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Blood Pressure Measurements: Factors Affecting Readings Accuracy

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Abstract: *Accurate blood pressure (Bl P) measurement is fundamental to the diagnosis and management of hypertension. Blood pressure measurement is one of the most important preventable causes of premature morbidity and mortality in the world.* ***Design:*** *A descriptive research design was used to conduct this study.* ***Objective:*** *To identify factors affecting accurate measurement of blood pressure for patients in the medical departments.* ***Setting:*** *The study was carried out in themedical departments(Cardiology, Gastroenterology, Hepatology, Endocrinology, and Nephrology) at the Alexandria Main University Hospital.* ***Subjects:*** *All available nurses (100 nurses) who are working in the previously mentioned setting.* ***Tool:*** *Blood Pressure Measurement: Observational Checklist (BPMOC) was used in order to collect data. It includes data related to the following parts; Part I: Sociodemographic characteristics, Part II: Blood pressure measurement checklist, Part III: Factors affecting accurate blood pressure reading.* ***Results****: Imply statistically significant differences between nurses and researcher measurements of blood pressure. The most affecting factors were cuff size, cuff over clothes, resting 3-5 minutes, emotional status, talking during measurement ($P \leq 0.05$). There was also a highly statistically significant difference regarding factors of: empty bladder before measurement and suitable time during measuring ($P \leq 0.001$).* ***Conclusion:*** *Accuracy of blood pressure measurements was affected by the factors mentioned before.* ***Recommendations:*** *Guideline manual should be available in the medical units. All nurses who are working in the medical units especially newly recruited nurses should attend in-service training program about accurate Bl P measurements.*

Key Words: *Blood Pressure, Measurement, Factors.*

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I. Introduction

Hypertension (HTN) is an increasingly important public health issue [(1)].Historical evidence suggests that the Egyptians, as early as 3150 BC, noticed bloodpressure pulsation using simple palpation.The concept of blood pressure as known in modern medicine was first evoked by William Harvey who suggested in 1616 that thebody contained a finite amount of blood. The first experimental blood pressure measurementswere made only in (1733)[(1, 2)] by inserting a brass pipe inside a horse's crural artery. Theausculatory method, i.e., combined use of a stethoscope and sphygmomanometer, wasdeveloped by Nikolai Korotkoff in (1905) [(1, 2)]. Korotkoff's soundsare still used clinically to measure the brachial artery systolic/diastolic blood pressures [(1, 2)].

Nowadays, the concept of blood pressure is central in medicine. Hypertension (HTN)affecting more than a quarter of the overall population globally. It has been estimated that 1 in 3 adults aged over 20 years will have the diseaseby the year 2025. This has significant effects since high systemicblood pressure is often correlated to important short and long term risks[(3, 4)].

Blood pressure is defined as the tension in the blood vessel wall, resulting from blood flow through the lumen.Itis a product of cardiac output (CO) and total peripheral vascular resistance (PVR) both of which are influenced by multiple genetic and environmental factors[(5, 6)].

Accurate blood pressure (BP) measurement is fundamental to the diagnosis and management of hypertension. Hypertension is one of the mostimportant preventable causesof premature morbidity andmortality in the world; it is amajor risk factor for ischaemic and haemorrhagicstroke, myocardial infarction,heart failure, chronic kidney disease, cognitivedecline and premature death,while hypotension can lead to dizziness and fainting[(7, 8)].

Uncontrolled resistant hypertension (RHTN) is defined as systolic blood pressure(SBP)140 mm Hg and/or diastolic blood pressure(DBP) 90 mm Hg with the use of at least 3 antihypertensive medications. Falsely elevated BP levels contribute to pseudoresistant HTN, that is, BP levels that appear uncontrolled, but actually are not. The prevalence of pseudoresistance among persons with apparent resistant hypertension (RHTN) is estimated to be as high as 50%.The most commoncauses of pseudoresistance are inaccurate BP measurement technique, medication nonadherence, undertreatment, and white coat HTN. Of these, only pseudoresistance secondary to inaccurate BP measurement has not been previouslyquantified[9, 10].

Underestimating true blood pressure by 5 mm Hg would mislabel more than 20 million with prehypertension when true hypertension is present. It has been predicted that the consequences of an untreated 5 mm Hg of excessive systolic blood pressure would be a 25% increase over current levels of fatal strokes and fatal myocardial infarctions for these individuals. Conversely, overestimating true blood pressure by 5 mm Hg would lead to inappropriate treatment with anti-hypertension medications in almost 30 million, with attendant exposure to adverse drug effects, the psychological effects of misdiagnosis, and unnecessary cost [11-13].

The trap is that in acknowledging the consequences of small measurement inaccuracies, errors of 5 to 10 mm Hg commonly occur as a result of improper blood pressure technique. Such as; active listening to the patient, when the medical assistant(MA) is talking during blood pressure measurement, can increase systolic blood pressure by 10 mm Hg. Obtaining a measurement from an unsupported arm can increase the systolic pressure by 10 mm Hg. Lack of back support and crossed legs increase blood pressure. If a patient needs to urinate, a blood pressure measurement taken before bladder emptying can increase the systolic pressure by >10 mm Hg. Measurements taken over clothing or with tight clothing pushed up on the arm, causing a tourniquet effect, also produce significant artifacts[11,14].

Proper technique is essential to accurateBP measurement.However, during delivery of routine health care; guidelinesfor accurate BP measurement are rarely followed. Errorscommonly made during routine BP measurements include:use of an incorrectly size and distance of the cuff; placing the cuff over clothes; relying on standing BP measurements, unsupported arm, back & feet;deflating BP cuff too fastcompressed;arm by rolls up sleeves; omitting 3–5 minutes of restbefore BP measurement; taking the BP simultaneouslywith other ongoing activities like completing forms oranswering questions and full bladder[15]. Armisn't relaxed &not at the heart level, unconsidered emotional status& environmental temperature as well as unconsidered smoking&caffeine[14].

Nurses are usually at the frontline of BP screening and control, if nurses wish to play an important role as primary health care providers, they must, as suggested be more proactive in the assessments of blood pressure and the other vital signs. Only then, nurseswill be able to optimally contribute to the identification and management of blood pressure problems in the patients' survey, able to give greatest assistance to other health professionals [16].

Significant Of The Study:

In Egypt, Egyptian National Hypertension Project (2015) [17]estimates the prevalence of HTN in Egypt at 26.3% [17, 18],which mean that about 15 million person had hypertension[19, 20].

Furthermore, according Egypt demographic and health survey (EDHS 2008)[21,22]; there was a wide variation in the prevalence of hypertension in different governorates of Egypt, ranging from a minimum of 7 % in Sharkia to a maximum of 25.3% in Ismailia, Alexandria, Port Said, and Gharbia [21,22]. Another data about the incidence of hypertension in Egypt was obtained during the year 2005[23] by Noncommunicable Disease Surveillance Unit (NCDSU) and Central Epidemiology and Disease Surveillance (ESU) of the Ministry of Health population, which revealed that the prevalence of mild hypertension seen in 26.7% with a little bit equal distribution between males and females, severe hypertension seen in 6.9%, in males while 7.2% in females [23].

AIM OF THE STUDY:

To identify factors affecting accurate measurement of blood pressure for patients in the medical departments.

RESEARCH QUESTION:

What are the factors that affect accuracy of blood pressure measurement?

II. Materials And Method

MATERIALS

Research design:

A descriptive research design was utilized to conduct this study.

