

BMJ Open Impact of primary care nursing workforce characteristics on the control of high-blood pressure: a multilevel analysis

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ABSTRACT

Objective: To determine the impact of Primary Health Care (PHC) nursing workforce characteristics and of the clinical practice environment (CPE) perceived by nurses on the control of high-blood pressure (HBP).

Design: Cross-sectional analytical study.

Setting: Administrative and clinical registries of hypertensive patients from PHC information systems and questionnaire from PHC nurses.

Participants: 76 797 hypertensive patients in two health zones within the Community of Madrid, North-West Zone (NWZ) with a higher socioeconomic situation and South-West Zone (SWZ) with a lower socioeconomic situation, and 442 reference nurses. Segmented analyses by area were made due to their different socioeconomic characteristics. Primary outcome measure: Poor HBP control (adequate figures below the value 140/90 mm Hg) associated with the characteristics of the nursing workforce and self-perceived CPE.

Results: The prevalence of poor HBP control, estimated by an empty multilevel model, was 33.5% (95% CI 31.5% to 35.6%). In the multilevel multivariate regression models, the perception of a more favourable CPE was associated with a reduction in poor control in NWZ men and SWZ women (OR=0.99 (95% CI 0.98 to 0.99)); the economic immigration conditions increased poor control in NWZ women (OR=1.53 (95% CI 1.24 to 1.89)) and in SWZ, both men (OR=1.89 (95% CI 1.43 to 2.51)) and women (OR=1.39 (95% CI 1.09 to 1.76)). In all four models, increasing the annual number of patient consultations was associated with a reduction in poor control (NWZ women: OR=0.98 (95% CI 0.98 to 0.99); NWZ men: OR=0.98 (95% CI 0.97 to 0.99); SWZ women: OR=0.98 (95% CI 0.97 to 0.99); SWZ men: OR=0.99 (95% CI 0.97 to 0.99)).

Conclusions: A CPE, perceived by PHC nurses as more favourable, and more patient–nurse consultations, contribute to better HBP control. Economic immigration condition is a risk factor for poor HBP control. Health policies oriented towards promoting positive environments for nursing practice are needed.

Strengths and limitations of this study

- This is the largest study in Spain to determine how the characteristics of the Primary Health Care nursing workforce, including the self-perceived working environment, exert influence on the control of high-blood pressure of adult patients.
- The cross-sectional and observational nature of the study limits the establishment of causal relationships, but the analytical approach, linked to the fact that the vast majority of independent variables are temporarily located prior to the outcome variable, minimises such limitation. Anyhow, future longitudinal analytical and experimental studies are necessary to confirm a few of the outcomes.
- The utilisation of documental sources can lead to information bias, although the current information systems, such as the ones used in this study, are demonstrating good validity and consistency as a source of information on epidemiological studies.

INTRODUCTION

The results on the health of the population are influenced by multiple factors, among which the healthcare system is an intermediate determinant and, within it, the actions of healthcare professionals.¹ Any healthcare system is not solely sustained by medical assistance, but also depends in a determinant manner on the care given by nursing staff.² In recent times, studies have been made on nursing staff characteristics, from the viewpoint of their impact on patients' health results, such as mortality, adverse effects or avoidable complications.^{3–6} Most of these studies have been conducted in the hospital environment, while only Griffiths *et al*^{7 8} performed their study in Primary Health Care (PHC) where they found better results with

regard to control of chronic diseases where the user/nurse ratio was more favourable, that is to say, when the number of users assigned to each nurse was smaller.

Moreover, evidence points to the practice environment as one of the variables with the greatest impact on the quality of care, with clear repercussions on health results, such as mortality, average hospital stay and patient satisfaction.^{9–11} This construct was defined by Lake¹² in 2002 as the set of organisational characteristics at the workplace that hinder or aid professional practice.

Factors inherent to progress (ageing, obesity and unhealthy lifestyles) are contributing to an increasing prevalence of high-blood pressure (HBP),^{13–14} which is becoming one of the principal reasons for consultation in PHC. According to the latest National Health Survey 2011–2012, a rise in chronic pathologies can be appreciated and 18.5% of the population suffers from hypertension.¹⁵ The chief objective of the treatment and control of HBP is to reduce cardiovascular morbimortality associated with HBP.^{16–17}

Regarding the impact on health of Primary Care nursing, in the review by Keleher *et al*,¹⁸ the results observed when the care was provided by nurses were similar to when such care was provided by physicians, except in relation to the acquisition of knowledge, adherence to treatment and user satisfaction, in which areas the results were more favourable for nurses. Recent works, which examine the nurse's role as leader in monitoring patients with HBP (with major responsibility, with possibility of prescribing or adjusting treatment in concordance with guidelines) as opposed to the traditional model (nurse as an assistant to the doctor), have shown better results in controlling HBP,^{19–21} and therefore an estimated reduction of up to 30% of the risk of cardiovascular events.¹⁹

In view of the above and owing to the absence of studies on PHC, the aim of this paper was to determine how the characteristics of the PHC nursing workforce, and the working environment as perceived by this professional group, impact on the control of HBP of adult patients.

