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Differences in knowledge of hypertension by age, gender, and blood pressure self-measurement among the Israeli adult population☆

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ABSTRACT

Background: Hypertension (HTN) is the most important risk factor for death and disability worldwide. Hypertensive patients' HTN knowledge was shown to be associated with control of HTN. Understanding factors affecting HTN knowledge might help control HTN.
Objectives: To examine differences in HTN knowledge by age, gender, ethnicity, years of education and whether HTN was diagnosed, and to explore whether HTN knowledge is affected by self-measurement of blood pressure (BP), in Israel's general population.
Methods: A cross-sectional, descriptive, correlational design was used. A convenience sample of 430 Israeli adults, sampled in community centers across Israel, in four age groups (18–34, 35–49, 50–64, and above 64) were interviewed by 17 registered nurses, using a structured questionnaire with open-ended questions, during March 2017 and March 2018. ANOVA and chi-square tests for assessing differences between age groups in sociodemographic characteristics and BP measurement were used. Factors predicting knowledge of various HTN aspects and total HTN knowledge were explored by logistic and ordinal regression analyses.
Results: Older participants, those with more years of education, and those who self-measured blood pressure had better knowledge of particular aspects of HTN and higher total HTN knowledge. Women had greater knowledge of normal systolic and diastolic BP.
Conclusions: Higher age, more years of education, and blood pressure self-measurement were associated with higher total HTN knowledge. The attention of health authorities should be drawn to improving HTN knowledge among younger adults, and to including blood pressure self-measurement in the regular practices of the general population.

Introduction

HTN is the most important risk factor for death and disability worldwide,[1] during 2013–2015 being among the 20 leading causes of death in Israel's general population and among the 10 leading causes of death among 65–74 year old Israelis.[2] During 2000–2014, the age adjusted mortality rate due to HTN in Israel was 1.9 times higher than in 15 European Union countries.[3] According to the Israeli National Health Interview Survey-3 (INHIS-3), self-reported HTN prevalence among adults increased from 15.4% in 2003 to 20.6% in 2015.[4]

Previously, HTN control was shown to be associated with hypertensive patients' HTN knowledge. Better HTN knowledge was associated with controlling HTN among hypertensive patients in China.[5] Among hypertensive patients in Poland, a high level of HTN knowledge was among the factors predicting medication adherence.[6] American hypertensive patients with low HTN knowledge were less likely to reduce their salt intake and eat less to lose weight, compared to patients with high HTN knowledge.[7] Patients' beliefs about HTN management, their knowledge of hypertension and its management and physician counseling on a healthy lifestyle had an independent effect on compliance with recommended lifestyle behaviors among hypertensive patients in Israel.[8]

Previous research has demonstrated that HTN knowledge levels vary between individuals of different ages and between men and women. Among Turkish adults, the mean knowledge scores of HTN drug compliance, HTN complications, and total HTN knowledge were lower in individuals aged sixty years and older, compared to younger adults.[9] Among Iranian hypertensive patients aged 30 and older, participants aged 30–39 had the highest levels of hypertension knowledge.[10] Jordanian women showed higher levels of knowledge regarding the definition and complications of HTN, compared to men.[11] Similarly, among middle-aged participants in Japan, women demonstrated higher hypertension knowledge than men.[12]

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HTN knowledge has been shown to be affected by self-measurement of BP. Among HTN patients, self-measurement of BP increased HTN knowledge and empowered them to make changes to improve their BP.[13] Self-monitoring of BP improved patients' knowledge and understanding of BP, and gave them a confidence to take control of their own care by self-titration of antihypertensive medication.[14]

In recent years, nationwide campaigns have been launched in Israel, aimed at changing behavior by increasing population health knowledge and awareness. The Neeman Association for Stroke Survivors led a media campaign aimed at increasing knowledge of stroke signs and symptoms to encourage people with suspected stroke go to the hospital immediately.[15] The Israeli National Transplant Center led a media campaign to increase population awareness of the priority in organ allocation granted to those who sign an organ donor card.[16] Despite the sharp increase in HTN prevalence in Israel during the last decade and a half, no media campaigns aimed at increasing general population's HTN knowledge, similar to those mentioned above, were held in Israel. Heymann et al. (2011) demonstrated that 57% of hypertensive patients in Israel reportedly received explanation from their physician regarding HTN risks and complications and 24% received explanation on how to measure BP.[8] No studies were found to examine actual HTN knowledge of the general public in Israel.

The purpose of the current study was to examine the effect of age, gender, and self-measurement of BP on HTN knowledge among the adult population in Israel.

Methods

Study design and research population

The study, approved by the Tel Aviv University ethics committee, was conducted at the Nursing Department of Tel Aviv University. A cross-sectional, descriptive correlational design was used. The study included 430 Israelis 18 years old or older whose professional occupation was not connected to the medical field (were not physicians, nurses, or had any other medical profession). The participants were recruited as a convenience sample in community centers in different geographical areas of Israel. Community centers are designed for informal education and cultural activities and constitute a central axis for the social and communal activities of community and neighborhood residents. A short explanation regarding the purpose of the study was given to the participants and signed informed consent was obtained.

