5 | 0.3 | 1.7-4.1 | 84 | 62.0 | 0.4 | 2.9-9.2 |
| 45-59y | 421 | 13.2 | 108 | 26.5 | 1.8 | 1.6-2.7 | 297 | 76.7 | 0.9 | 1.6-3.9 | 111 | 87.4 | 0.3 | 1.5-7.6 | 57 | 80.0 | 0.5 | 3.7-11.3 |
| Women | 377 | 24.5 | 96 | 15.1 | 1.9 | 1.6-2.7 | 225 | 76.1 | 0.7 | 1.5-7.6 | 89 | 78.1 | 0.5 | 2.8-11.3 |
| Total | 802 | 17.2 | 204 | 25.6 | 1.9 | 1.6-2.7 | 522 | 76.4 | 0.7 | 1.5-7.6 | 148 | 78.6 | 0.5 | 2.8-9.6 |
| 60-74y | 774 | 70.2 | 2691 | 53.8 | 1.8 | 1.6-2.7 | 184 | 70.4 | 0.7 | 1.5-7.6 | 105 | 80.0 | 0.4 | 2.4-11.5 |
| Women | 724 | 70.2 | 2136 | 54.5 | 1.8 | 1.6-2.7 | 122 | 76.1 | 0.7 | 1.5-7.6 | 96 | 80.0 | 0.4 | 2.4-11.5 |
| Total | 1503 | 70.2 | 4827 | 53.8 | 1.8 | 1.6-2.7 | 306 | 70.4 | 0.7 | 1.5-7.6 | 101 | 80.0 | 0.4 | 2.4-11.5 |

CI = confidence interval; OR = odds ratio.
* Odds ratios derived from logistic regressions, adjusted for gender, age group, and gender X age group.
FIG 1. Systolic blood pressure by body mass index (BMI) and age (adjusted for sex). All patients includes patients that are either uninitiated (normal or high blood pressure) and patients receiving antihypertensive treatment.

FIG 2. Proportion of hypertensive patients by body mass index (BMI) in different age groups. Patients either have elevated blood pressure (>140/90 mm Hg) or are receiving antihypertensive medication.
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References