METHODS

Design

A transversal analytical study, conducted in 2010, based on data obtained from Primary Care information systems and through the validated questionnaire Practice Environment Scale Nursing Work Index (PES-NWI).^{22–24}

Subjects

The original population was composed of all patients over 14 years diagnosed with HBP—128 193—at the 45 health centres in two health zones within the Community of Madrid, North-West Zone (NWZ), with a better socioeconomic situation, and South-West Zone (SWZ), with a worse socioeconomic situation; and the 507 nurses employed at these health centres and

referred to the said patients. The following were excluded:

Patients under 14 years of age (n=143), patients who had not registered any BP values in their clinic records in 2010 (n=44.295), those who had not identified the pair doctor–nurse (n=6.958). The patient population was finally established at 76 797. A further inclusion criterion was that nurses should have held their current post for at least 6 months (the final sample of nurses was 442).

All analyses were made separately in each zone due to their different socioeconomic situation.

Variables

Dependent variable

Poor HBP control (not adequate): patients were considered to be under adequate control when the systolic blood pressure (SBP) and diastolic blood pressure (DBP) (arithmetic mean of measurements in 1 year) were below the value 140/90 mm Hg.¹³

Independent variables

Patient variables: age; sex; economic immigration condition (to render this variable operable, the country of origin was taken into account; if this was without the Organisation for Economic Cooperation and Development, the patient was considered an economic immigrant). The variable time from diagnosis, despite its importance, could not be included due to the low reliability of these data in information systems.

Nursing staff variables: age; sex; contract type (permanent or temporary post); professional experience and experience in the current post (years); educational level (bachelors, higher degree in nursing or studies in other disciplines); professional category (clinical nurse and nurse manager); users/nurse ratio of the general population and patients over 65 years of age; average nursing consultations per day; patients' average nursing consultations per year; percentage of economic immigrant population within the assigned quota to each nurse; perception of the workplace climate through the questionnaire Practice Environment Scale Nursing Work Index (PES-NWI) validated for the Spanish environment and for Primary Care,^{22–24} which measures 31 items, grouped into five factors: Participation in Hospital affairs (maximum score 36), Nursing Foundations for Quality of Care (maximum score 40), Nurse Managers ability and support for nurses (maximum score 20), Staffing adequacy (maximum score 16), Nurse–physician Relationship (maximum score 12). The global score can range from 31 to 124. The procedure of questionnaires administration has been described previously.²⁵

Other study variables: users/physician ratio, proportion of patients with HBP whose hypertension is not measured at the centre (ie, they had not registered any BP values) (HBPnotM) (aggregate variable related to health centre), deprivation index (DI) per basic health zone (aggregate variable related to the geographic zone where the health centre is located), drawn from four

basic indicators in the 2011 census: manual workers, unemployment, temporary personnel and total insufficient training. This index allows the population's socioeconomic situation to be detected (the higher the score, the more unfavourable the situation). It has been built following the index methodology drawn up for the MEDEA project,^{26 27} and values were categorised in quartiles (Q1: most favourable socioeconomic situation).

Data analysis

First, a descriptive analysis was conducted (measure of central tendency and frequency distribution) of patient and nurse characteristics.

Multilevel logistic regression models were adjusted to estimate the prevalence of poor HBP control and to identify the patient and nurse characteristics that are associated with poor HBP control. The multilevel models are particularly appropriate when individuals clustered within groups and these groups share characteristics. To take into account this hierarchical structure, random effects terms are introduced into the model to estimate the effect of the different levels. Fixed effect variables can also be included.

In our models, the response variable was poor HBP control; the random effect variables were the health centre and the physician–nurse pair and the fixed effect variables were the patient and nurse characteristics as well as the group variables.

The prevalence rates of poor HBP were estimated by means of adjusting a multilevel logistic regression model without fixed effects (called 'empty model') and previously mentioned random effects: health centre and physician–nurse pair. For each health zone, prevalence rates were reported by sex and immigration status, with 95% CIs.

Subsequently, univariate multilevel regression models were adjusted for each fixed effect variable in order to explore its association with poor HBP control taking into account the hierarchical structure of the data. The variables with $p < 0.20$ were considered statistically significant and included in the multivariate analysis.

To select the final multilevel multivariate models, comparisons were made among models by means of the likelihood-ratio test. For each zone, the final multivariate model was also estimated for men and women separately, in order to understand the cultural construction of gender.^{28 29}

The random effect was quantified through the mean Median OR (MOR).³⁰ MOR can be interpreted as the increase (in median) in the odds to poor control of a patient if he or she changes from one group to another of higher risk. The random effect of the centre on slope of the PES-NWI variable was analysed. CIs were calculated with a confidence of 95%, considering a significance level of 0.05. For this analysis, the STATA V.12 statistical package was used.