Data collection

Data were collected from March 2017 to March 2018. Personal interviews were conducted by seventeen registered nurses, who were students in Master's degree nursing program and were trained by the author for this purpose.

One of the students' tasks in the Clinical Research course in the Masters in Nursing program at Tel Aviv University was to interview a convenience sample of 25 respondents each. During two training meetings, nurses were instructed by the author how to conduct the interview. The nurses asked participants open-ended questions that contained no professional terminology. The questionnaire included open questions on knowledge of systolic and diastolic BP values, HTN signs and symptoms, risk factors, why it is important to prevent HTN, questions regarding BP measurement and demographic characteristics. The nurses were given a list of correct answers for each item, to assist them in reporting the responses. A score of 1 was given for a correct answer and 0 for an incorrect answer.

Questions were supposed to be comprehensible to the interviewees capable of understanding ordinary native speech and carrying out an exchange of ideas. Participants were encouraged to ask the nurse if the question was unclear. During the training meetings, a list of possible answers expected from participants with different levels of knowledge for each item was supplied to the nurses, to assist them in correctly reporting the responses.

Each nurse interviewed 25–26 participants. On average, each interview lasted 25 to 30 min.

Variables and measures

The structured questionnaire was comprised of two parts: The first part examined the prevalence of chronic diseases, among them HTN, whether, when, and by whom BP was measured, and participants' sociodemographic characteristics (Appendix A, Part 1). It was based on the questionnaire previously used in INHIS-3 by the Israel Center for Disease Control.[4]

The second part examined participants' knowledge about HTN (Appendix A, Part 2). Most instruments used in the past to assess individuals' knowledge about HTN used a correct/incorrect response format, however valid and easy to use assessment tools are scarce.[17] Moreover, no valid and reliable instruments were found in Hebrew. Previously, Magadza et al. (2009) and Lima et al. (2015) used interviews with open-ended questions, with no prompts, to examine HTN knowledge among hypertensive patients.[18,19] Concerning stroke, open-ended questions were previously used by Hickey (2012) and by Melnikov et al. (2017) to examine stroke knowledge.[20,21] Stroke knowledge was defined as being able to list two or more risk factors and how to control them, as well as being able to list two or more stroke warning signs and what to do when a first stroke sign is evident. Answers to all questions comprised total stroke knowledge.[21] Similarly, in the current study HTN knowledge was defined as being able to provide recommended values of systolic and diastolic blood pressure, as classified by the ESH/ESC guidelines (2013), as well as to list two or more HTN risk factors[22] and two or more HTN complications.[23] Participants were also asked about HTN signs and symptoms. Answers to these five questions comprised a total score of HTN knowledge and ranged from 0 to 5, where"0" means failing to provide a correct answer to any of the five questions and "5" - successfully providing correct answers to all five questions. The instrument was pilot tested with 10 members of the public. The structured interview form was reviewed and tested for validity by three researchers whose main research area is HTN.

The "Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure" (JNC 7), published in 2003, defined BP as normal when systolic BP is $<$120 mm Hg and diastolic $<$80 mm Hg, prehypertension when systolic BP is 120–139 mm Hg or diastolic BP 80–89 mm Hg, and HTN as blood pressure readings of $\geq$140/90 mm Hg.[24] In November 2017, the AHA/ACC guidelines were updated and defined HTN as blood pressure readings of $\geq$130/80 mm Hg.[25] According to the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC), optimal systolic BP is $<$120 mm Hg and diastolic $<$80 mm Hg; normal BP is 120–129 mm Hg and/or 80–84 mm Hg; high normal BP, 130–139 mm Hg and/or diastolic BP 85–89 mm Hg; and HTN is defined as blood pressure readings of $\geq$140/90 mm Hg.[26] The current study was conducted prior to AHA/ACC guidelines updates and referred to the ESH/ESC HTN definition, defining systolic BP $<$140 mm Hg and diastolic $<$90 mm Hg as normal and BPs $\geq$140/90 as HTN.

For the question "To your knowledge, what are the normal values of systolic BP/top value?" the answer "lower than 140 mm Hg" or citing a value lower than 140 mm Hg was considered a correct answer, as classified by ESH/ESC guidelines (2013).[26] All other answers were considered incorrect. For the question "To your knowledge, what are the normal values of diastolic BP/lower value?" the answer "below 90 mm Hg" or citing a value lower than 90 mm Hg was considered

correct, as classified ESH/ESC guidelines (2013).[26] All other answers were considered incorrect. For the question "Who is at risk for developing HTN?" providing two or more HTN risk factors (family history/genetics, old age, gender, ethnicity, chronic kidney disease, sedentary life style/lack of physical activity, unhealthy diet/too much salt in the diet, being overweight/obese, drinking too much alcohol, smoking/tobacco use, sleep apnea, high cholesterol, diabetes, and stress, as classified by AHA, 2017[22] was defined as knowledge of HTN risk factors. Respondents unable to provide two or more HTN risk factors were considered not having knowledge of HTN risk factors. For the question "To your knowledge, what are the signs of HTN/high BP?" the answer "Usually HTN/high BP has no signs or symptoms/you don't feel HTN" was considered a correct answer, as classified by AHA, 2017.[27] All other answers were considered incorrect. For the question "Why is it important for blood pressure to be within the normal range?" providing two or more HTN complications (to prevent: stroke, heart attack/failure, angina/chest pain/pressure, kidney disease/failure, impaired vision/vision loss, blood vessel diseases/peripheral artery disease, sexual dysfunction, as classified by AHA, 2017[23] was defined as knowledge of HTN complications. Respondents unable to provide two or more HTN complications were considered not having knowledge of HTN complications.