Setting of the study:

The study was conducted in the medical departments of the Main University Hospital of Alexandria as: Cardiology, Gastroenterology, Hepatology, Endocrinology, and Nephrology.

Subjects of the study:

The study subjects comprised 100 available staff nurses who are working in the previously mentioned setting at the time of data collection and were interested in participating in the study, 20 nurses in each unit. This setting is thought to be representative for hypertensive patients.

Tools:

One tool was used in order to collect pertinent data in this study:

Nurses Blood Pressure Measurements: Observational Checklist (BPMOC):

This tool was developed by the researchers after reviewing the recent related literatures[24-27] to determine factors affecting blood pressure measurement for patients in medical departments. It consists of three parts:

Part I: Sociodemographic Characteristics and Academic Data

This part consists of eight items which include the following: code number, gender, age, marital status, academic qualification, years of experience, department and the working shift.

Part II: Blood Pressure Measurement Checklist:

This part was developed based on validated checklist that was available in the international clinical procedure text and student procedure manual. It contains two columns;onecolumn for Bl. P values measured by nurses and Bl. P values measured by the researcher and a columnfor variance in measurements.

Part III: Factors Affecting Blood Pressure Reading:

This part was developed after extensive review of international clinical procedure and validated procedure manual of the nursing students of Faculty of Nursing. It includes items related to:

- Before Bl. P measurement; example: patient's resting for 3-5 minutes.
- During Bl. P measurement; example: avoidance of talking with patient.

This part consists of 17 items which includes the following: cuff size, cuff distance, cuff over clothes, compressed arm by rolls up patient's sleeves, patient's resting for 3-5 minutes, supporting patient's (arm, back, feet), patient's arm relaxation, patient's arm at the heart level, site of the patient's arm, proper time before measuring Bl. P, patient's emotional status, emptiness of patient's bladder, avoidance of talking with patient, patient's avoidance of caffeine& smoking for 30 minutesbefore measuring Bl. P, considering patient's environmental temperature and the patient's position.It also contains a column for if the item is followed or not.

Scoring system for measurements:

Two level of scoring was adopted for each item:

- Followed accurately was given a score of (1).
- Unfollowed was given a score of (zero).

The total score for nurses' performance level:

Level of performance	Percentage
Satisfactory	≥ 75%
Unsatisfactory	< 75%

METHOD

- An official approval was obtained from administrative authorities to carry out the study after explanation of the purpose of the study.
- One tool was developed by the researchers based on extensive review of the relevant literature (Nurses Blood Pressure Measurement: Observational Checklist NBPMOC)
- Content validity of the developed tool was tested by a jury of five experts in the related field two prof from medical department and three from medical surgical nursing department
- Tool reliability was testing using test-retest method and it was ($r = 0.70$).
- A pilot study was carried out on ten nurses to test applicability and feasibility of the developed tool, necessary modifications was done. Data obtained was excluded from the actual study.
- Data was collected from the identified subjects using the developed Tool: Nurses blood pressure measurement: observational checklist (NBPMOC). It was done through observation of each nurse individually for 3 different shifts.

- Each nurse was asked to measure the blood pressure for each patient and then measurement was rechecked by the researcher following all items in the checklist and the patient preparation mentioned in the checklist
- Data collection was taken from 1/6/2016 to 1/10/2016 it was extended for period of 4 months.
- The collected data was analyzed to identify factors affecting accurate measurement of blood pressure for patients in the medical departments.

Ethical considerations

- Written informed consent was obtained from nurses after explanation of the aim of the study.
- Privacy and confidentiality are assured to the study subjects.
- Nurses were informed that their participation is voluntary and they have the right to be withdrawn from the study with a full respect.

Statistical Analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.Quantitativedata were described using number and percent. Significance of the obtained results was judged at the 5% level[28, 29].

The used tests were:

1. **Chi-square test:** To compare between different groups
2. **Fisher's Exact or Monte Carlo correction:** Correction for chi-square when more than 20% of the cells have expected count less than 5.Every nurse was observed 3 times during her work in the shift while measuring the blood pressure using the developed tool (Nurses Blood Pressure Measurement: Observational Checklist NBPMOC) through inferreted observation. Reading was rechecked by the researcher for checking accuracy of blood pressure measurement.
3. **Regression:** Multivariant analysis regression was assessed to detect the most independent/ affecting factor for blood pressure measurement.

Graphical presentations:

The given graphs were constructed using Microsoft excel software.

III. Result

Table (1): Sociodemographic characteristics of the studied nurses

This table illustrates sociodemographic characteristics of studied nurses.The majority of nurses (91.0 %) were females, the highest percentage (45.0%) were in age group of 30 < 40 years and the highest percentage (87.0%) were married.

Table (1): Sociodemographic characteristics of studied nurses

Personal Characteristics		no.	%
Sex:			
1.	Male	9	9.0
2.	Female	91	91.0
Age groups (in years**)**			
1.	< 20	1	1.0
2.	20 -	32	32.0
3.	30 -	45	45.0
4.	40 – 50	22	22.0
mean ± SD=35.77 ± 7.49			
Marital status:			
1.	Single	10	10.0
2.	Married	87	87.0
3.	Widow	3	3.0

Fig. (1): Academic qualification of the studied nurses

This figure shows that the highest percentage (45.0%) had diploma degree while 39.0% of nurses had bachelor degree; on the other hand 16.0% of them had associated degree.

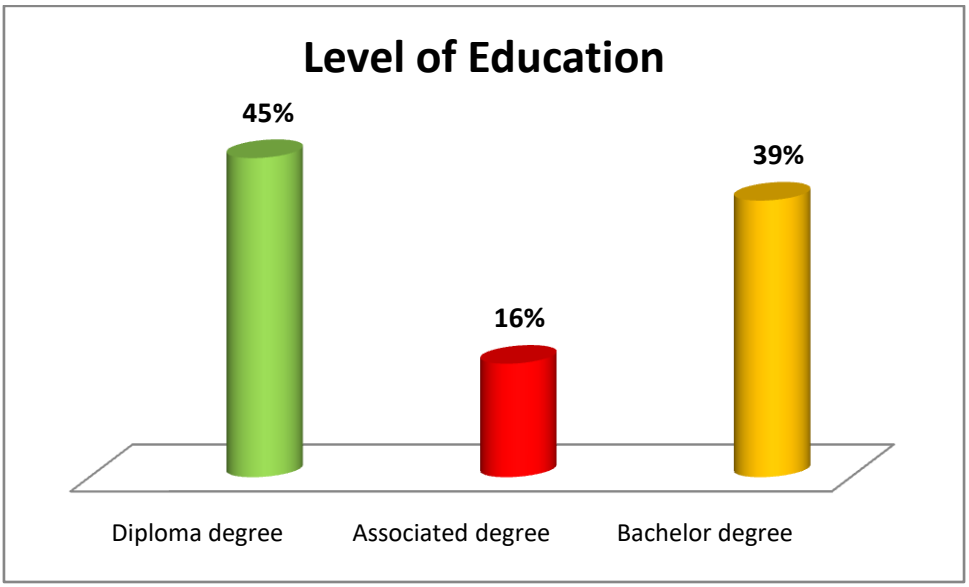

Fig. (1): Academic qualification of the studied nurses

Fig. (2): Years of experience of working in medical wards of the studied nurses

Regarding **years of the working experience,** the current figure ascertain that the majority (72.0%) of nurses had ≥ 10 years of the working experience in medical wardswith mean ± SD=15.94 ± 7.66

