Annals of Medicine and Surgery 77 (2022) 103631

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Cross-sectional Study

Prevalence of inter-arm blood pressure difference among young healthy adults: Results from a large cross-sectional study on 3235 participants

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ARTICLE INFO

Keywords:
Inter-arm blood pressure difference
Systolic inter-arm difference
Diastolic inter-arm difference
Hand dominance
Blood pressure

ABSTRACT

More than 100 years ago, the difference in blood pressure (BP) between arms was first reported. Recent studies have shown that different blood pressure between the right and left arm leads to cardiovascular events. Three thousand and thirty volunteers participated in our cross-sectional study. The sIABP was equal in 163 of 3030 persons (5.37%), dIABP was equal in 222 out of 3030 persons (7.32%), from a total of 792/3030 persons (26.1%) sIAD >10 mmHg, and dIAD > or = 10 mmHg was found in 927 out of 3030 persons (33.5%) in the right arm, and 32.4% in the left arm. In 2692 of 3030 volunteers BP, initially recorded in the dominant hand (right arm), showing sIAD > or = 10 mmHg was found in 943 (37.1%) volunteers, and when the first measurement was done in 338 left-handed volunteers it showed sIAD > or = 10 mmHg in 112 of 338 (34.1%), P < .001; 95% confidence interval for systolic right hand were (115.73: 116.73), and for systolic left hand 95% confidence interval were (113.17:114.15). Furthermore, height, residential area, and heart rate above 90 bpm had a significant effect on IAD (P = . 041, 0.002, <001, respectively). In conclusion, significant inter-arm systolic and diastolic BP differences above (10 mm Hg) is common in the young, healthy population. Hand dominance is a significant consideration while measuring blood pressure. It is mandatory to measure blood pressure in both arms in a sitting position with a stable condition.

Evidence before this study

- More than 100 years ago, the difference in blood pressure (BP) between arms was first reported. Recent studies have shown that different blood pressure between the right and left arm leads to cardiovascular events.
- The prevalence of IAD has been estimated only in older adults, diseased adults, pregnant women, and diabetic patients. In a young healthy population, the prevalence is unknown.
- In most of the other studies, BP was measured in the right arm for detection of hypertension.

Added value of this study

- The aim of the present study was to establish an inter-arm blood pressure difference (IAD) and the dominant hand effect on the elevation of blood pressure among a young healthy population.
- In this study, the prevalence of IAD among young, healthy adults was reported.
- It is mandatory to measure blood pressure in both arms in a sitting position with a stable condition

1. Introduction

Blood pressure should be measured in both arms due to differences in values between them to avoid under-diagnosis of hypertension [1]. In the clinical setting, both systolic and diastolic values should be measured [2]. Accurate assessment of blood pressure is mandatory to prevent cardiovascular, cerebrovascular, and renal diseases because hypertension is a modifiable risk factor that increases mortality and morbidity [3]. Detection of an inter-arm difference is an indication of peripheral vascular disease; therefore, knowledge of evaluation, recent guidelines, and risk factors is essential [2]. IAD is recognized as a sign of peripheral vascular disease (PVD), and it may be a prognostic factor for cardiovascular disease and causes a decrease in ankle-brachial pressure

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https://doi.org/10.1016/j.amsu.2022.103631
Received 23 February 2022; Received in revised form 11 April 2022; Accepted 11 April 2022
Available online 20 April 2022

Abbreviations

ABPI	ankle-brachial pressure index
BMI	body mass index
BP	blood pressure
CVD	cardiovascular diseases
DIABP	Diastolic Inter Arm Blood Pressure
DIAD	Diastolic Inter Arm Difference
IAD	inter-arm difference
IASBPD	Inter Arm Systolic Blood Pressure Difference
ICU	Intensive Care Unit
PVD	Peripheral vascular disease
SIABP	Systolic Inter Arm Blood Pressure
SIAD	Systolic Inter Arm Difference

index (ABPI) [2].