RESULTS

Description of the population in the study

A total of 76797 subjects were studied. The participants' characteristics were: average age 65.9 years (SD 12.8); 55.4% were women; 4.9% were economic immigrants. 32.2% (95% CI 31.8% to 32.5%) had poor HBP control. Nurses: average age was 47.1 years (SD 10.3); 83% were women; average time in post was from 8.3 (SD 7.5) to 24 years (SD 10.5) regarding professional practice. In total 88.5% were clinical nurses; 76% had a permanent post and 82.2% held a bachelor's degree; the PES-NWI was responded to by 268 nurses (response rate: 60.6%); the average PES-NWI score was 81.2 (95% CI 79.2 to 8.4); the average users/nurse ratio was 2213.2 (SD 548.5); the ratio of patients over 65 years was 280.6 (SD 128.9); the average percentage of immigrant population per nurse was 8.5% (95% CI 7.9% to 9.1%); the average number of patient consultations per day was 16.18 (SD 3.0); the annual average number of consultations per patient with HBP was 7.3 (SD 7.0). We may highlight that in the SWZ there is no population in the Q1 in a better socioeconomic situation (table 1).

Control of HBP

Prevalence of poor HBP control

The prevalence of poor HBP control among the total population, estimated by means of a multilevel empty model, was 31.5% (95% CI 31.5% to 35.6%). By sex, 34.5% (95% CI 32.5% to 36.6%) of native men had poor control against 43.4% (95% CI 40.7% to 46.2%) of immigrant men and 31.4% (95% CI 29.5% to 33.4%) of native women against 39.9% (95% CI 37.4% to 42.7%) of immigrant women; all prevalences were calculated taking into account centre and physician–nurse pair as random effect variables. With regard to random effect variables, the centre variable obtained an MOR of 1.29, or 29% more (on average) of poor control if the patient changed centre, and for the physician–nurse pair variable an MOR of 1.51 was obtained, that is, 51% more of poor control if the patient changed pair, in both health zones (table 2).

Multilevel univariate analysis

In the multilevel univariate analysis, in the NWZ, poor HBP control decreased significantly ($p \leq 0.05$): with age; in women; when the nurse held a temporary contract; with the nurse's favourable perception of the environment; with higher rates of nursing consultations per day; with higher rates of patient consultations per year. However, the condition of being an economic immigrant; nurse's professional experience exceeding 20 years; being a nurse manager; older nurses; a higher ratio of patients over the age of 65 and a higher proportion of HBPnotM patients, all contributed to a significant increase ($p \leq 0.05$) in poor HBP control. In the SWZ: age; being a woman; higher general population ratio; higher PES-NWI score; higher rate of patient consultations per year and a deprivation index in the

Table 1 Sociodemographic characteristics of nurses and patients

Characteristics of nurses	n	Mean (SD)	(95% CI)	North-West Zone (NWZ)	South-West Zone (SWZ)
				Mean (SD)	Mean (SD)
Age (years)	260	47.1 (10.3)	(45.9 to 48.4)	48.6 (10.7)	45.09 (9.2)
Years of profession	257	24.1 (10.6)	(22.8 to 25.4)	25.4 (11.5)	22.2 (8.7)
Professional experience in the current post (years)	259	8.3 (7.5)	(7.4 to 9.3)	8.3 (7.9)	8.3 (7.005)
Users/ratio of patients over 65 years of age	442	280.6 (128.9)	(268.5 to 292.6)	304.5 (130.8)	247.0 (118.3)
Users/ratio of the population in general	442	2213.2 (548.5)	(2161.9 to 2264.5)	2358.8 (604.8)	2007.0 (370.6)
Average nursing consultations per day	435	16.2 (3.8)	(15.8 to 16.5)	14.7 (3.6)	18.2 (3.2)
Patients' average nursing consultations per year	419	7.3 (7.0)	(6.6 to 8.0)	6.7 (7.2)	7.9 (6.4)
Economic Immigrant population per nurse (%)	442	8.5 (6.3)	(7.9 to 9.1)	8.4 (5.7)	5.1 (2.9)
Summary scores of the factors and the global PES-NWI					
Nurse participation in hospital affairs	248	22.5 (5.3)	(21.9 to 23.2)	22.4 (5.3)	22.6(5.3)
Nursing foundations for quality of care	252	26.5 (5.2)	(25.8 to 27.1)	25.9 (5.5)	27.1(4.5)
Nurse manager ability and support for nurses	245	14.6 (4.5)	(14.0 to 15.2)	14.8 (4.6)	14.2 (4.2)
Staffing adequacy	258	9.6 (2.9)	(9.2 to 9.9)	10.07 (3.03)	8.8 (2.5)
Nurse-doctor relationship	268	8.3 (2.1)	(8.0 to 8.5)	8.4 (2.09)	8.05 (2.1)
Total score	213	81.3 (15.4)	(79.2 to 83.4)	81.2 (16.1)	81.2 (14.4)
		Per cent	(95% CI)	Per cent	Per cent
Sex					
Woman	217	82.8	(78.2 to 87.4)	86.6	77.68
Man	47	17.18	(12.57 to 21.77)	13.33	22.32
Employment status					
Permanent post	191	76.1	(70.7 to 81.4)	72.03	81.4
Temporary post	60	23.9	(18,6 to 29,2)	27.9	18.5
Educational level					
Bachelor's degree	213	82.24	(77.55 to 86.92)	77.85	88.18
Higher degree	15	5.79	(2.92 to 8.65)	8.72	1.82
Professional category					
Clinical nurse	225	88.6	(84.64 to 92.52)	88.2	88.9
Nurse manager	254	11.4	(7.47 to 15.35)	11.7	11.01
Characteristics of patients					
		Mean (SD)	(95% CI)	Mean (SD)	Mean (SD)
Age (years)	76 797	65.9 (12.8)	(65.8 to 66.0)	68.05 (13.003)	64.39 (12.5)
		Per cent	(95% CI)	Per cent	Per cent
Age group					
14–64	34 331	44.7	(44.3 to 45.0)	31.167 (n)	45.628 (n)
65+	42 466	55.3	(54.9 to 55.6)	37.3	49.7
Sex					
Man	34 273	44.6	(44.2 to 45.0)	62.6	50.2
Woman	42 524	55.3	(55.0 to 55.7)	31.169 (n)	45.628 (n)
				44.8	44.4
				55.1	55.5