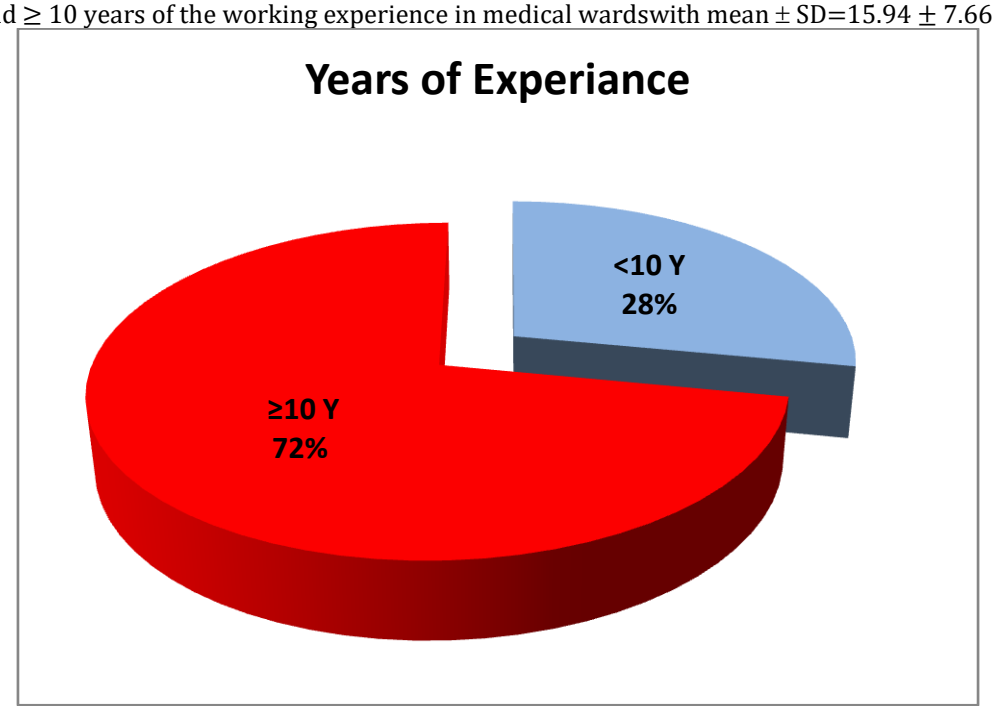

Fig. (2): Years of experience of the studied nurses

Fig. (3): Working shift of the studied nurses

Regarding **working shift**, this figure reveals that the majority (91.0%) of nurses worked at morning shift.

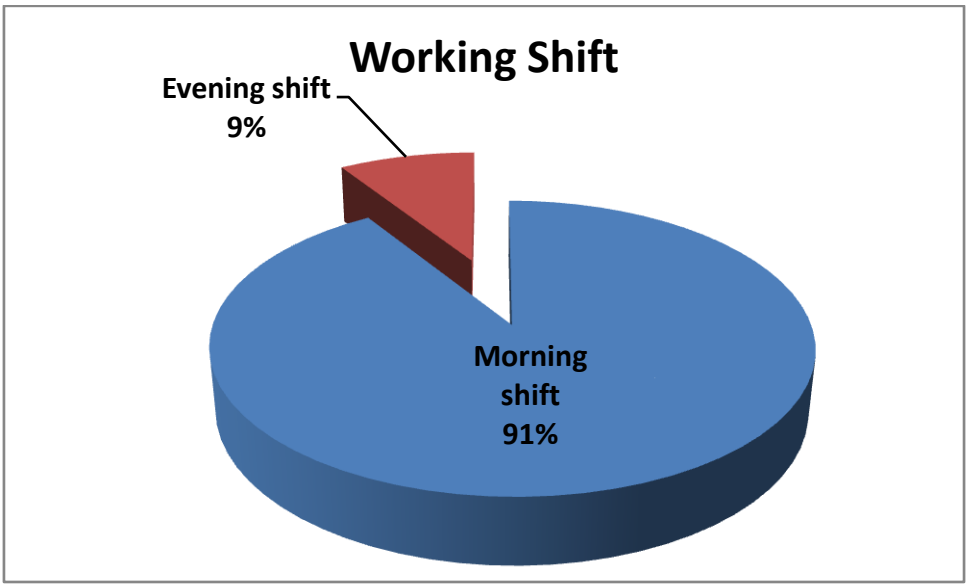

Fig. (3): Working shift of the studied nurses

Table (2): Blood pressure measurement differences according to the researcher's measurements

As regard **blood pressure measurement differences**,this table shows that only (14.0%) and (7.0%) of the studied subject had measured systolic and diastolic blood pressure with no variation respectively.

Table (2): Blood pressure measurement differences according to the researcher's measurements

Blood pressure measurement differences		no.	%
Systole:			
1.	Increase	41	41.0
2.	Decrease	45	45.0
3.	No variant	14	14.0
Diastole:			
1.	Increase	42	42.0
2.	Decrease	51	51.0
3.	No variant	7	7.0

Table (3): Factors affecting the accuracy of blood pressure measurement

Concerning using cuff over the arm sleeves, positioning of the arm at the heart level, supporting the patient's feet, respecting the emotional status, andavoidance talking during measurementthe table illustrates that (56.0%), (85.0%), (80.0%), (78.0%), (89.0%) of nurses respectively did not give any concern to its importance.

Concerning supporting the patient's arm and respecting the patient's resting before starting measurement by 3 – 5 mints the table indicates that (85.0%), (61.0%) of nurses respectively considered these factors.

Table (3): Factors affecting the accuracy of blood pressure measurement

Factors affecting BLP measurement		followed		Not followed	
		no.	%	no.	%
Blood pressure cuff:					
1.	Suitable size.	78	78.0	22	22.0
2.	Correct distance.	53	53.0	47	47.0
3.	Not used over clothes	44	44.0	56	56.0
Blood pressure measured arm:					
1.	Uncompressed by rolls up sleeves.	55	55.0	45	45.0
2.	Arm is relaxed.	45	45.0	55	55.0
3.	Arm is at the level of the heart.	15	15.0	85	85.0
4.	Correct site of the arm.	21	21.0	79	79.0

Position of the patient:					
1.	Support measured arm.	85	85.0	15	15.0
2.	Support back of the patient.	43	43.0	57	57.0
3.	Support feet of the patient.	20	20.0	80	80.0
The nurse should consider:					
1.	Resting 3 – 5 mints before taking reading.	61	61.0	39	39.0
2.	Emotional status.	22	22.0	78	78.0
3.	Empty bladder.	26	26.0	74	74.0
4.	Avoid talking.	11	11.0	89	89.0
5.	Suitable time before measuring	41	41.0	59	59.5
6.	Avoid caffeine for 30 min.	100	100.0	0	0.0
7.	Avoid smoking for 30 min.	100	100.0	0	0.0
8.	Room temperature (worm and cold).	100	100.0	0	0.0

Table (4): Relations betweensociodemographic characteristics and blood pressure measurement accuracy

As regardrelationbetween**nurses' age** and blood pressuremeasurement differences**,** this table reveals that, there wasstatistically significant relation with diastolic blood pressure measurement.

Regarding relationbetween both nurses' **qualification** and **years ofexperience** with blood pressure measurement differences, this table asserted that there was a highly statistically significant relation (P= ≤0.001).