In the latest United Kingdom guideline for the management of hypertension [2], and the 2017 American College of Cardiology/American Heart Association Guideline and the seventh report of the Joint National Committee [3], taking BP in both arms is recommended and the higher value should be recorded. Difficulty in the measurement of BP in bilateral arms arises due to cost, lack of time, manpower, and workforce; in most of the other studies, BP was measured in the right arm for detection of hypertension [3]. The prevalence of IAD has been estimated only in older adults, diseased adults, and pregnant women. In a young healthy population, the prevalence is unknown as few studies have been done [1]. Many studies and meta-analyses have been conducted on diseased patients or patients admitted to ICU [4–9], but IABPD has rarely been studied in healthy populations [10,11]. In Hirono's study of 700 cardiovascular disease patients, 11% of patients had higher BP in the left arm than the right by approximately 5 mmHg, but in 16% of patients the right arm BP was higher than the left by a minimum of 5 mmHg, the other having an IAD of less than 5% [12]. In a study by Cassidy and Jones, the right arm blood pressure was higher than the left arm by approximately 4–5 mmHg [13]. The right arm SBP was higher in 147 hypertensive patients by approximately 2–3 mmHg [14]. Another study with 877 patients in whom IASBPD >2 mmHg showed that SBP was similar in 9%, higher in the right arm in 48%, and higher in the left arm in 43% of patients, with no difference in mean SBP between the left or right arms [1]. The aim of the present study was to establish an inter-arm blood pressure difference (IAD) and the dominant hand effect on the elevation of blood pressure among a young healthy population.

2. Materials and methods

2.1. Background and study design

This was a cross-sectional study using quantitative methods for both data collection and data analysis, carried out in the Sulaimanyah governorate in the Kurdistan Region of Iraq among a young, healthy population. The current study has been reported in line with the SCARE 2020 criteria [49].

2.2. Population

Volunteers were 3030 young and healthy for the study from May 13th, 2019 to February 22nd, 2020. Direct permission was received from volunteers for clinical knowledge. The inclusion criteria were: being between the ages of 15 and 40 years; and being in good health. We excluded 205 out of 3235 volunteers because they were not healthy: one case was below 15 years; 49 were above 40 years; 155 had chronic diseases by a medical diagnosis like; 8 were hypertensive; 7 were known to have diabetes mellitus; 10 had hyperthyroidism; 25 had hypothyroidism; 45 had hypercholesterolemia; 22 had renal diseases; 1 had heart problems; and 27 had genetic diseases, all of which were thalassemia.

2.3. Instruments and tools

For data collection, the study instruments were composed of an oscillometer monitor (OMRON model M2 HEM-7120-E, Healthcare Co., Ltd., Japan, accuracy ± 3 mmHg, pulse indicator, arm cuff 22–32 cm, with movement indicator, hypertension indicator, and irregular heartbeat detection) and a standard mercury sphygmomanometer (ALPK2-300 VSN Aluminum die cast body brown, manometer 0–300 mmHg, Accuracy ± 2 mmHg, air system Velcro cuff with latex bag, bulb with valves, weight 1.18 kg), with a fingertip pulse oximeter (model YK-80C) and stethoscope (MDF single-head stethoscope). The tools that were used were chosen after a lot of research and studies about the differences in inter-arm blood pressure in young, healthy people.

2.4. Blood pressure measurements and data collection

The data was collected using a constructed tool, and face-to-face interviews with the participants. Volunteers were seated for 10 min before measurements and refrained from smoking or caffeine ingestion and exercise for >30 min. The volunteer's arm was kept at heart level during the measurement, and using an appropriately sized cuff, two measurements were made in the sitting position, and the mean BP in each arm was recorded. At least one to 2 min elapsed between BP measurements. The first arm (dominant hand) was measured for blood pressure; the arm was supported during each measurement. No tight clothing constricted the arm. Participants sat in a chair with their legs flat on the floor; three trained nurses experienced in collecting clinical data measured brachial BP.