In this study, the item difficulty index (P) refers to the percentage of the total number of correct responses to the questionnaire item. It is calculated by the formula P = R/T, where R is the number of correct responses and T is the total number of responses. Hence, the higher this index value, the lower is the difficulty, and the greater the difficulty of an item the lower its index. The P difficulty index range distributes as P ≥ 75% (very easy), P = 50–74% (moderately easy), P = 25–49% (moderately difficult), P<25% (very difficult).[28] The criterion score was based on norm-referenced interpretation of test results, with a norm group being the sample of research participants.

Statistical analysis

The distribution of continuous variables was presented as mean and SD. For categorical variables, the number of participants and percentages were shown. Differences between the demographic and clinical characteristics and the level of HTN knowledge in different age groups were analyzed using the χ^2 or the Fisher exact test for categorical variables. An ANOVA was performed to examine differences in the means of total knowledge score among participants interviewed by different nurses ($F(17,412)=9.43$, $p<.001$), which led to an intra-class correlation assessment (ICC=0.199) that indicated differences between nurses in the interview results, yet the data lacked information for potential explanation for this source of variability. Adjusted standardized residuals (AR) were examined to identify cells making a significant contribution ($z = \pm 1.96$) within significant results.[29] Differences between four age groups in years of education were analyzed using ANOVA with post-hoc tests. Associations between age, gender, checking BP, and HTN knowledge were studied using logistic regression models, confounding variables, and interactions between age, gender, and who checked BP were assessed. Three models were studied: model 1 including age, gender, and who checked BP; model 2 including in addition confounding variables, such as nationality, whether HTN was diagnosed by a doctor, and years of education; model 3 examining the interaction between age and gender, between age and who checked BP, and between gender and who checked BP. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were estimated using multivariable logistic regression models to identify predictors of knowledge of systolic and diastolic BP values, HTN risk factors, signs and consequences. Association between total HTN knowledge and age, gender, and by whom BP was measured were studied using ordinal regression model (model 1), including confounding variables such as ethnicity, whether HTN was diagnosed by a doctor, and years of education (model 2), as well as interactions between age and gender, age and by whom BP was measured, and gender and by whom BP was measured (model 3). G*Power software was used to estimate posterior power.[30] Achieved power to detect χ^2 with goodness of fit tests, a moderate effect size of 0.3, at 5% alpha error and five degrees of freedom with a sample size of 148 participants (the number of participants in the smallest age group, $n = 37$, multiplied by four groups) was 0.82. The achieved power for the ANOVA analysis, with an effect size of 0.4, at 5% alpha error and 16 degrees of freedom with a sample size of 425 participants (the lowest number of participants interviewed by nurses, $n = 25$, multiplied by 17 groups) was 0.99. Similarly, a regression model with five indicators and taking medium effect size ($f^2=0.15$) yielded power ($1-\beta$) of 0.99.[30] All tests were two-sided, and a p-value of less than 5% was considered statistically significant. Data were analyzed using SPSS Statistics for Windows, Version 24.0 (IBM Corp, Armonk, New York).

Results

Sample

In total, 430 Israelis, 160 (37.2%) men and 270 (62.8%) women, took part in this study, which corresponds with 50.1% and 50.9% of men and women, respectively, in Israel's general population.[31] Three hundred thirty three (77.4%) participants were Jewish, 40 (9.3%) were Muslim Arabs, 10 (2.3%) were Christian Arabs, 29 (6.7%) were Druze, and 14 (3.3%) were of other ethnicity, which corresponds to 74%, 17.6%, 1.5%, 1.6% and 4.0%, respectively, in Israel's general population.[31,32] The age distribution was as follows: 143 (33.3%) were 18 to 34 years old, 160 (37.20%) 35 to 49 years old, 83 (19.3%) 50 to 64 years old, and 44 (10.2%) were above 64 years old, which corresponds with 24.6%, 18.1%, 14.4%, and 11.2%, respectively, in Israel's general population.[32] The mean (SD) age was 42.3 (±15.3) years (median, 40 years; range, 71 years; min-max, 18–89 years). Significant differences in years of education were found between the four age groups ($F = 14.68$, df.=3, $P<.001$). Subsequent Bonferroni-adjusted pairwise comparisons showed that, as compared with participants aged 35–49 (M = 15.4, SD=2.73), years of studies of the 18–34 (M = 14.27, SD=2.37, Mean Dif. (I-J)=1.13, Std. Error=0.33) and above 64 age groups (M = 12.24, SD=3.44, Mean Dif. (I-J)=3.16, Std. Error=0.49) were significantly lower, $p<.01$ and $p<.001$, respectively. No significant differences were found in years of education between men and women (M = 14.65, SD=2.66 vs M = 14.56, SD=3.14, t = 0.31, P=.75). Characteristics of the participants are shown in Table 1.