Continued

Table 1 Continued

Characteristics of nurses	n	Mean (SD)	(95% CI)	North-West Zone (NWZ)	South-West Zone (SWZ)
				Mean (SD)	Mean (SD)
Economic immigration condition	75 834			30.605 (n)	45.229 (n)
No	72 120	95.1	(94.9 to 95.2)	93.07	96.4
Yes	3714	4.9	(4.7 to 5.0)	6.9	3.5
Poor high-blood pressure control	76 797			31.169 (n)	45.628 (n)
No	52 090	67.8	(67.5 to 68.15)	64.3	70.2
Yes	24 707	32.1	(31.8 to 32.5)	35.6	29.7
Other study variables		Mean (SD)	(95% IC)	Mean (SD)	Mean (SD)
Users/physician ratio	76 797	1579.3 (255.7)	(1575.5 to 1581.1)	1795.1 (237.8)	1431.9 (133.7)
Patients with HBP not measured by centres (%)	76 797	34.08 (13.8)	(33.9 to 34.1)	47.9 (10.8)	24.6 (4.4)
Deprivation Index				-1.01 (0.59)	0.7 (0.5)
Quartile 1*	18 269	-1.46 (0.27)		-1.46 (0.27)	
Quartile 2	15 707	-0.40 (0.18)		-0.44 (0.18)	-0.28 (0.42)
Quartile 3	12 261	0.22 (0.19)		0.23 (0)	0.22 (0.19)
Quartile 4	30 560	1.06 (0.20)		0.84 (0)	1.07 (0.20)

*Quartile 1 (better socioeconomic situation), in SWZ no values for this quartile.
HBP, high-blood pressure; PES-NWI, Practice Environment Scale of the Nursing Work Index.

Table 2 Prevalence of poor high-blood pressure (HBP) Control according to place of origin, sex and health zone

	Total Population			North-West Zone			South-West Zone		
	Men Prev (%) (95% CI)	Women Prev (%) (95% CI)	Total Prev (%) (95% CI)	Men Prev (%) (95% CI)	Women Prev (%) (95% CI)	Total Prev (%) (95% CI)	Men Prev (%) (95% CI)	Women Prev (%) (95% CI)	Total Prev (%) (95% CI)
Immigrant	43.44 (40.73 to 46.20)	39.99 (37.37 to 42.67)	33.54 (31.54 to 35.60)	46.27 (43.21 to 49.25)	42.76 (39.88 to 45.68)	36.30 (34.0004 to 27.03)	39.10 (35.89 to 42.41)	35.78 (32.70 to 38.97)	29.49 (38.67 to 32.08)
Native	34.54 (32.54 to 36.60)	31.40 (29.50 to 33.36)		37.20 (34.89 to 39.57)	33.95 (31.74 to 36.22)		30.64 (28.17 to 33.23)	27.71 (25.39 to 30.15)	
Random effects:									
Centre (Varianza/MOR)	0.06949/1.28		0.0756/1.29	0.045/1.22		0.0495/1.23	0.0499/1.23		0.0528/1.24
Physician-nurse pair (Varianza/MOR)	0.1869/1.51		0.1870/1.51	0.162/1.46		0.1618/1.46	0.2101/1.54		0.2104/1.54

MOR, median OR.