2.5. Statistical analysis

The data were organized and coded into computer files, by using SPSS version 25. Data were expressed as percentages of individuals with systolic IAD and diastolic IAD and mean (± standard deviation) for the inter-arm difference in systolic blood pressure and diastolic blood pressure (DBP). To evaluate the association between IAD and age, BMI, heart rate, systolic BP, and diastolic BP, Pearson's correlation test was used. The Chi-square test was used to compare the prevalence inter-arm difference category between groups; $P < .05$ was considered significant, while $P < .001$ was considered significant.

3. Results

We studied 3235 young, healthy participants from May 13th, 2019 to February 22nd, 2020. We excluded 205 volunteers; because they were not healthy**.**

Finally, 3030 volunteers remained (1377 (45.4%) male, 1653 (54.6%) female, mean age 19.5 (±5) years old, mean BMI 22.3 (±3.9)) all were in good health. Of 3030 participants, 2732 (90.1%) were single, 297 of 3030 volunteers (9.8%) were married, and only one female was divorced. There was no relationship between these factors and IAD, ($P =$ .451). Regarding the weight of participants, 1904 out of 3030 (62.8%) had normal weight, and 124 (4.1%) were obese. A total of 115/3030 volunteers (3.7%) had a hard-physical occupation (hard duty), 751 out of 3030 volunteers (24.7%) had a moderate duty, and 2164 out of 3030 volunteers (71.4%) had a low duty (Tables 1, 2 and 5).

Furthermore, 1369 out of 3030 (45.2%) volunteers had never previously had their blood pressure measured; a total of 3030 volunteers 1634 had normal BP, 592 had pre-hypertension, but hypertension stage 1 was recorded in 420, and hypertension stage 2 was recorded in 221volunteers (Table S1 & Table 6).

Regarding the prevalence of inter-arm difference, a total of 163/

Table 1
Demographic and Clinical Measurements of the study sample.

				Systolic BP mmHg		Diastolic BP mmHg	
	N	Mean age/years	Mean BMI	Right hand	Left hand	Right hand	Left hand
Entire Cross-Sectional	3030	1 9.5 ± 5	22.3 ± 3.9	116.2 ± 14	113.6 ± 13	72.9 ± 10	72.37 ± 11
Right first hand	1692	20 ± 5	22.3 ± 3.8	116.4 ± 14	113.1 ± 13	72.8 ± 11	72.12 ± 11
Left first hand	338	20 ± 5	22.5 ± 3.7	114 ± 13	118.2 ± 13	73.1 ± 10	74.3 ± 10

Data are presented as mean ± standard deviation.

Table 2
General characteristics of study participants.

Variables	Total N (%)	Male N (%)	Female N (%)	*P*-Value
Age (years)	19.56 ± 5.14	20.65 ± 5.96	18.65 ± 4.13	<.001
Height (cm)	165.83 ± 9.82	172.96 ± 7.68	159.89 ± 7.08	<.001
Weight (kg)	61.84 ± 13.39	68.58 ± 13.37	56.23 ± 10.52	<.001
BMI (kg/m2)	22.38 ± 3.84	22.87 ± 3.95	21.97 ± 3.68	<.001
Classification of BMI				<.001
Under weight (BMI >18.5)	440 (14.5)	169 (38.4)	271 (61.6)	
Normal weight (BMI 18.5–24.99)	1904 (62.83)	831 (43.6)	1073 (56.3)	
Over weight (BMI 25–29.99)	562 (18.5)	304 (55)	258 (45.9)	
Obesity (BMI ≤30)	124 (4.1)	73 (59)	51 (41)	
Marital status				<.001
Single	2732 (90.16)	1182 (43.26)	1550 (56.73)	
Married	297 (9.8)	195 (65.6)	102 (34.3)	
Divorced	1 (0)		1 (0)	
Occupational Status				<.001
High duty	115 (3.7)	66 (57)	49 (42)	
Moderate duty	751 (% 24.7)	453 (% 60.3)	298 (39.6)	
Low duty	2164 (71.4)	858 (39.6)	1306 (60.35)	
Level of Education				<.001
Unable to read and write	10 (0.33)	5 (50)	5 (50)	
Able to read and write	17 (0.56)	7 (41.17)	10 (58)	
High school	2356 (77.75)	1122 (47.6)	1234 (52.37)	
Institute Graduate	41 (1)	26 (63.4)	15 (36)	
Under Graduate	483 (15.9)	158 (32.7)	325 (67.2)	
College Graduate	119 (3.9)	56 (47)	63 (53)	
Post Graduate	4 (0.13)	3 (75)	1 (25)	