BP measurement and treatments

Findings of BP measurements and HTN diagnosis are presented in Table 2. Twenty participants aged 18–34 years (14.0%) compared to one (2.3%) participant aged 50–64 years reported that they did not check their BP at some point in their life ([χ^2=16.1, df=6, P=.01]; AR=3.1 18–34; AR=0.1 35–49, AR=–1.8 50–64, AR=–2.2 >64). Seventy-eight (54.5%) participants 18–34 years reported their BP was checked during the last year, versus 37 (84.1%) participants aged above 64 years ([χ^2=28.45, df=9, P=.001]; AR=–4.0 18–34, AR=–0.4 35–49, AR=3.0 50–64, AR=3.2 >64). Eighteen (14.9%) participants aged 18–34 years reported that they measured their BP by themselves, versus 14 (34.1%) participants aged above 64 years ([χ^2=25.51, df=6, P<.001]; AR=–2.4 18–34, AR=–1.9 35–49, AR=2.3 50–64, AR=3.7 >64). Four (2.8%) participants aged 18–34 years reported that they had HTN diagnosed by a doctor, versus 29 (65.9%) participants aged above 64 years ([χ^2=125.76, df=3, P<.001]; AR=–5.3 18–34, AR=–2.3 35–49, AR=2.5 50–64, AR=7.8 >64). One (3.3%) participant aged 18–34 years reported that in the last two weeks took a medicine

Table 1
Demographic and clinical characteristics of participants ($n = 430$).

Variable	Age group				p-value
	18–34 $n = 143$ (% of age group)	35–49 $n = 160$ (% of age group)	50–64 $n = 83$ (% of age group)	>64 $n = 44$ (% of age group)	
Gender					
Men	38 (26.6)	75 (46.9)	34 (41.0)	13 (29.5)	**.002**
Women	105 (73.4)	85 (53.1)	49 (59.0)	31 (70.5)	
Ethnicity					
Jewish	105 (73.4)	133 (83.1)	63 (75.9)	36 (81.8)	.67
Muslim Arab	17 (11.9)	13 (8.1)	8 (9.6)	2 (4.5)	
Christian Arab	2 (1.4)	4 (2.5)	2 (2.4)	2 (4.5)	
Druze	13 (9.1)	6 (3.8)	7 (8.4)	3 (6.8)	
Other	6 (4.2)	4 (2.5)	3 (3.6)	1 (2.3)	
Education (years), mean (SD)	14.3 (±2.4)	15.4 (±2.7)	14.8 (±3.4)	12.2 (±3.0)	<**0.001**
Current smoking	29 (20.3)	46 (28.8)	16 (19.3)	2 (4.5)	**.01**

for treating HTN, versus 26 (83.9%) participants aged above 64 years ([χ^2=164.36, df=3, p<.001]; AR=−5.3 18–34, AR=−4.1 35–49, AR=3.0 50–64, AR=11.8 >64).

Factors predicting knowledge of various aspects of HTN

Difficulty indices of the questions were as follows: systolic BP knowledge, P = 78.2% (very easy), diastolic BP knowledge, P = 76.3% (very easy), knowledge of at least two HTN risk factors, P = 42.5% (moderately difficult), knowledge of at least two HTN complications, P = 31.9% (moderately difficult), and knowledge of HTN signs and symptoms, P = 7.2% (very difficult). Twelve respondents (2.8%) answered all five questions correctly (100 percentile), 71 (16.5%) respondents answered four questions correctly (97 percentile), 123 (28.6%) respondents answered three questions correctly (80 percentile), 131 (30.5%) answered two questions correctly (52 percentile), 37 (8.6%) answered one question correctly (22 percentile), and 56 (13.0%) gave no correct answers (13 percentile). Table 3A presents the results of binary logistic regression examining factors significantly associated with knowledge of various aspects of HTN. In multivariable analysis, higher age, female gender, and self-measurement of BP were associated with a higher likelihood of knowing the normal systolic (P<.01, P=.05, P=.01) and diastolic BP (P<.001, P=.02, P<.01, respectively) values (Table 3A, Model 1). After adjustment for ethnicity, whether HTN was diagnosed by a doctor, and years of education, knowledge of normal systolic BP values remained associated with higher age and self-measurement of BP (P<.01 and P=.02, respectively) (Table 3A, Model 2). The knowledge of normal diastolic BP, after adjustment, remained associated with higher age, gender and self-measurement of BP, in addition to years of education (P=<0.01, P=.03, P<.01 and P=.03, respectively) (Model 2). Knowledge that HTN usually has no signs or symptoms was positively associated with years of education (P=.01) (Model 2). Knowledge of two or more HTN risk factors was associated with BP self-measurement (P<.01) (Model 1). After adjustment, the association of knowledge of two or more HTN risk factors with self-measurement of BP together with years of education was significant (P<.01 and P<.001, respectively) (Model 2). Knowledge of two or more HTN complications was associated with higher age (P<.001) (Model 1). After adjustment, the knowledge of two or more HTN complications remained associated with age and years of education (P<.01 and P=.05, respectively) (Model 2). No interactions were found between the main research variables.