Table (4): Relations between sociodemographic characteristics and blood pressure measurement accuracy

Personal Characteristics Of the nurses	Blood Pressure Measurement Differences															
	Systole								Diastole							
	Increase		Decrease		No Variant		X^2	P-value	Increase		Decrease		No Variant		X^2	P-value
	no.	%	no.	%	no.	%			no.	%	no.	%	no.	%		
Age groups (in years**)**																
1. < 20	1	2.4	0	0.0	0	0.0			1	24.0	0	0.0	0	0.0		*
2. 20 -	13	31.7	18	40.0	1	7.1	7.16	0.306	10	23.8	22	43.1	0	0.0	12.69	**0.048**
3. 30 –	19	46.3	18	40.0	8	57.1			23	54.8	16	31.4	6	85.7		
4. 40 – 50	8	19.5	9	20.0	5	35.7			8	19.0	13	25.5	1	14.3		
Level of education																
1. Diploma	16	39.0	27	60.0	2	14.3		**	15	35.7	26	51.0	4	57.1		*
degree	3	7.3	12	26.7	1	7.1	**26.81**	**0.000**	3	7.1	13	25.5	0	0.0	14.19	**0.007**
2. Associated degree	22	53.7	6	13.3	11	78.6			24	57.1	12	23.5	3	42.9		
3. BSc degree																
Years of experience								**								
1. <10 Y	19	46.3	9	20.0	0	0.0	**13.72**	**0.001**	15	35.7	12	23.5	1	14.3	2.40	0.301
2. ≥10 Y	22	53.7	36	80.0	14	100.0			27	64.3	39	76.56	6	85.7		

(*) Statistical significant difference, P≤0.05

(**) Highly statistically significant difference, P≤0.001

Table (5): Relations betweenfactors affecting blood pressure measurement and variation

This table indicates statistical significant relation between factors as: cuff size, cuff not over clothes, site of the arm, resting 3–5 minutes before measurement, considering emotional status and avoid talking during measurement and blood pressure measurement differences at (P ≤ 0.05).While there was highly statistically significant difference between the factors: empty bladder before measurement and suitable time for measurementand blood pressure measurement differences at (P ≤ 0.001).

Table (5): Relations between factors affecting blood pressure measurement and variation

Factors Affecting BLP Measurement		Blood Pressure Measurement Differences															
		Systole								Diastole							
		Increase		Decrease		No Variant		X^2	P-value	Increase		Decrease		No Variant		X^2	P-value
		no.	%	no.	%	no.	%			no.	%	no.	%	no.	%		
Blood pressure cuff:																	
4. Suitable size.	Follow	34	82.9	30	66.7	14	100.0	7.90	*	35	83.3	37	72.5	6	78.0	1.82	0.402
	Unfollow	7	17.1	15	33.3	0	0.0		**0.019**	7	16.7	14	27.5	1	22.0		
5. Correct	Follow	23	56.	22	48.	8	57.1	0.5	0.75	25	59.	25	49.	3	42.	1.3	0.51

distance.	Unfollow	18	1 43.9	23	9 51.1	6	42.9	6	6	17	5 40.5	26	0 51.0	4	9 57.1	3	4
6. Not used over clothes	Follow Unfollow	24 17	58.5 41.5	16 29	35.6 64.4	4 10	28.6 71.4	6.17	*** 0.046**	26 16	61.9 38.1	16 35	31.4 68.6	2 5	28.6 71.4	9.44	*** 0.009**
Blood pressure measured arm: 5. Uncompressed by rolls up sleeves.	Follow Unfollow	26 15	63.4 36.6	25 20	55.6 44.4	4 10	28.6 71.4	5.13	0.077	23 19	54.8 45.2	27 24	52.9 47.1	5 2	71.4 28.6	0.85	0.653
6. Arm is relaxed.	Follow Unfollow	24 17	58.5 41.5	15 30	33.3 66.7	6 8	42.9 57.1	5.54	0.063	24 18	57.1 42.9	18 33	35.3 64.7	3 4	42.9 57.1	4.46	0.108
7. Arm is at the level of the heart.	Follow Unfollow	6 35	14.6 85.4	5 40	11.1 88.9	4 10	28.6 71.4	2.56	0.278	8 34	19.0 81.0	6 45	11.8 88.2	1 6	14.3 85.7	0.96	0.618
8. Correct site of the arm.	Follow Unfollow	9 32	22.0 78.0	5 40	11.1 88.9	7 7	50.0 50.0	9.77	*** 0.008**	11 31	26.2 73.8	9 42	17.6 82.4	4 6	14.3 85.7	1.22	0.544
Position of the patient: 4. Support measured arm.	Follow Unfollow	36 5	87.8 12.2	35 10	77.8 22.2	14 0	100.0 0.0	4.57	0.102	38 4	90.5 9.5	42 9	42.4 17.6	5 2	71.4 28.6	2.28	0.320
5. Support back of the patient.	Follow Unfollow	16 25	39.0 61.0	24 21	53.3 46.7	3 11	21.4 78.6	4.88	0.087	14 28	33.3 66.7	26 25	51.0 49.0	3 4	42.9 57.1	2.93	0.231
6. Support feet of the patient.	Follow Unfollow	12 29	29.3 70.7	6 39	13.3 86.7	2 12	14.3 85.7	3.74	0.154	9 33	21.4 78.6	8 43	15.7 84.3	3 4	42.9 57.1	2.93	0.231

(*) Statistical significant difference, P≤0.05.

(**) Highly statistically significant difference, P≤0.001

Cont. Table (5): Relations between factors affecting blood pressure measurement and result accuracy

Factors affecting BLP measurement		Blood Pressure Measurement Differences															
		Systole								Diastole							
		Increase		Decrease		No Variant		X^2	P-value	Increase		Decrease		No Variant		X^2	P-value
		no.	%	no.	%	no.	%			no.	%	no.	%	no.	%		
The nurse should conceder:																	
9. Resting 3 – 5 minutes before taking reading.	Follow	32	78.0	22	48.9	7	50.0		*	28	66.7	27	52.9	6	85.7		
	Unfollow	9	22.0	23	51.1	7	50.0	8.49	**0.014**	14	33.3	24	47.1	1	14.3	3.76	0.153
10. Emotional status.	Follow	16	39.0	3	6.7	3	21.4	13.09	*	16	38.1	6	11.8	0	0.0	11.43	*
	Unfollow	25	61.0	42	93.3	11	78.6		**0.001**	26	61.9	45	88.2	7	100.0		**0.003**
11. Empty bladder.	Follow	18	43.9	3	6.7	5	354.7	16.26	**	19	45.2	6	11.8	1	14.3	13.95	*
	Unfollow	23	56.1	42	93.3	9	64.3		**0.000**	23	54.8	45	88.2	6	85.7		**0.001**
12. Avoid talking.	Follow	9	22.0	0	0.0	2	14.3	10.74	*	10	23.8	0	0.0	1	14.3	13.42	*
	Unfollow	32	78.0	45	100.0	12	85.7		**0.005**	32	76.2	51	100.0	6	85.7		**0.001**
13. Suitable time during measuring.	Follow	29	70.7	5	11.1	7	50.0	32.07	**	28	66.7	12	23.5	1	14.3	19.94	**
	Unfollow	12	29.3	40	88.9	7	50.0		**0.000**	14	33.3	39	76.5	6	85.7		**0.000**
14. Avoid caffeine for 30 min.	Follow	41	100.0	45	100.0	14	100	100	--	42	100.0	51	100.0	7	100.0	100	--
	Unfollow	0	0.0	0	0.0	0	0.0			0	0.0	0	0.0	0	0.0		
15. Avoid smoking for 30 min.	Follow	41	100.0	45	100.0	14	100	100	--	42	100.0	51	100.0	7	100.0	100	--
	Unfollow	0	0.0	0	0.0	0	0.0			0	0.0	0	0.0	0	0.0		
16. Room temperature.	Follow	41	100.0	45	100.0	14	100	100	--	42	100.0	51	100.0	7	100.0	100	--
	Unfollow	0	0.0	0	0.0	0	0.0			0	0.0	0	0.0	0	0.0		