Table 3 OR of poor high-blood pressure control according to Univariate analysis by health Zone and Sex*

	North-West Zone (NWZ)				South-West Zone (SWZ)			
	n	OR	p Value	(95% CI)	n	OR	p Value	(95% CI)
Patient variables				(LI-LS)				(LI-LS)
Age	31 169	0.99	0.05†	(0.99 to 1.00003)	45 628	0.99	0.00†	(0.99 to 0.99)
Sex‡ (women)	31 169	0.89	0.00†	(0.85 to 0.94)	45 628	0.85	0.00†	(0.82 to 0.89)
Economic immigrant condition	30 605	1.26	0.00†	(1.14 to 1.38)	45 229	1.73	0.00†	(1.53 to 1.90)
Nursing staff Variables								
Sex‡ (women)	18 217	1.06	0.60	(0.85 to 1.32)	27 960	0.98	0.86	(0.81 to 1.19)
Professional experience (years)§	18 228				26 960			
11–20		1.04	0.74	(0.82 to 1.33)		1.14	0.32	(0.87 to 1.48)
Over 20		1.25	0.04†	(1.02 to 1.55)		1.37	0.00†	(1.08 to 1.72)
Professional category¶ (nurse manager)	17 414	1.18	0.13†	(0.95 to 1.46)	27 268	0.85	0.22†	(0.66 to 1.10)
Contract type** (temporary post)	17 505	0.86	0.05†	(0.74 to 0.99)	26 730	0.82	0.07†	(0.67 to 1.07)
Educational level††	18 171				27 511			
Higher degree in nursing		0.98	0.87	(0.77 to 1.25)		0.66	0.14	(0.38 to 1.15)
Studies in other disciplines		1.05	0.67	(0.85 to 1.29)		1.09	0.48	(0.84 to 1.43)
Age	18 149	1.01	0.01†	(1.001 to 1.02)	26 998	1.02	0.00†	(1.01 to 1.02)
Users/ratio of the general population	31 169	1.00004	0.45	(0.9900 to 1.0001)	45 628	0.99	0.00†	(0.99 to 0.99)
Users/ratio of patients over 65 years of age	31 169	1.0003	0.15†	(0.9900 to 1.001)	45 628	1.001	0.21†	(0.99 to 1.001)
Summary score of global PES-NWI	15 538	0.99	0.01†	(0.99 to 0.99)	22 176	0.99	0.02†	(0.98 to 0.99)
Average nursing consultations per day	31 169	0.98	0.02†	(0.96 to 0.990)	43 895	0.98	0.19†	(0.96 to 1.01)
Patients' average nursing consultations per year	28 627	0.98	0.00†	(0.98 to 0.99)	44 449	0.98	0.00†	(0.97 to 0.98)
Economic immigrant population per nurse (%)	31 169	1.05	0.91	(0.42 to 2.62)	45 628	0.76	0.78	(1.14 to 5.09)
Global group variables								
Users/physician ratio	31 169	0.99	0.78	(0.78 to 0.99)	45 628	0.99	0.28†	(0.99 to 1.0002)
Proportion of patients with HBP not measured by centres	31 169	2.53	0.02†	(1.13 to 5.66)	45 628	4.30	0.17†	(0.52 to 3.52)
Deprivation index by quartiles‡‡	31 169				45 628			
Quartile 2	1.968	1.006	0.94	(0.81 to 1.23)	1.072			
Quartile 3	22	1.3	0.38	(0.71 to 2.37)	3.442	0.64	0.01†	(0.46 to 0.88)
Quartile 4	39	1.2	0.51	(0.67 to 2.19)	8.973	0.83	0.22†	(0.62 to 1.11)

*LR test versus Logistic regression, p=0.000 for random effect variables (Health Centre and the doctor–nurse Pair, in all models).

†Significant p≤0.2.

‡Reference category: men.

§Reference category: 3–10 years.

¶Reference category: clinical nurse.

**Reference category: permanent post.

††Reference category: bachelor's degree.

‡‡Reference category: quartile 1 (better socioeconomic situation) in NWZ & Quartile 2 in SWZ.

quartile 3, significantly reduced ($p \leq 0.05$) poor HBP control. However, the condition of being an immigrant; nurse's professional experience exceeding 20 years; older nurses; and a higher proportion of HBPnotM, all contributed to a significant increase ($p \leq 0.05$) in poor HBP control (table 3).

Multilevel multivariate models

In the multilevel multivariate model for men in NWZ, the variables that remained significant ($p \leq 0.05$), with a protective effect (reduction of poor HBP control), were: age of the patient (OR: 0.99; 95% CI 0.98 to 0.99); perceived working environment (OR: 0.99; 95% CI 0.98 to 0.99), average patient consultations per year (OR: 0.98; 95% CI 0.97 to 0.98), deprivation index (OR: 0.34; 95% CI 0.13 to 0.88). Nevertheless, the following showed a risk effect (increase in poor HBP control): being a nurse manager (OR: 1.41; 95% CI 1.007 to 1.46) and a higher proportion of HBPnotM patients (OR: 5.31; 95% CI 1.58 to 17.83). With respect to random effect variables, the physician–nurse pair obtained an MOR of 1.43, that is, on average, 43% more of poor control if the patient changed to another physician–nurse pair. In the case of women, the number of patient consultations per year had a protective effect (OR: 0.98; 95% CI 0.97 to 0.99) and age proved to have a risk effect (OR: 1.01; 95% CI 1.007 to 1.01), as did being an immigrant (OR: 1.53; 95% CI 1.24 to 1.89) and the patient being a nurse manager (OR: 1.35; 95% CI 0.97 to 1.88). The centre random effect variable obtained an MOR of 1.14, and the physician–nurse pair obtained an MOR of 1.41 (table 4).