To complement the test of the knowledge of each relevant HTN aspect item, an ordinal regression was performed, in which the

Table 2
Blood pressure measurements, hypertension diagnosis and treatment ($n = 430$).

	Age group				p-value
	18–34 $n = 143$ (% of age group)	35–49 $n = 160$ (% of age group)	50–64 $n = 83$ (% of age group)	>64 $n = 44$ (% of age group)	
Has your BP been checked at some point? (percent in parentheses; columns sum to 100)					
Yes	121 (84.6)	145 (90.6)	81 (97.6)	41 (93.2)	**.01**
No	20 (14.0)	12 (7.5)	2 (2.4)	1 (2.3)	
Don't know	2 (1.4)	3 (1.9)	0	2 (0.5)	
When was your BP checked?					
During the last year	78 (54.5)	107 (66.9)	68 (81.9)	37 (84.1)	**.001**
1 to 3 years ago	27 (18.9)	25 (15.6)	8 (9.6)	2 (4.5)	
More than 3 years ago	7 (4.9)	9 (5.6)	1 (1.2)	0	
Don't Remember	31 (21.7)	19 (11.9)	6 (7.2)	5 (11.4)	
Who measured your BP?	**n = 121 (%)**	**n = 145 (%)**	**n = 81 (%)**	**n = 41 (%)**	
Healthcare Worker[a]	100 (82.6)	115 (79.3)	56 (67.5)	27 (65.9)	<**0.001**
By yourself	18 (14.9)	26 (17.9)	26 (31.3)	14 (34.1)	
By someone else	3 (2.5)	4 (2.8)	1 (1.2)	0	
Have you had HTN that was diagnosed by a doctor?	**n = 143 (% of age group)**	**n = 160 (% of age group)**	**N = 83 (% of age group)**	**N = 44 (% of age group)**	
Yes	4 (2.8)	14 (8.8)	25 (30.1)	29 (65.9)	<**0.001**
In the last two weeks, did you take a medicine prescribed by a doctor?					
Yes	30 (21.0)	35 (21.9)	40 (48.2)	31 (70.5)	<**0.001**
Were these drugs for treating high BP?	**n = 30 (%)**	**n = 35 (%)**	**n = 40 (%)**	**n = 31 (%)**	
Yes	1 (3.3)	7 (20.0)	19 (47.5)	26 (83.9)	<**0.001**

[a] Healthcare worker – nurse or physician.

Table 3A
Logistic regression models for the knowledge of systolic and diastolic BP, signs, HTN risk factors and complications.