(*) Statistical significant difference, P≤0.05,
(**) Highly statistically significant difference, P≤0.001(--) Not valid

Table (6): Relations betweenfactors affecting blood pressure measurement and academic qualification

Regarding nurses' **qualification,** the current table illustrates that, there was a highly statistically significant relation between factors affecting BLP measurement and nurse's qualifications in: patient resting 3 – 5 minutes before starting measurement and considering emotional status of the patient at (P ≤ 0.001).Similarly there was statistical significant relation between factors affecting BLP measurement and nurse's qualifications in;arm relaxation& arm at the level of the heart, empty bladder and suitable time during measuringat (P ≤ 0.05).

Concerning nurses'**experience**, the same table also illustrates a statistical significant relation between factors affecting BLP measurement and nurse's experience in: cuff over clothes, supportpatients' feet, empty bladder and taking suitable time during measuring at (P ≤ 0.05).

Table (6): Relations between factors affecting blood pressure measurement and academic qualification

Factors affecting BLP measurement		Personal Characteristics													
		Qualification								Experience					
		Diploma		Associated		BSc degree		X^2	P-value	<10 Y		>10 Y		X^2	P-value
		no.	%	no.	%	no.	%			no.	%	no.	%		
Blood pressure cuff:															
1. Suitable size.	Follow	32	71.1	13	81.2	33	84.6	2.34	0.337	22	78.6	56	77.8	0.01	0.212
	Unfollow	13	28.9	3	18.8	6	15.4			6	21.4	16	22.2		
2. Correct distance.	Follow	28	62.2	9	43.8	18	46.2	2.82	0.249	16	57.1	37	51.4	0.27	0.155
	Unfollow	17	37.8	9	56.2	21	53.8			12	42.9	35	48.6		
3. Not used over clothes	Follow	22	48.9	10	62.5	12	30.8	5.43	0.064	16	57.1	28	38.9	2.73	*
	Unfollow	23	51.1	6	37.5	27	69.2			12	42.9	44	61.1		**0.047**
Blood pressure measured arm:															
1. Uncompressed by rolls up sleeves.	Follow	24	53.3	10	62.5	21	53.8	0.44	0.830	16	57.1	39	54.2	0.07	0.171
	Unfollow	21	46.7	6	37.5	18	46.2			12	42.9	33	45.8		
2. Arm is relaxed.	Follow	12	26.7	9	56.2	24	61.5	11.24	*	15	53.6	30	41.7	1.15	0.282
	Unfollow	33	73.3	7	43.8	15	38.5		**0.002**	13	46.4	42	58.3		

3. Arm is at the level of the heart.	Follow Unfollow	342 93.3	6.7	61 0	37.5 62.5	633	15.4 84.6	8.81	*** 0.011**	325	10.7 89.3	1260	16.7 83.3	0.56	0.454
4. Correct site of the arm.	Follow Unfollow	936	20.0 80.0	313	18.8 81.2	930	23.1 76.9	0.18	0.945	622	21.4 78.6	1557	20.8 79.2	0.00	0.947
Position of the patient: 1. Support measured arm.	Follow Unfollow	378	82.2 17.8	124	75.0 25.0	363	92.3 7.7	3.16	0.247	253	89.3 10.7	6012	83.3 16.7	0.56	0.199
2. Support back of the patient.	Follow Unfollow	2223	48.9 51.1	610	37.5 62.5	1524	38.5 61.5	1.16	0.569	1513	53.6 46.4	2844	38.9 61.1	1.77	0.182
3. Support feet of the patient.	Follow Unfollow	1134	24.4 75.6	016	0.0 100.0	930	23.1 76.9	4.79	0.083	919	32.1 67.9	1161	15.3 84.7	3.58	*** 0.039**

Cont. Table (6): Relations between factors affecting blood pressure measurement and academic qualification

Factors affecting BLP measurement		**Personal Characteristics**													
		Qualification								**Experience**					
		Diploma		Associated		BSc degree		**X²**	**P-value**	<10 Y		>10 Y		**X²**	**P-value**
		no.	**%**	**no.**	**%**	**no.**	**%**			**no.**	**%**	**no.**	**%**		
The nurse should consider: 1. Resting 3 – 5 minutes before taking reading.	Follow Unfollow	27 18	60.0 40.0	4 12	25.0 75.0	30 9	76.9 23.1	12.89	**** 0.001**	16 12	57.1 42.9	45 27	62.5 37.5	0.24	0.159
2. Emotional status.	Follow Unfollow	54 0	11.1 88.9	0 16	0.0 100.0	17 22	43.6 56.4	18.22	**** 0.000**	9 19	32.1 67.9	13 59	18.1 81.9	2.33	0.126
3. Empty bladder.	Follow Unfollow	63 9	13.3 86.7	3 13	18.8 81.2	17 22	43.6 56.4	10.46	*** 0.005**	12 16	42.9 57.1	14 58	19.4 80.6	5.74	*** 0.016**
4. Avoid talking.	Follow Unfollow	63 9	13.3 86.7	0 16	0.0 100.0	53 4	12.8 87.2	2.36	0.356	32 5	10.7 89.3	86 4	11.1 88.9	0.00	0.954
5. Suitable time during measuring.	Follow Unfollow	14 31	31.1 68.9	3 13	18.8 81.2	24 15	61.5 38.5	11.90	*** 0.002**	15 13	53.6 46.4	26 46	36.1 63.9	2.54	*** 0.051**
6. Avoid caffeine for 30 min.	Follow Unfollow	45 0	100.0 0.0	16 0	100.0 0.0	39 0	100.0 0.0	100	--	28 0	100.0 0.0	72 0	100.0 0.0	100	--
7. Avoid smoking for 30 min.	Follow Unfollow	45 0	100.0 0.0	16 0	100.0 0.0	39 0	100.0 0.0	100	--	28 0	100.0 0.0	72 0	100.0 0.0	100	--
8. Room temperature.	Follow Unfollow	45 0	100.0 0.0	16 0	100.0 0.0	39 0	100.0 0.0	100	--	28 0	100.0 0.0	72 0	100.0 0.0	100	--

(*) Statistical significant difference, P≤0.05
(**) Highly statistically significant difference, P≤0.001
(--) Not valid

Table (7): Multi-Variant Analysis Regression forblood pressure Measurement Variant betweenresearcher and Nurse Measurement

This tableemphasizes that the mostfactors affect blood pressure measurement were; Suitable size of the cuff, Uncompressed arm, Correct site of the arm with same level on the other hand, the factor that has the major effect on blood pressure measurement accuracy is nurses qualification especially diploma degree {Coefficients 18.950, 1.156, 1.137 and 2.042} respectively with (p - value 0.998, 0.123, 0.117, 0.006) respectively.