Data are expressed as mean ± standard deviation, or numbers (%). The p value was derived from independent *t*-test, chi square, test. BMI = body mass index; underweight if BMI>18.5; normal weight if BMI (18.5–24.99); over weight if BMI 25–29.99); and obesity if BMI ≤30.

Table 3
Inter-arm blood pressure (BP) difference for the entire study population.

		Systolic BP		Diastolic BP		
Inter-Arm BP Difference	All N (%)	Right Arm > Left Arm	Left Arm > Right Arm	All N (%)	Right Arm > Left Arm	Left Arm > Right Arm
Entire cross-sectional						
0 mm/Hg	163 (5.3)			222 (7.3)		
1 mm/Hg	303 (10)	213	90	245 (8.1)	119	126
2 mm/Hg	230 (7.5)	155	75	265 (8.7)	140	125
3 mm/Hg	225 (7.4)	138	87	229. (7.3)	116	104
4 mm/Hg	168 (5.5)	114	54	198 (6.5)	101	97
5 mm/Hg	352 (11.6)	226	126	397 (13.1)	221	176
6 mm/Hg	140 (4.6)	84	56	157 (5.1)	89	68
7 mm/Hg	153 (5.0)	95	58	136 (4.5)	70	66
8 mm/Hg	128 (4.2)	78	50	129 (4.2)	81	48
9 mm/Hg	113 (3.7)	72	41	134 (4.5)	70	64
10 mm/Hg	263 (8.6)	178	85	252 (8.3)	160	92
Above 10 mm/Hg	792 (26.1)	515	277	675 (22)	348	327
Total n (%)	3030 (100)	1868 (61.65)	999 (32.9)	3030 (100)	1515 (50)	1293 (42.67)

Data are presented as frequency and percentages.

3030 volunteers (5.37%) sIABP was equal, a total of 222/3030 volunteers (7.3%) dIABP was equal, a total of 926/3030 persons (30.7%) sIAD was 1–4 mmHg, 1149 of 3030 volunteers (37.88%) sIAD was 5–10 mmHg, and 792 out of 3030 (26.1%) volunteers had a sIAD >10 mmHg (Table 3). The dIAD > or = 10 mmHg was found in 508/1515 volunteers (33.5%) in the right arm, and 419/1293 volunteers (32.4%) in the left arm (Table 4). The IAD was greater in males (P < .001) (Table 5).

Moreover, a total of 85/3030 volunteers (3%) were past smokers, 288 of 3030 volunteers (9.5%) were current smokers mostly smoking 10 to 20 cigarettes per day, a total of 290/3030 volunteers (9.6%) were smoking a hookah (Table S2). Nearly all had IAD ranging from 1 to 20 mmHg, and 30% of their IAD was above 10 mmHg (P < .001) (Table 5). In 2692 volunteers, BP was initially recorded in the dominant hand (right arm), but showed sIAD 5–9 mmHg in 787out of 2692 persons (30.99%), and sIAD > or = 10 mmHg was found in 943 of 2692 volunteers (37.1%) in the right arm. The first measurement was done in 338 left-handed volunteers and showedsIAD 5–9 mmHg in 99 out of 338 volunteers (30%), and sIAD > or = 10 mmHg in 112 out of 338 (34.1%), (P < .001) (Table 4). In addition, the blood oxygen level (SPO2) of all the volunteers was normal. There was no association with basic SPO_2, (P = .20) (Table 5).