	Knowledge of normal systolic BP			Knowledge of normal diastolic BP		
Model 1	OR	(95% CI)	*p*-value	OR	(95% CI)	*p*-value
Age, years	**1.03**	**(1.01–1.05)**	**<0.01**	**1.03**	**(1.01–1.05)**	**<0.001**
Gender, female	**1.58**	**(1.0–2.56)**	**.05**	**1.78**	**(1.1–2.88)**	**.02**
Self-BPM[a]	**2.76**	**(1.26–6.06)**	**.01**	**3.61**	**(1.58–8.28)**	**<0.01**
Model 2						
Age, years	**1.03**	**(1.0–1.05)**	**<0.01**	**1.03**	**(1.0–1.05)**	**<0.01**
Gender, female	1.49	(0.91–2.44)	.12	**1.7**	**(1.05–2.74)**	**.03**
Self-BPM	**2.66**	**(1.19–5.9)**	**.02**	**3.66**	**(1.59–8.43)**	**<0.01**
Ethnicity, Jewish	1.44	(0.81–2.54)	.21	1.27	(0.72–2.23)	.41
Diagnosed HTN	.87	(0.38–1.99)	.73	1.02	(0.45–2.33)	.96
Education, years	1.09	(0.99–1.2)	.06	**1.1**	**(1.0–1.2)**	**.03**
Model 3						
Int.[b] Age/Gender	1.0	(0.97–1.05)	.7	1.01	(0.97–1.05)	.58
Int. Age/Self-BPM	.96	(0.91–1.0)	.12	.97	(0.92–1.03)	.35
Int. Gender/Self-BPM	.24	(0.04–1.46)	.12	.54	(0.1–2.95)	.48
	Knowledge that HTN has no signs or symptoms			Knowledge of two and more HTN risk factors		
Model 1	OR	(95% CI)	*p*-value	OR	(95% CI)	*p*-value
Age, years	1.01	(0.99–1.04)	.42	.99	(0.98–1.01)	.64
Gender, female	.84	(0.4–1.77)	.64	1.42	(0.95–2.13)	.09
Self-BPM	2.04	(0.9–4.6)	.09	**1.98**	**(1.21–3.24)**	**<0.01**
Model 2						
Age, years	1.01	(0.96–1.06)	.65	.99	(0.98–1.01)	.67
Gender, female	1.1	(0.08–14.09)	.93	1.43	(0.94–2.19)	.09
Self-BPM	5.37	(0.33–88.0)	.24	**2.14**	**(1.28–3.58)**	**<0.01**
Ethnicity, Jewish	3.97	(0.91–17.45)	.07	93	(0.56–1.54)	.77
Diagnosed HTN	.54	(0.19–1.55)	.25	1.08	(0.58–2.03)	.81
Education, years	**1.18**	**(1.03–1.34)**	**.01**	**1.15**	**(1.07–1.24)**	**<0.001**
Model 3						
Int. Age/Gender	.99	(0.94–1.05)	.84	1.0	(0.97–1.04)	.65
Int. Age/Self-BPM	.98	(0.93–1.04)	.56	.99	(0.96–1.03)	.8
Int. Gender/Self-BPM	.72	(0.14–3.8)	.7	.8	(0.27–2.23)	.65
	Knowledge of two and more HTN complications					
Model 1	OR	(95% CI)	*p*-value			
Age, years	**1.03**	**(1.01–1.04)**	**<0.001**			
Gender, female	1.16	(0.75–1.79)	.5			
Self-BPM	1.17	(0.7–1.96)	.55			
Model 2						
Age, years	**1.03**	**(1.02–1.05)**	**<0.01**			
Gender, female	1.17	(0.75–1.83)	.3			
Self-BPM	1.28	(0.76–2.16)	.36			
Ethnicity, Jewish	1.1	(0.62–1.86)	.8			
Diagnosed HTN	.68	(0.35–1.32)	.25			
Education, years	**1.08**	**(1.0–1.16)**	**.05**			
Model 3						
Int. Age/Gender	.99	(0.96–1.02)	.46			
Int. Age/Self-BPM	1.0	(0.97–1.05)	.61			
Int. Gender/Self-BPM	.65	(0.22–1.93)	.44			

dependent variable was level of knowledge, from "0″ (failing to provide a correct answer to any of the five questions) to "5″ (successfully providing correct answers to all five questions). Table 3B provides the results of the three-step model following the item-by-item analysis. Based on the three steps, the older the person, the more knowledgeable he or she was (b=−0.02, $p<.001$), women showed higher knowledge compared to men (b=−0.37, p=.04), and blood pressure self-measurement was associated with a higher knowledge level as well (b=−0.76, $p<.001$), as expected. Other background variables, aside from education level (positive effect on higher level of knowledge), showed no significant effect, and this included the test for interaction effects between the major background variables. Note that the significant gender effect was gone when additional indicators were added.

Discussion

The current study found that more than 21% of the participants answered correctly less than 2 questions on HTN knowledge. The older the participants, the higher their number of education years, and measuring their BP by themselves, the higher their total HTN knowledge.

Differences in knowledge on HTN by age

Older age was associated with better knowledge of normal systolic and diastolic BP values. The current results differ from those reported by Li et al. (2013) that among participants aged 30 and older, knowledge levels regarding HTN definition did not vary by age.[33] On the other hand, rates of HTN awareness among a Portuguese adult population were greater among patients with HTN aged above 64, and among the 35–64 age group vs among the 18–34 age group.[34] In the study by Polonia et al. (2014), higher awareness among older patients was explained by the higher treatment-seeking behavior of older adults.[34] A possible explanation of the higher knowledge of recommended values of systolic and diastolic BP among older participants in the current study might be connected to the higher treatment-seeking behavior of older participants, among whom HTN prevalence is higher than among younger age groups.[35] In the current study, higher age was associated with higher knowledge of two and more HTN complications. The current results differ from those described by Baliz Erkos et al., (2012) who demonstrated that mean scores on the complications knowledge were significantly lower in Turkish adults aged sixty years and over,

Table 3B
Ordinal regression models for total HTN knowledge level.