Table (7): Multi-Variant Analysis Regression for blood pressure Measurement Variant between researcher and Nurse Measurement

Item	*Unstandardized Coefficients*		OR	*p-value*	*95% Confidence Interval for B*	
	B	*Std. Error*			*Lower*	*Upper*
Suitable size of the cuff	18.950	7.701	2.008	0.998	0.000	-
Uncompressed arm	-1.156	0.750	0.315	0.123	0.072	1.369
Correct site of the arm	1.137	0.725	3.119	0.117	0.753	12.915
Qualification						
Bachelor degree	2.439	0.894		0.012*		
Diploma degree	2.042	1.172	11.462	0.006*	1.988	66.088
Associated degree	0.494	0.815	7.709	0.081	0.775	76.707

IV. Discussion

Blood pressure (BLP) measurement is a fundamental clinical skill that is frequently performed by staff nurses and one considered technically challenging to master for nurses [30]. Accuracy is imperative for patient health assessment and for informing clinical decision making and it is, therefore, essential that nurses are taught to perform the skill correctly [31].Therefore, the focus of this study was to assess blood pressure measurements: factors affecting readings accuracy.

The findings of present study illustrate that there are many factors that affect blood pressure measurement three of them which are: suitable size of the cuff, uncompressed arm, and correct site of the arm; in addition to the nurses' qualification had the major effect on the accuracy of measurement.

Sociodemographic characteristics

The sample had a higher percentage of female gender with mean age 35.77 $\pm$ 7.49 and less than half of them had diploma. In agreement with this, **Christopher et al (2015)**[32] reported in their study that was applied on 17 nurses in the University of Sydney, in Australia, founded that most of their studied subject are females but less than half of them had Bachelor degree.

The lack to follow factors that affect BLP reading among nurses in the current study is that about half of them measure BLP inaccurately less thanreading by the researcher while less than half of the studied subject measure BLP more than BLP values measured bythe researcher.

According to the present study findings, there was a relation between personal characteristics and blood pressure measurement differences,it significantly affect the accuracy of measurement such as their qualification, level and years of experience,while nurses' age had no relation with their practice. In the same line **Zhang et al (2017)** [33]found that there was a significant relationbetween the measurement accuracy and nurses experience.

Moreover, results of the current study demonstrated factors that significantly influence BLP measurement such as; suitable cuff size This is agreed with**Reyeset al (2009)** [34]theyfound that, an erroneous reduction in cuff size significantly increased the measurements for systolic (SBP)and diastolic (DBP)blood pressure, whereas an increase in cuff size significantly decreased the measurements reading.

The current study assess the factors affect measurementaccuracy the cuff placed over clothing found that significantly affect the SBP but there was not significantly affect DBP.On contrary **Holleman et al (1993)** [35] and **Pinar et al (2010)**[36] reported non-significant relation for both while guidelines often specify that the sphygmomanometer cuff should be placed over a bare arm; however, the empirical evidence does not provide any clear support for this recommendation. It was supported by **Grace et al (2008)**[37] report they found on their studies that applied on two groups one group measured BP on bare arm and the second group sleeved-arm, after investigation these study found difference between first and second systolic pressure readings in the sleeved-arm group. It was lower than expected. The effect was a statistically non-significant between-groups difference of 0.76 mm Hg and the mean difference between the 2 groups when comparing the first and second diastolic pressure readings was –0.31 mm Hg.

Arm at the level of theheart,as the present study investigated the effect of level of the measured arm on BP measurement accuracy it was found no significant effect. In contrast with **Adiyaman et al (2006)** [38]who found that both SBP and DBP were found to increase (by a small to large amount) when the arm was lower than heart level.

Measured arm should be uncompressed by rolls up sleeves. Itwas another factor that presented in the current study where there was no significant effect in both SBP and DBP measurement accuracy. Similar finding was in the study done by**Hoon, et al (2013)** [39]on GangneungAsan Hospital, when

investigate effect of blood pressure measurement accuracy with completely exposing the upper arm, the cuff placed over the sleeve or with the sleeve rolled up, found that there were no significant differences among the three groups in the accuracy of SBPat ($P = 0.32$) and in the accuracy DBPat ($P = 0.77$).

Correct site of the arm, finding of the current study that illustratesthat when BP cuff put by correct way in correct position on the measured arm, had a significant effect on SBP accuracy while there was nosignificant effect on DBP. On contrary with **Biloet al (2017)** [40]they found that when the size of a standard auscultatory BP measuring device cuff was appropriate, its incorrect placement in relation to the brachial artery did not significantly affect measurement accuracy, conversely, when the cuff was too small in relation to the arm circumference (undercuffing), cuff displacement resulted in a significant overestimation of BP.

Support measured arm, Support back of the patient and Support feet of the patient, Findings of current study indicated that there was no statistically significant effect on BP measurement accuracy. On contrary,**Familoni and Olunuga (2005)** [41]found small but significant increases in measurements of BP in an unsupported arm compared with a supported arm for both SBP and DBP. In addition to **Cushman et al (1990)** [42]who reported that sitting on a table with no back support increased DBP (but not SBP) by a moderate amount, compared with sitting on a chair with back support. Regarding to legs support, **Pinar et al (2010)** [36] reported an increase in SBP when legs were crossed compared with sitting with feet flat. Significant effects ranged from small to moderate increases in both SBP and DBP.

Regarding**resting period before BP measurement,**the present study showed resting 3 – 5 mints before starting measurement had significantly effect on systolic BP accuracy while there was no significant effect on diastolic accuracy measurement. This is in agreement with **Nikolic et al (2014)** [43] who assessed the effect of rest period duration on BP found that patients had significantly higher SBP and DBP if they did not rest for a sufficient period of time prior to measurement. It was shown that resting for 10 or 16min could decrease SBP by a small-to-moderate amount and DBP by a small amount.

In relation to **considering emotional status before measurement** of the patient, the current resultsrevealed that there was greater significant effect of the emotional status on SBP and DBP measurement accuracy. Which supported by **Pan et al. (2015)** [44] who suggested that there was an association between anxiety and increased risk of increase SBP and DBP. These results support early detection and management of anxiety in hypertensive patients.On the same line**Shah et al., (2011)** [45]**; Jackson et al., (2016)** [46]**; Mermerelis et al, (2016)** [47]found thatdepression alsohad a significant and independent risk factor for increase BP reading, especially in young people.

Findings of current study indicated that **empty bladder before BP measurement** had highly significant effect on the accuracy of SBP and significant effect on DBP measurement. This finding is incongruence with**Choiet et al (2011)** [48] who found that full bladder influence both SBP and DBPmeasurements**.**

Moreover, the present study results illustrate that **talking during measurement** had significant effect on accuracy of both systolic and diastolic blood pressure measurement. In the same track,**Zheng et al (2012)** [49]evaluated the effect of the patient talking on BP measurement; found that there was an increase in both SBP and DBP. Significant effects ranged from mild to moderate increases for SBP, and small-to-moderate increases for DBP, compared with no talking.

Concerning **Suitable time during blood pressure measurement (inflation and deflation),** the present study indicated highly statistical significant effect on BP measurement accuracy. Thesefindings are in agreement with those, **Zheng et al (2011)** [50] who examined the effect of cuff deflation faster than the recommended, reported that the significant effects ranged from mild to moderate decreases in SBP and mild to moderate increases in DBP. The magnitude of effects was found to depend on the speed of deflation and the patient's heart rate.