On the other hand, the height of participants had an effect on IAD (P = .041), and the residential area had a significant effect on IAD; urban participants had more inter-arm difference than rural area participants, (P = .002) (Table 5). The blood group had no effect on the inter-arm difference, (P = .65) (Table 5); a total of 440/3030 volunteers (14.5%) were under weight, and 558 of 3030 volunteers (18.4%) were overweight. The IAD of overweight persons showed that 180 of 558 volunteers (32.2%) had IAD; 123 had IAD approximately 5–10 mmHg, and 57 had >10 mmHg, (P = .046). In addition, 124 of 3030 volunteers (4.1%) were obese, just 30 of 124 (24%) had IAD; 18 had IAD approximately 5–10 mmHg, and 12 had >10 mmHg, (P = .04) (Table S3). The heart rate of 985 of 3030 volunteers was above 90 bpm, and 234 of 985 had IAD; in 162 (% 69.2) were between 5 and 10 mmHg, in 72 (%30.76) were >10 mmHg, (P = .001) (Table S4).

4. Discussion

One of the main goals of this study is to establish the prevalence of

Table 4
Inter arm systolic and diastolic difference.

Clinical variables Dominant Hand	1–4 mm Hg N (%)	5–9 mm Hg N (%)	10–14 mm Hg N (%)	15–19 mm Hg N (%)	≥20 mm Hg N (%)	*P* value
Systolic inter-arm Difference (sIAD)						
Right first hand, Right hand was dominant (n = 2692)	809 (32.6)	787 (30.9)	490 (19.2)	196 (7.7)	257 (10.1)	<.001
Left first hand, Left hand was dominant (n = 338)	117 (35.6)	99 (30)	58 (18)	26 (7.9)	28 (8.5)	
Diastolic inter-arm Difference (dIAD)						
Right hand (n = 1515)	476 (31.4)	531 (35.05)	302 (19.9)	116 (7.6)	90 (5.9)	<.001
Left hand (n = 1293)	452 (34.9)	422 (32.63)	232 (17.9)	106 (8.2)	81 (6.2)	

Association was analysed by chi square, test. P ≤ .05 is considered as statistically significant. And excluded (n = 153) (0.68%) From right first hand and (n = 10) (2.9%) from left hand first in this table because there is no difference between systolic right and left arm BP measurements, and excluded (n = 222) (7.3%) of the study sample in this table because there is no difference between diastolic right and left arm BP measurements.

IAD and the effect of the dominant hand on elevation blood pressure. in a young healthy population. The present study revealed that the prevalence sIAD more than 10 mmHg was found in 792 of 3030 volunteers (26.1%), and dIAD > or = 10 mmHg was found in 927 of 3030 volunteers (30.5%). In our study, the dominant hand had a significant effect on elevation blood pressure. The left-handed people, SBP was higher in the left hand than the right hand.

Most of the previous studies were on patients with cardiovascular diseases and diabetic patients [4,6,7,12,15–17]. Few studies were done with a young, healthy population [10]. Our study involved young, healthy population from the age of 15–40 years. The prevalence of IAD is greater in known hypertensive patients [18]. According to NICE, and Beevers's guidance, the range of IAD below 10 mmHg can be healthy, but more than 10 mmHg should be referred to a specialist [19,20]. Harvey's did not find a role of hand dominance with IABPD [21]. In our study, the dominant hand has higher blood pressure than the non-dominant, as shown by Olmedilla's and Loenneke's studies, and they hypothesised this might be related to a larger circumference due to greater muscle mass and biceps girth [22,23]. In other studies, the right arm had higher SBP with no relationship to hand dominancy [13,14]. Our study in left-handed persons, showed higher SBP in the left arm than in the right arm.