In the multilevel multivariate model for men in SWZ, a protective effect was shown by patient age (OR: 0.98; 95% CI 0.98 to 0.99); number of patient consultations per year (OR: 0.98; 95% CI 0.97 to 0.99), the deprivation index (OR: 0.60; 95% CI 0.40 to 0.90): and a risk effect was seen in being an immigrant (OR: 1.89; 95% CI 1.43 to 2.51) and having between 11 and 20 years' work experience (OR: 1.65; 95% CI 1.42 to 2.62). MOR obtained from the physician–nurse pair variable was 1.45. As for women, a protective effect was gained from the nurses' perception of the working environment (OR: 0.98; 95% CI 0.98 to 0.99), patient average number of consultations per year (OR: 0.98; 95% CI 0.97 to 0.99), deprivation index (OR: 0.55; 95% CI 0.32 to 0.97); and a risk effect was caused by: patient age (OR: 1.005; 95% CI 1.001 to 1.009) and being an immigrant (OR: 1.39; 95% CI 1.09 to 1.76). MOR obtained for the centre and physician–nurse pair random variables was 1.15 and 1.62, respectively (table 5).

The analysis of centre random effect on slope of the PES-NWI variable was not statistically significant.

DISCUSSION AND CONCLUSIONS

In total 33.54% of the HBP patient population had poor control. Prior studies have shown poorer degrees of

control than in this work; it must be underlined that in these studies the general population is analysed and samples also include people with HBP who had not been diagnosed before and therefore had not been monitored.^{31 32}

Moreover, a working environment perceived as more favourable by nurses, and patients with HBP having more consultations with a nurse, are factors that contribute to keeping a better control of the disease. Working environment quality has been an important focus in health research, as there is evidence that it is directly or indirectly associated with professionals, patients and results within health organisations.^{4 9 11}

This study shows that when the average nursing consultation per year was increasing, the poor control of hypertension was decreasing. In the interpretation of these results, and taking into account the transversal nature of the study, we must consider the possibility of 'inverse care' consisting in giving more attention to those who demand more attention and who may be patients whose blood pressure data are better than others who are in need of closer attention and whose HBP data are poorer. Diverse clinical tests on the impact of nursing care on controlling hypertension in which good results are yielded^{20 33} may lead us to believe that the greater the number of consultations with the nurse, the greater the control over HBP figures, thanks to the nurse's influence in changing the patient's lifestyle. In any case, consolidation of these findings will require further longitudinal studies.

Regarding other variables relating to the characteristics of nursing staff, the following proved significant in the multilevel univariate analysis: age, professional experience, contract type, professional category, workload (nursing consultations per day), users/nurse ratio for all users and users over 65. However, most of them lost their statistical significance in the multilevel multivariate analysis, including users/nurse ratio. These results do not coincide with other studies carried out in the hospital setting^{3–6} and the work performed in PHC by Griffiths,⁷ where the users/nurse ratios were far higher than in this work. Also, it is striking to note that the older age of nurses contributes to poorer control. This finding has been reported previously in other studies in Spain, in Hospital and Primary Health Care.^{34 35} Senior staff reflect a poorer perception of its working environment, as well as a reduced ability to incorporate evidence into clinical practice. These contradictory results could be explained by the lack of a professional career which encourages nurses to make progress on their own development, and consequently a progressive professional exhaustion could contribute to this perception. Additionally, younger professionals are more likely to have received a pregrade education on evidence-based practice.

The results presented here underline the impact of nurses on health and the effects of their surveillance activities and monitoring of chronic diseases such as

Table 4 Poor high-blood pressure control according to multivariate multilevel logistic regression models in North-West Zone by sex*