Finally, regarding**avoid caffeine for 30 min, avoid smoking for 30 min and room temperature,**the present study found that all these factors were invalid because, according to the hospital policy inhibit smoking and caffeine drinking for inpatient and room temperature was maintained by central air condition. But there was other studies that found significant effect on BP accuracy such as; **Mesas et al (2011)** [51] reported that caffeine had significant effects on SBP and DBP ranging frommild to moderate, while**Farsalinoset al (2014)** [52]reported that there was significant effects of acute nicotine use (cigarette smoking or passive cigarette smoke exposure) on blood pressure measurements accuracy ranging from mild to very high increases for both SBP and DBP were measured as far as 20–30min after smoking.In addition to**Greaney et al (2014)** [53]when assessed the effect of patient exposure to cold found that there was significantly effects on BP measurement accuracy ranged from moderate to high increases in SBP and mild to very high increases in DBP.

Regression analysis of the current study revealed that**Suitable size of the cuff, uncompressed arm and correct site of the arm** were the most factors that had effects on the accuracy of BLP measurement.Also, findings revealed that the educational level of the nurses was the factor that had the major effect on the accuracy of BLP measurement. This result supported by **Freseet al (2011)** [(11)], they found that the systolic and diastolic blood pressure measurements performedwith standard cuffs gave false reading than those with large cuffs, and that the difference observed was statistically significant.

The researchers' point of view, the results of the current study might be explained as the majority of nurses were influenced by the previous BlP measurements by her colleagues or by the concession physician. In addition numbers of nurses were hesitated and had low self confidence in her skills. It was noticed that the main focus was how much the difference between their own measurements and the previous measurements not the actual reading.

Hypertension is a complex, chronic condition that is often referred to as the "silent killer". As clients are often asymptomatic, detection and treatment delays may occur which may result in the development of target organ damage and other debilitating complications [(54)]. Data from numerous observational epidemiological studies have provided persuasive evidence of a direct relationship between high blood pressure and cardiovascular disease **(Pickering et al., 2005**)[(55)]. High blood pressure increases the risk of ischemic heart disease 3-to-4 fold and of overall cardiovascular risk by 2-to-3 fold. The incidence of stroke increases approximately 8-fold in persons with definite hypertension. It has been estimated that 40% of cases of acute myocardial infarction or stroke are attributable to hypertension **(WHO, 2003)** [(56)]. **(Pickering et al., 2005**) [(55)]report on a recent meta-analysis that aggregated data across 61 prospective observational studies and found that there were strong, direct relationships between hypertension and vascular mortality. Cardiovascular mortality was found to increase progressively throughout the range of blood pressures including the pre-hypertensive **(Pickering et al., 2005**) [(55)]. Hypertension accelerates atherosclerosis and blood vessel injury, increasing the risk of vascular disease and subsequent end organ damage (heart, brain, kidney, eye or limbs). The detection, prevention and control of hypertension have a major impact on health, quality of life and disability [(54)].

V. Conclusion

The findings of thepresent study concluded that:

Academic qualification had proven to be an important factor. Moreover, inappropriate site of the arm, unsuitable size of the cuff and compressed arm with roll up of sleeves had also been thought to be one of the more important variant that affect blood pressure measurement accuracy.

VI. Recommendations

- In-service training program for nurses should be conducted also with newly recruited nurses.
- Procedure manual should be available in each ward.
- Replicate this study of large probability sampling and different hospitals in different geographical locations.

References

[1] Katritsis D, Gersh B, Camm J. Clinical cardiology: current practice guidelines. U.K: Oxford co., 2013; 109-15.
[2] Charles Tremblay-Darveau. Measuring blood pressure using micro-bubbles and ultrasound. Department of Medical Biophysics University of Toronto.2011.
[3] Al Alwan I, Badri M, Al-Ghamdi M, Aljarbou A. Prevalence of self-reported cardiovascular risk factors among Saudi physicians. International Journal of Health Sciences 2013; 7 (7):4-7.
[4] Tiessen A, Smit A, Spithoven E. Cardiovascular screening in general practice in a low SES area. BMC Family Practice 2012; 13:117-9.
[5] Mancia G, Grassi G, Parati G, Zanchetti A. White coat hypertension: An unresolved diagnostic and therapeutic problem. Switzerland: Springer Science &Business Media co., 2015; 1-23.
[6] Blush J. Integrative treatment of hypertension: A clinical, mechanistic approach. London: Taylor & Francis Group co., 2016; 35-8.
[7] Adelmann G. Cardiology essentials in clinical practice. 2nd ed. London: Springer Science &Business Media co., 2011; 104-13.
[8] National Institute for Health and Clinical Excellence. Hypertension: clinical management of primary hypertension in adults. 2011 Available at www. nice.org.uk/CG127 Retrieved on 25/3/2017.
[9] Ringrose J, Millay J, Babwick S, Neil M, Langkaas L, Padwal R. Effect of overcuffing on the accuracy of oscillometric blood pressure measurements. Journal of the American Society of Hypertension 2015; 9(7): 563–8.
[10] James P, Oparil S, Carter B, Cushman W, Himmelfarb C, Handler J. Evidence-based guideline for the management of high blood pressure in adults: Report from the panel members appointed to the Eighth Joint National Committee (JNC8). JAMA 2014; 311(5): 507–20.
[11] Frese E, Fick A, Sadowsky S. Blood pressure measurement guidelines for physical therapists. Cardiopulm Phys Ther J. 2011; 22(2): 5–12