In our study, sIAD in smokers is significantly higher than in non-smokers. It is like Donfrancesco's study, which involved young, healthy smoker Italian adults [24]. In Daniel's study, there was no significant IAD associated with smoking and hypertension [25]. Our study shows a significant difference associated with smoking and high blood pressure. In the same study, there was no association between IAD and BMI [26]. In our study, there is a significant difference between IAD and BMI. Singh, in his pairwise meta-analysis of five studies, found that IASBPD had no relation to age, sex, diabetes, hypertension, dyslipidemia, or smoking [26]. In the present study, IABPD is greater in males, hypertensive, and smokers, but because we only involved young, healthy populations, we do not have data on diseased populations. Thus, our results did not show any relationship between IAD and cardiovascular risk. However, Clark et al. and some other studies found that an IAD >15 mmHg is a risk factor for vascular diseases and death [18]. At first, the IAD was suspected as a sign of aortic aneurysm [27], but in an early study, the IAD has no relation with aneurysm [28]. CE Clark showed that IAD>10 mmHg in patients with CVD was 19%, but patients without CVD it was 2.7% [2]. Moll found that 83% of patients had

Table 5
Inter arm systolic difference. (N = 2867).

Clinical variables	1–4 mm Hg N (%)	5–10 mm Hg N (%)	Above 10 mm Hg N (%)	*P* value
Age of participant by years				0.467
Age below 25 years (n = 2543)	830 (32.6)	1018 (40)	695 (27.3)	
Age above 25 years (n = 324)	96 (29)	131 (40.4)	97 (30)	
Weight of participant by (kg)				0.057
Weight below 55 kg (n = 1052)	331 (31.4)	403 (38.3)	318 (30.2)	
Weight above 55 kg (n = 1815)	595 (32.7)	746 (41.1)	474 (26.1)	
Height of participant by (cm)				0.041
Height below 160 cm (n = 1059)	323 (30.5)	415 (39.2)	321 (30.3)	
Height above 160 cm (n = 1808)	603 (33.3)	734 (40.6)	471 (26)	
Residential area				0.002
Rural (n = 236)	75 (31.7)	113 (47.9)	48 (20)	
Suburban (n = 1186)	400 (33.7)	484 (40.8)	302 (25.4)	
Urban (n = 1445)	451 (31.2)	552 (38.2)	442 (30.6)	
Level of Education				0.055
Unable to read and write (n = 9)	4 (44)	3 (33)	2 (22)	
Able to read and write (n = 14)	3 (21)	6 (43)	5 (36)	
High school (n = 2231)	734 (32.9)	877 (39.3)	620 (27.8)	
Institute graduate (n = 39)	19 (48)	12 (30)	8 (20.5)	
Undergraduate (n = 461)	141 (30.6)	207 (44.9)	113 (24.5)	
College graduate (n = 110)	24 (22)	43 (39)	43 (39)	
Postgraduate (n = 3)	1 (33)	1 (33)	1 (33)	
Blood group (n = 2762)				0.635
A (n = 717)	238 (33.2)	277 (38.6)	202 (28.5)	
B (n = 420)	147 (35)	161 (38.3)	112 (26.6)	
AB (n = 172)	50 (29)	71 (42)	51 (29)	
O (n = 1000)	310 (31)	416 (41.6)	274 (27.)	
Unknown blood group (n = 453)	158 (34.8)	172 (37.9)	123 (27.1)	
Gender				<.001
Male (n = 1284)	453 (35.2)	521 (40.5)	310 (24.1)	
Female (n = 1583)	473 (29.8)	628 (39.6)	482 (30.4)	
Marital status				.451
Single (n = 2590)	848 (32.7)	1030 (39.7)	712 (27.5)	
Married (n = 277)	78 (28.1)	117 (42.2)	80 (28.9)	
Past smoking				<.001
Yes (n = 78)	26 (33)	27 (34)	25 (32)	
No (n = 2789)	900 (32.2)	1122 (40.22)	767 (27.5)	
Current smoking				<.001
Yes (n = 274)	84 (30.6)	104 (37.9)	86 (31)	
No (n = 2593)	842 (32.4)	1045 (40.30)	706 (27.2)	
Smoking hookah				<.001
Yes (n = 273)	88 (32.2)	113 (41.3)	72 (26.3)	
No (n = 2594)	838 (32.3)	1036 (39.9)	720 (27.7)	
First time BP measurement				.187
Yes (n = 1578)	487 (30.8)	648 (41)	443 (28)	
No (n = 1289)	439 (34)	501 (38.8)	349 (27)	
SPO2%				.200
SPO_2 between (91–95%), (n = 131)	33 (25)	59 (45)	39 (29)	
SPO_2 between (96–99%), (n = 2736)	893 (32.6)	1090 (39.83)	753 (27.5)	