Variables	Global model		Model for men		Model for women	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex of patient† (women)	0.90‡	(0.83 to 0.97)				
Patient age	1.0024	(0.9900 to 1.0058)	0.99‡	(0.98 to 0.99)	1.01‡	(1.0007 to 1.01)
Economic immigrant condition	1.25‡	(1.07 to 1.46)	1.04	(0.82 to 1.33)	1.53‡	(1.24 to 1.89)
Professional experience (years)§						
11–20	0.93	(0.67 to 1.28)	0.78	(0.54 to 1.12)	1.04	(0.73 to 1.49)
Over 20	1.24	(0.79 to 1.95)	0.95	(0.57 to 1.58)	1.44	(0.86 to 2.41)
Contract type¶ (temporary post)	1.06	(0.83 to 1.37)	1.12	(0.84 to 1.48)	1.01	(0.77 to 1.34)
Professional category** (nurse manager)	1.36‡	(1.02 to 1.82)	1.41‡	(1.007 to 1.46)	1.36	(0.97 to 1.88)
Nurse age	0.99	(0.98 to 1.01)	1.01	(0.99 to 1.02)	0.99	(0.98 to 1.01)
Ratio of patients over 65 years of age	0.99	(0.999 to 1.0003)	0.99	(0.99 to 1.0002)	0.99	(0.99 to 1.003)
Summary score of global PES-NWI	0.99	(0.99 to 1.001)	0.99‡	(0.98 to 0.99)	0.99	(0.99 to 1.00 004)
Average nursing consultations per day	0.99	(0.97 to 1.03)	1.01	(0.98 to 1.05)	0.99	(0.95 to 1.02)
Patients' average nursing consultations per year	0.98‡	(0.97 to 0.99)	0.98‡	(0.97 to 0.98)	0.98‡	(0.98 to 0.99)
Users/physician ratio	0.99	(0.99 to 1.0002)	0.99	(0.99 to 1.0001)	0.99	(0.99 to 1.0002)
Deprivation index by quartiles††						
Quartile 2	0.83	(0.65 to 1.07)	0.77‡	(0.61 to 0.99)	0.87	(0.66 to 1.14)
Quartile 3	0.51	(0.23 to 1.13)	0.34‡	(0.13 to 0.88)	0.65	(0.27 to 1.53)
Quartile 4	0.40‡	(0.16 to 0.97)	0.41	(0.13 to 1.34)	0.39‡	(0.15 to 1.03)
Proportion of patients with HBP not measured by centres	3.52	(1.06 to 11.6)	5.31‡	(1.58 to 17.83)	3.07‡	(0.84 to 11.16)
Random effect variables						
Centre (var/MOR)		0.017/1.13‡‡		≈0/1		0.019/1.14‡‡
Physician–nurse pair (var/MOR)		0.13/1.42‡‡		0.14/1.43‡‡		0.13/1.41‡‡

*LR test versus Logistic regression.

†Reference category: men.

‡Significant $p \leq 0.05$.

§Reference category: 3–10 years of profession.

¶Reference category: permanent post.

**Reference category: clinical nurse.

††Reference category: quartile 1 (better socioeconomic situation).

‡‡ $p = 0.000$ for random effect variables (Health Centre and the physician–nurse pair, in all models).

HBP, high-blood pressure; MOR, median OR; var, variance.

Table 5 Poor high-blood Pressure control according to multivariate multilevel logistic regression models in South-West Zone by sex*

	Global model		Model for men		Model for women	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex of patient† (woman)	0.86‡	(0.80 to 0.92)				
Patient age	0.99	(0.99 to 1.00)	0.99‡	(0.98 to 0.99)	1.005‡	(1.001 to 1.01)
Economic immigrant condition	1.55‡	(1.29 to 1.85)	1.89‡	(1.43 to 2.51)	1.39‡	(1.09 to 1.76)
Professional experience (years)§						
11–20	1.51	(0.90 to 2.53)	1.66‡	(1.04 to 2.62)	1.47	(0.81 to 2.65)
Over 20	1.50	(0.77 to 2.93)	1.80	(0.97 to 3.32)	1.34	(0.62 to 2.90)
Professional category¶ (nurse manager)	0.97	(0.70 to 1.34)	0.88	(0.64 to 1.20)	0.98	(0.67 to 1.44)
Contract type** (temporary post)	1.33	(0.78 to 2.27)	1.36	(0.85 to 2.18)	1.30	(0.70 to 2.42)
Educational level††						
Higher degree	0.83	(0.34 to 2.00)	0.85	(0.36 to 1.99)	0.73	(0.26 to 2.05)
Studies in other disciplines	1.03	(0.68 to 1.55)	1.03	(0.74 to 1.43)	1.03	(0.66 to 1.60)
Nurse age	1.01	(0.98 to 1.04)	0.99	(0.97 to 1.03)	1.01	(0.97 to 1.04)
Users/ratio of the general population	0.99	(0.99 to 1.0004)	0.99	(0.99 to 1.0003)	1.00008	(0.99 to 1.0006)
Users/ratio of patients over 65 years of age	1.0004	(0.99 to 1.002)	1.00010	(0.99 to 1.001)	1.001	(0.99 to 1.003)
Summary score of global PES-NWI	0.99	(0.99 to 1.001)	0.990	(0.99 to 1.004)	0.99‡	(0.98 to 0.99)
Average nursing consultations per day	1.02	(0.98 to 1.05)	1.01	(0.98 to 1.05)	1.01	(0.97 to 1.05)
Patients' average nursing consultations per year	0.99‡	(0.98 to 0.99)	0.99‡	(0.97 to 0.99)	0.98‡	(0.97 to 0.99)
Users/physician ratio	0.99	(0.99 to 1.001)	0.99	(0.990 to 1.0004)	0.99	(0.99 to 1.0008)
Deprivation index by quartiles‡‡						
Quartile 3	0.55‡	(0.35 to 0.85)	0.49	(0.33 to 0.73)	0.56‡	(0.32 to 0.97)
Quartile 4	0.68	(0.43 to 1.07)	0.60‡	(0.40 to 0.91)	0.73	(0.42 to 1.27)
Proportion of patients with HBP not measured by centres	18.72	(0.67 to 525.74)	7.20	(0.38 to 136.35)	30.18	(0.53 to 1714.36)
Random effect variables						
Centre (var/MOR)		0.009/1.09§§		≈0/1		0.023/1.15§§
Physician-nurse pair (var/MOR)		0.21/1.55§§		0.15/1.45§§		0.26/1.62§§

*LR test versus Logistic regression.