Threshold	b	SE	EXP(b)	(95% CI)	*p*-value
5 items	**−3.55**	**0.29**	**0.03**	**0.016–0.051**	**<0.001**
4 items	**−1.43**	**0.12**	**0.24**	**0.19–0.3**	**<0.001**
3 items	−0.084	0.1	0.92	0.761–1.1	.39
2 items	**1.29**	**0.12**	**13.62**	**2.88–14.56**	**<0.001**
1 item	**1.9**	**0.14**	**6.68**	**5.04–8.84**	**<0.001**
Model 1					
Age, years	**−0.02**	**0.01**	**0.98**	**0.97–0.99**	**<0.001**
Gender, female	**−0.37**	**0.18**	**0.69**	**0.48–0.98**	**.04**
Self-BPM	**−0.76**	**0.21**	**0.47**	**0.31–0.71**	**<0.001**
Model 2					
Age, years	**−0.02**	**0.01**	**0.98**	**0.966–0.991**	**>0.001**
Gender, female	−0.33	0.18	0.72	0.503–1.034	.075
Self-BPM	**−0.8**	**0.22**	**0.45**	**0.294–0.683**	**<0.001**
Ethnicity, Jewish	−0.22	0.21	0.8	0.532–1.206	.29
Diagnosed HTM	0.07	0.26	1.07	0.635–1.77	.78
Education, Years	**−0.15**	**0.03**	**0.87**	**0.811–0.923**	**<0.001**
Model 3					
Int. Age/Gender	0.01	0.01	1.01	0.983–1.032	.57
Int. Age/Self-BPM	0.01	0.01	1.01	0.987–1.036	.35
Int. Gender/Self-BPM	0.61	0.43	1.83	0.789–4.267	.16

[a]BPM – Blood Pressure Measurement.
[b]Int. -Interaction.

compared to other age groups.[9] A possible explanation of the lower knowledge of HTN complications among younger participants in the current study might be connected to the fact that among young Israeli adults aged 21 to 34 years HTN is reported as being uncommon, i.e., 6.2% among men and 5.1% among women.[4] Therefore, HTN is perceived as irrelevant for young adults. However, because of the recent reports regarding the substantial increase of self-reported HTN among Israeli adults aged 21–44 from 2003 to 2015,[4,36,37] primary prevention and improving knowledge of HTN in younger adults are crucial.

Differences in knowledge on HTN by gender

At the first stage in the regression model, female gender predicted higher knowledge of systolic BP values and higher total HTN knowledge. In both cases, significant gender effect was gone when a variable "years of education" was added. In the current study, no significant differences were found in years of education between men and women. Perhaps, knowledge differences between men and women were masked by the higher number of education years among men in the current sample, which is not necessarily true for Israel's general population. Over the last one and a half decade, a percentage of Israeli women with Bachelor's and Master's academic degrees was higher than that of men (60.2%, 57.9% and 59.8% at 2004/5, 2009/10 and 2014/15, respectively).[38] It can be assumed, that in the current study the effect of gender on various aspects of HTN knowledge was masked by years of education.

Differences in knowledge on HTN by years of education

Higher number of education years was associated with diastolic BP knowledge, knowledge that HTN usually has no signs and symptoms, and with knowledge of two and more HTN risk factors. Moreover, years of education were positively associated with total HTN knowledge level. Higher HTN knowledge in more educated participants is supported by a World Health Organization statement, according to which health literacy was found to be significantly higher among people with more education in the European countries that took part in the survey.[39]

Differences in knowledge of HTN by BP self-measurement

Among hypertensive patients, self-measurement of BP increased patients' involvement in their own care, increased their knowledge about their condition, improved patients' autonomy, and empowered them to make changes to benefit/improve their BP.[13] In the current study, higher knowledge of normal systolic and diastolic BP, knowledge of two or more HTN risk factors and higher total HTN knowledge among participants who measured their BP by themselves, might be similarly explained by participants' higher involvement in their own care, improved autonomy, and empowerment. A recent systematic review reported that while BP self-monitoring alone was not associated with lower BP or better HTN control, it was recommended to lower BP when combined with other co-interventions (systematic medication titration by doctors, pharmacists, or patients; education; and lifestyle counseling).[40] Therefore, in addition to providing guidance for a healthy life-style, physicians and nurses should also encourage their patients to measure BP at home by themselves. Patients' education on the subject of HTN, together with guidance for self-measurement of BP and routine assessment of whether home BP measurement took place, might be among the responsibilities of primary clinic nurses. Giving patients responsibility for measuring their own BP and reference to BP values may assist physicians in the titration of the drug therapy in patients with HTN. The inclusion of BP self-measurement in the routine practice of the general population, together with national educational campaigns aimed at expanding HTN knowledge, should be brought to the attention of health authorities. Moreover, educational campaigns aimed at increasing knowledge of HTN among the general population and targeting the younger population, with a focus on individuals with known HTN risk factors, are recommended.

Future studies

The reasons for the sharp increase in the HTN rate in Israel during the last decade are not entirely clear. The effect of HTN knowledge and BP self-measurement on behaviors aimed at reducing HTN prevalence among adults of different ages in Israel might be a focus for future studies.

Limitations

Convenience sampling might be considered a threat to the generalizability of the current results. One of the consequences of this might be significant differences in the means of total knowledge scores among participants interviewed by different nurses. Further studies including representative samples of Israeli subpopulations are recommended. Additional limitation of the study is that nurses conducted personal interviews, which might affect the reliability of the results. While in the current study reliability was not affected, the inter-rater reliability might affect results reliability. An additional limitation of the current study is that the HTN knowledge questionnaires were not validated.

Conclusions

Older age, BP self-measurement, and more years of education were associated with higher total HTN knowledge. Nurses and physicians could take initiative in promoting HTN education and BP-self-measurement among adult patients. The inclusion of BP self-measurement in the routine practice of the general population, together with national educational campaigns aimed at expanding HTN knowledge, are recommended.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.hrtlng.2019.02.001.