Data are expressed as frequency and percentage, or numbers (%). The *P* value was derived from, chi square test. $P \leq .05$ is considered a statistically significant. Abbreviations: Kg = kilogram, *Cm* = centimetre. Blood group (A, B, AB, O) both positive, SPO_2 = peripheral capillary oxygen saturation.

Table 6
Inter Arm Systolic Difference (N = 2867) in normotensive, pre-hypertension, and stage 1,2 of hypertension volunteers.

variables	1–5 mm Hg N (%)	5–10 mm Hg N (%)	10–15 mm Hg N (%)	15–20 mm Hg N (%)	Above >20 mm Hg N (%)	*P* value
Normotensive (n = 1634)	648 (39.6)	516 (31.5)	299 (18.3)	117 (7.1)	54 (3)	<.001
Pre-hypertension (n = 592)	169 (28.5)	201 (33.9)	106 (17.9)	71 (12)	45 (7)	
Hypertension stage 1 (n = 420)	86 (20)	117 (27.8)	95 (22)	65 (15)	57 (13)	
Hypertension Stage 2 (n = 221)	23 (10)	52 (23)	48 (22)	32 (14)	66 (29)	

Association was analysed by chi square test. $P \leq .05$ is considered as statistically significant. And excluded (n = 163) (5.37%) of the study sample in this table because there is no difference between systolic right and left arm BP measurements.