†Reference category: men.

‡Significant $p \leq 0.05$.

§Reference category: 3–10 years of profession.

¶Reference category: clinical nurse.

**Reference category: permanent post.

††Reference category: bachelor's degree.

‡‡Reference category: quartile 2. in SWZ there were not individuals in Quartile 1 (better socioeconomic situation).

§§ $p=0.000$ for random effect variables (Health Centre and the physician–nurse pair, in all models).

MOR, median OR; PES-NWI, Practice Environment Scale of the Nursing Work Index; var, variance.

hypertension, given that the time dedicated to each patient may prove essential to enabling therapeutic communication. Recent studies have shown the efficiency of a nurse-led clinic as opposed to usual care on reduction in HBP figures in the general population³³ and the immigrant population suffering from HBP without control.²⁰ Moreover, Clark *et al*¹⁹ conducted a systematic review and meta-analysis of trials on nursing intervention in the control of patients with HBP, in which they found that a nurse-led intervention reduces 3 mm Hg in SPB and 4 mm Hg in DBP, which in turn translated into a reduction of up to 30% in cardiovascular events.

It must be highlighted that major differences exist in the prevalence of poor HBP control among men and women, both among natives and in the immigrant population, the highest levels occurring among men. Being a woman is associated with up to 14% lower risk in the SWZ (worse socioeconomic level). This is consistent with the findings from other works in the Spanish context,^{32–36} which imply the need to seek more effective actions to control hypertension in men, grounded on studies that identify the factors leading to poor hypertension control in men.

The condition of being an economic immigrant, moreover, raises the likelihood of poor HBP control for men in the SWZ up to 89%. Aerny *et al*,³⁷ who studied the health of the immigrant population in the Community of Madrid, pointed to HBP screening below the recommended standards, especially among men (16% less); likewise, the immigrant population with shorter terms of residence made less frequent visits to the health services than did the native population. Palacios-Soler *et al*³⁸ studied the differences in the degree of control of HBP among the immigrant and native populations, and found that fewer diagnostic tests were conducted on immigrants and that the pharmacological treatment they received was inferior to that administered to the native population.

Among the results from random effect variables, it is especially significant that an average increase is observed of poor HBP control, reaching up to 15% if the patients receive care at one or another health centre and up to 62% depending on the physician–nurse pair treating them. Multilevel analyses in health sciences are becoming increasingly more numerous as it is recognised that health results are conditioned by the variability in healthcare structures and in health professionals. Fuste and Rue³⁹ applied multilevel analysis to the differences in the performance of preventive activities among PHC teams, and found that variability existed among these PHC teams that was not explained by individual characteristics, and that was associated in part with the workload of the team.

One of the strengths of this study is that it includes socioeconomic variables such as the deprivation index or the percentage of the immigrant population per nurse, which undoubtedly has an impact on the care given to the population.⁴⁰ This study shows that under worse socioeconomic conditions, the HBP figures are

better; this finding is contrary to what is described in the literature, pointing to an increase in blood pressure to lower socioeconomic status.⁴¹ However, in our context, the frequency of consultations made in PHC is higher in manual workers or people with smaller incomes while people with high incomes tend to use private health-care,^{42–43} which could explain the data. As limitations, should be noted that the cross-sectional and observational nature of the study, limits establishing causal relationships; however, the analytical approach, linked to the fact that the vast majority of independent variables are temporarily located prior to the outcome variable, minimises the aforementioned limitation. To collect the data from the questionnaire PES-NWI, it was an essential requisite that the nurse had a postoccupancy, with the same quota of patients, for more than 6 months. Since the questionnaire was administered in the period from June to October, we could guarantee, in part, that the findings could be due to the nurse's performance. In addition, it should be noted that the structure of the PHC system in Spain is characterised by the allocation of professionals, like the nurse, to each patient, ensuring continuity of care, and would, at least partially, attribute the impact of the professional on the patient. Anyway, future longitudinal analytical and experimental studies are necessary. On the other hand, the use of documentary sources can lead to information bias, although the current information systems, such as the ones used in this study, are demonstrating good validity and consistency to be used as a source of information on epidemiological studies.^{44–45} Finally, it may happen that the index of deprivation, which is not a single variable but is centre aggregated, could lead us into an ecological fallacy, so it requires further research to deepen this issue.

The current situation requires that nurses move towards taking a leading role in PHC, owing to the increase in age and chronic conditions among the population. This study provides evidence of the roles played by Primary Care nurses and the impact they have on patients' health. A working environment perceived by Primary Care nurses as more favourable contributes to better HBP control. It is fundamental to promote a favourable organisational climate in order to achieve better health results.

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