[12] Handler J. The Importance of accurate blood pressure measurement. Journal List Perm J 2009; 13(3): 51–4.
[13] Kantola I, Vesalainen R, Kangassalo K, Kariluoto A. Bell or diaphragm in the measurement of blood pressure. J Hypertens 2005; 23(3):499–503.
[14] National Institute for Health and Clinical Excellence. Hypertension clinical Management of Primary Hypertension in Adults. London:NICEpublications; 2011; 11-28. Available at www.nice.org.ukRetrieved on 27/3/2017.
[15] Judd E, Calhoun D. Apparent and true resistant hypertension: definition, prevalence and outcomes. J Hum Hypertens 2014; 28(8): 463–8.
[16] Sierra A, Segura J, Banegas JR, Gorostidi M, de la Cruz JJ, Armario P, Clinical features of 8295 patients with resistant hypertension classified on the basis of ambulatory blood pressure monitoring. Hypertension 2011; 57(5): 898–902.
[17] Awad E, Gwaied B, Fouda L, Essa H. Compliance of hypertensive patients with treatment regimen and its effect on their quality of life. Journal of Nursing and Health Science 2015; 4(2):26-9.
[18] Ibrahim M. The Egyptian hypertension society, Egyptian hypertension guidelines. The Egyptian Heart Journal 2014; 66: 79-84.
[19] Mohsen M. Problem of hypertension in Egypt. The Egyptian Heart Journal 2013; 65(3): 233-5.
[20] Zwawilla N. Hypertension in Egypt. The health 2013; 4(1):11-3.
[21] Arafa N, Ez-Elarab H. Epidemiology of Prehypertension andHypertension among Egyptian Adults. The Egyptian Journal ofCommunity Medicine 2011; 29 (1): 1-3.
[22] El-Zanaty F, Way A. Egypt Demographic and Health Survey 2008. Cairo, Egypt: Ministry of Health. Available at: http://dhsprogram.com/pubs/pdf/fr220/fr220.pdf. Retrieved on 20/3/2017.
[23] Ellabany E. Community Based Survey Study on Noncommunicable Diseases and their Risk Factors, Egypt, 2005- 2006. Available at:
[24] http://www.who.int/chp/steps/STEPS_Report_Egypt_2005-06.pdf. Retrieved on 21/2/2017.
[25] Lynn P. Taylor's Handbook of Clinical Nursing Skills. 2nd ed.Philadelphia: Wolters Kluwer, 2015; 89-100.
[26] Berman A, Snyder S, Kozier B, Erb G, Hales M. et al Kozier and Erb's Fundamentals of Nursing. 10th ed. Australia: Pearson, 2016; 589- 99.
[27] Wilkinson J, Treas L, Barnett K, Smith M. Fundamentals of Nursing theory, concept and applications. 3rd ed. Philadelphia: Davis Digital, 2015; 611-45.
[28] Charlotte county public school, Nursing Procedure Manual. Florida 2014; 10-56.
[29] John H. Handbook of biological statistics: 2009, Available at: http: // udel. edu / mcdonald / statfishers. Html. Retrieved on: 27/11/2016.
[30] Leslie E, Geoffrey J, James M. Statistical analysis. In: Interpretation and uses of medical statistics. 4th ed. Oxford Scientific Publications; 2011.P.411-6.
[31] Bloomfield J, Roberts J, While A. The effect of computer-assisted learning versus conventional teaching methods on the acquisition and retention of hand washing theory and skills in pre-qualification nursing students: a randomised controlled trial. Int J Nurs Stud. 2010; 47: 287-94. PMid:19762016/ Available at http://dx.doi.org/10.1016/j.ijn urstu.2009.08.003 Retrieved on 29/3/2017
[32] Bland M, Ousey K. Preparing students to competently measure blood pressure in the real-world environment: a comparison between New Zealand and the United Kingdom. Nurse EducPract. 2012; 12: 28- 35. PMid:21641869/ Available at http://dx.doi.org/10.1016/j.nepr.2011.04.009 Retrieved on 29/3/2017
[33] Christopher J. Gordon, Astrid Frotjold, Jacqueline G. Bloomfield. Nursing students' blood pressure measurement accuracy during clinical practice. Journal of Nursing Education and Practice 2015; 5(5): 1-9. Available at http://dx.doi.org/10.5430/jnep.v5n5p46 Retrieved on 31/3/2017
[34] Zhang M, Zhang X, Chen F, Dong B, Chen A, Zheng D. Effects of room environment and nursing experience on clinical blood pressure measurement: an observational study. Blood Press Monit. 2017; 22(2):79-85.
[35] Reyes S, Flores I, Casillas M, Macquarrie A. Differences and effects of medium and large adult cuffs on blood pressure readings in individuals with muscular arms. Blood Press Monit 2009; 14:166–71.
[36] Holleman R, Westman C, McCrory C, Simel L. The effect of sleeved arms on oscillometric blood pressure measurement. J Gen Intern Med 1993; 8:325–6.
[37] Pinar R, Ataalkin S, Watson R. The effect of clothes on sphygmomanometric blood pressure measurement in hypertensive patients. J ClinNurs 2010; 19:1861–4.
[38] Grace M, Sabin N, Dawes M.A comparison of blood pressure measurement over a sleeved arm versus a bare arm. CMAJ. 2008; 178(5): 585–9.
[39] Adiyaman A, Verhoeff R, Lenders M, Deinum J, Thien T. The position of the arm during blood pressure measurement in sitting position. Blood Press Monit 2006; 11:309–13.
[40] Hoon K, Kyeong O, Hee L. Differences in blood pressure measurements obtained using an automatic oscillometric sphygmomanometer depending on clothes-wearing status. Korean J Fam Med. 2013; 34(2): 145–51. Available at http://dx.doi.org/10.4082/kjfm.2013.34.2. Retrieved on 1/4/2017.
[41] Biloet G, Sala O, Perego C, Faini A, Gao L, Głuszewska A, Ochoa J, Pellegrini D, Lonati L, Parati G. Impact of cuff positioning on blood pressure measurement accuracy: May a specially designed cuff make a difference? Hypertension Research advance online publication 12 January 2017.
[42] Familoni OB, Olunuga TO. Comparison of the effects of arm position and support on blood pressure in hypertensive and normotensive subjects. Cardiovasc J South Afr 2005; 16:85–8.
[43] Cushman W, Cooper K, Horne R, Meydrech E**.** Effect of back support and stethoscope head on seated blood pressure determinations. Am J Hypertens 1990; 3:240–1.
[44] Nikolic S, Abhayaratna W, Leano R, Stowasser M, Sharman J.Waiting a few extra minutes before measuring blood pressure has potentially important clinical and research ramifications. J Hum Hypertens 2014; 28:56–61.
[45] Pan Y, Cai W, Cheng Q, Dong W, An T, Yan J. Association between anxiety and hypertension: A systematic review and meta-analysis of epidemiological studies. Neuropsychiatr. 2015.
[46] Shah J, Veledar E, Hong Y, Bremner J, Vaccarino V. Depression and history of attempted suicide as risk factors for heart disease mortality in young individuals. Arch. Gen. Psychiatry 2011; 68 1135–42.
[47] Jackson C, Pathirana T, Gardiner A. Depression, anxiety and risk of hypertension in mid-aged women: a prospective longitudinal study. J. Hypertens. 2016; 34 1959–66.

[48] Mermerelis A, Kyvelou S, Vellinga A, Papageorgiou C, Stefanadis C, Douzenis A. Association between anxiety and depression symptoms with resistant hypertension and central hemodynamics: a pilot study. Hellenic J. Cardiol. 2016; 57 203–4.
[49] Choiet E, Jeong D, Lee J, Lee S, Kim Y, Yi Y. The impact of bladder distension on blood pressure in middle aged women. Korean J Fam Med 2011; 32:306–10.
[50] Zheng D, Giovannini R, Murray A. Effect of respiration, talking and small body movements on blood pressure measurement. J Hum Hypertens 2012; 26:458–62.
[51] Zheng D, Amoore J, Mieke S, Murray A. How important is the recommended slow cuff pressure deflation rate for blood pressure measurement? Ann Biomed Eng 2011; 39:2584–91.
[52] Mesas A, Muñoz L, Artalejo F, Garcia E. The effect of coffee on blood pressure and cardiovascular disease in hypertensive individuals: A systematic review and meta-analysis. Am J ClinNutr 2011; 94:1113–26.
[53] Farsalinos K, Tsiapras D, Kyrzopoulos S, Savvopoulou M, Voudris V. Acute effects of using an electronic nicotine-delivery device (electronic cigarette) on myocardial function: Comparison with the effects of regular cigarettes. BMC CardiovascDisord 2014; 14:78–178.
[54] Greaney J, Stanhewicz A, Kenney W, Alexander L. Muscle sympathetic nerve activity during cold stress and isometric exercise in healthy older adults. J ApplPhysiol 2014; 117:648–57.
[55] Registered Nurses' Association of Ontario, Nursing best practice guideline: nursing management of hypertension 2005 Toronto, Ontario 23-25.
[56] Pickering T, Hall J, Appel L, Falkner B, Graves J, Hill M, Jones D, Kurtz T, Sheps S, Roccella E. Recommendations for Blood Pressure Measurement in Humans and Experimental Animals Part 1: Blood Pressure Measurement in Humans A Statement for Professionals From the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. American Heart Association 2005; 45:142–61.
[57] World Health Organization. The World health report: Switzerland2003: shaping the future. 83-6.

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