innominate or subclavian artery stenosis on the side that had higher blood pressure [29]. Hennereci and Lawson found that 78–88% of subclavian steal syndrome caused IAD [30,31]. Baribeau and Sin Lau found that sIAD > or = 15 mmHg is related to carotid and aortic artery disease by angiography; therefore, the affected arm had hypertension [32,33]. Siyu and Johansson showed that DBP has a significant effect on cardiovascular disorders [34,35], and Hu et al. showed the appearance of flow-mediated dilation of the arm due to dIAD that caused arterial endothelium lesion [36]. The dIAD > or = 4 mmHg and sIAD > or = 6 mmHg caused intracranial and extra cranial arterial stenosis, respectively [37]. The prevalence of sIABPD >10 mmHg (26.1%) in our study is higher than all previous studies [1,10,18,38,39], even in young, healthy normotensive adults [21]. In previous studies, sIAD ≥10 mmHg was 5–15%, 3–7%, 23.5%, 23,5%, 1.4–38%, 34%, 20.3% respectively [5,7,15,18,39–41,43,44], and dIAD ≥10 mmHg was 7%, 14%. 14.5%, 9.9% respectively [1,18,39,42–44]. Nevertheless, in our study the sIAD > or = 10 was % 36.79% of participants without any previous vascular disease. In a few studies, the BP is higher in the right arm than the left arm [13,41]. BP should be measured in both arms so as not to miss hypertension. Poon showed that 30% of hypertensive patients had normal blood pressure in whom single arm BP had been measured [45]. Our study showed that obesity has a high risk of increasing IAD as Kimura's study in Japan showed that obese patients had more sIAD >10 mmHg [46]. sIAD is higher in the right arm in the general population, according to Johansson's study and other studies [35]. However, in Wei ma's study sIAD is higher in the left arm than the right site but dIAD is lower [48]. Clark in his cross-sectional study showed that IASBPD >10 & 15 mmHg is related to PAD [18]. Canepa et al. measured carotid-femoral pulse wave velocity (cf-PWV) for detection of arterial stiffness and found that persons who had IAD >10 mmHg have recorded higher [47]. Jiji also showed that IAD has a significant relation with arterial stiffness; therefore, detection of IABPD is mandatory to decrease cardiovascular morbidity and mortality [43]. Verberk's meta-analysis showed that the IABPD should be measured precisely because this concurrent checking of BP in both arms is required [42]. Daniel recommends measuring blood pressure in the arm with higher blood pressure to diagnose potential hypertension [25]. However, this cross-sectional study was conducted with young, healthy adults who are apparently stable, Because of a lack of long-term follow-up; we could not conclude on the long-term effects of these results. The sequential or simultaneous measurement requires further research.

5. Challenges and implications

It was difficult to check the blood pressure of both arms on each person for this huge number of people in a very short time. It was also difficult to tell the young, healthy population to double-check their blood pressure in each arm.

It will be extremely beneficial in the future for young, healthy people who have IAD; because they will take care of their health issues and conduct numerous investigations to ensure that they are disease-free. It will also serve as a reminder to the young and healthy population to check their blood pressure in both arms.

6. Limitation

We had low volume cases, so it needs more data in the future. We did not perform any invasive procedures or interventions on the populations so that we could find any related vascular diseases.

7. Conclusion

Significant inter-arm difference (>10 mm Hg) is common in the young, healthy population. Hand dominancy is significant to consider while measuring blood pressure. In left-handed (dominant) people, the pressure is higher than in right-handed people. The rate was mostly between 5 and 10 mm Hg. When IAD is more than 20 mm Hg it requires proper assessment to detect any underlying pathology. It is mandatory to measure blood pressure in both arms in a sitting position with a stable condition. The sequential measurement or the simultaneous measurement needs more research to find the benefit of each. The inter-arm blood pressure difference is significant in young, healthy people and needs to be follow-up for a long time.

Inform consent

Written informed consent was obtained from volunteers for their participation in this study. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Trial registry number

Not applicable.

Data availability statement

The data presented in this study are available on request from the corresponding author.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Ethical approval

Ethical approval has been given by the ethics committee of Rania teaching hospital with approval number [299/2].

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contribution

Conceptualization, RAE and SKA; methodology, RAE. and SKA.; software, SKA and RAE.; validation, RAE, and SKA.; formal analysis, SKA and RAE.; investigation, RAE and SKA; resources, SKA and RAE; data curation, RAE, SKA; writing—original draft preparation, RAE, and SKA; writing—;review and editing, RAE, and SKA.; visualization RAE and SKA. All authors have read and agreed to the published version of the manuscript.

Registration of research studies

Not Applicable.

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Consent

Written informed consent was obtained from volunteers for their participation in this study. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Declaration of competing interest

There is no conflict to be declared.

Acknowledgments

Special thanks for Rozhgar Mohammed Qadir and Zhalla Khdir Mire have a major role in the data collection, we appreciate the efforts Dr. *Sanaa Hassan Abdulsahib* dean college of Nursing in the university of Raparin and for Roger Watson professor of Nursing, School of Health & Social Work, at University of Hull in UK for reviewing, editing and proofreading this paper.

Appendix ASupplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103631.

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