Appendix A

Part 1

I will ask you some questions about health and disease prevention.

The questionnaire is anonymous and is intended for learning and research purposes only. I would appreciate if you would answer all my questions in a way that reflects your opinion. Thanks in advance for your cooperation.

#	Question
1.	In what year were you born? 19I__I__I. Meaning, your age is_____
2.	Gender 1. Man 2. Woman
3.	In what country were you born? _____ I__I__I__I__I
4.	Country of birth of your father?_____ I__I__I__I__I
5.	In what year did you immigrate to Israel? I__I__I__I__I
6.	Are you: 1. Jewish 2. Muslim Arab 3. Christian Arab 4. Christian not Arab 5. Druze 6. Other_____
7.	What is your marital status? 1. Married or living with a spouse 2. Divorced or separated 3. Widowed 4. Single 5. Refuses to answer
8.	Do you have children? 1. Yes, how many?_____ 2. No
9.	How do you define yourself primarily? (You can mark more than one answer) 1. Employee (including permanent soldier) 2. Independent worker 3. Unemployed 4. Student 5. Retired 6. Housewife 7. Yeshiva student 8. Soldier on duty 9. Member of a kibbutz 10. Other_____
10.	How many years did you study in total? (Including university or vocational studies)? I __ I __I
11.	What is your highest educational certificate? 1. Matriculation certificate (High school) 2. Professional certificate, without matriculation certificate 3. Professional certificate, with matriculation certificate 4. Bachelor's degree 5. Master's degree/PhD 6. Certificate of rabbinical or Yeshiva studies 7. No certificate 8. Other_____
12.	A gross monthly income of NIS 5000 to 10,000 is the average income range in Israel right now. Is your income: 1. Below the average range 2. Within the average range 3. Above the average range 4. Refuses to answer
13.	Do you smoke/use tobacco? 1. Yes 2. No
14.	Do you have any chronic illness or health problem? 1. Yes 2. No 3. Don't know
15.	Do you have or have ever had: 1. HTN/High BP 2. Dyslipidemia/High cholesterol/Lipids in your blood 3. Myocardial infarction/Heart attack 4. Angina pectoris/Chest pain/Pressure 5. Stroke 6. Diabetes
16.	Has your BP been checked at some point? 1. Yes 2. No 3. Don't know
17.	When was your BP checked? 1. During the last year 2. 1 to 3 years ago 3. More than 3 years ago 4. Don't remember/Don't know
18.	Who measured your BP? 1. A healthcare worker (nurse or physician) 2. Yourself 3. Someone else
19.	Have you had HTN/High blood pressure that was diagnosed by a doctor? 1. Yes 2. No
20.	In the last two weeks, did you take a medicine prescribed by a doctor? 1. Yes 2. No
21.	Were these drugs for treating: 1. High blood pressure 2. Dyslipidemia/High Cholesterol/Lipids in your blood 3. Diabetes 4. Other diseases

Part 2

Number	Question
22.	To your knowledge, what are the normal values of systolic BP/top number?
23.	To your knowledge, what are the normal values of diastolic BP/bottom number?
24.	Who is at risk for developing hypertension?
25.	What are the signs/symptoms of hypertension?
26.	Why is it important for blood pressure to be within the normal range?

Possible answers

Question 22: To your knowledge, what are the normal values of systolic BP/top number?

Correct answer:

"Lower than 140 mm Hg" or citing value below 140 mm Hg

Question 23: To your knowledge, what are the normal values of diastolic BP/bottom number?

Correct answer:

"Lower than 90 mm Hg" or citing value below 90 mm Hg

Question 24: Who is at risk for developing hypertension?

Correct answers:

Someone who is/has:

1) Family history/genetics
2) Old age
3) Gender; until age 64, men are more likely to have high blood pressure than women. From age 65 and older, women are more likely to have high blood pressure
4) Ethnicity; African-Americans tend to develop high blood pressure more often than people of any other racial background
5) Chronic kidney disease
6) Sedentary life style/lack of physical activity
7) Unhealthy diet/too much salt in the diet/too much calories, saturated and trans fat and sugar
8) Being overweight/obese
9) Drinking too much alcohol
10) Smoking/tobacco use
11) Sleep apnea

(continued)

12) High cholesterol
13) Diabetes
14) Stress

Question number 24: What are the signs/symptoms of hypertension?

A correct answer: HTN usually has no signs and symptoms/you don't feel HTN

Possible incorrect answers:

1) Headaches
2) Nosebleeds
3) Redness in the eyes
4) Fainting
5) Red face
6) Dizziness

Question 24: Why is it important for blood pressure to be within the normal range?

Correct answers:

To prevent:

1) Stroke
2) Angina/chest pain/pressure
3) Heart attack/failure
4) Kidney disease/failure
5) Blood vessel diseases/Peripheral vascular disease
6) Impaired vision/vision loss
7) Sexual dysfunction

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