

Research Article

# Sonographic Measurement and Sex Variability of Portal Vein in a Sample of Sudanese Adults

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## Abstract

**Background:** Measurements of the normal portal venous dimension in a species population is so crucial. portal vein can be measured by several methods for assessing different parameters, Computed topography (CT) and sonographic imaging are common examples. The diagnosis of portal hypertension depends on the transverse portal vein diameter (normal diameter from 6-15 mm). The aim of this study is to assess the portal vein diameter and correlate the diameter with age, sex, weight, height and BMI in Sudanese populations. **Methodology:** This was a descriptive cross-sectional study that included a sample of Sudanese adults who were requested to have routine abdominal sonographic scanning due to reasons not related to liver or portal vein problems. The study was carried out at the Radiology Department of Qatar Alnada Hospital, Umbadda, Khartoum, Sudan 2022. **Results:** In this study, 376 participants were included of which more than half were females (56.1%, n=211), while 165 (43.9%) were males. The mean age of the participants was 38.12 + 15.57 years. The mean portal vein diameter was 10.79 + 1.27 millimeters. From this study the portal vein diameter varied with age (p value = 0.000), weight (p value = 0.002), height (p value = 0.000) and sex (p value = 0.000). It is not related to BMI (p value = 0.3). **Conclusion:** This study revealed that the portal vein diameter has positive correlation with age, sex, height, and weight of the person and has no correlation with the BMI.

## Keywords

Sonography, Portal Vein, Sudanese Adult

## 1. Introduction

The splenic vein and superior mesenteric vein meet beneath the pancreas neck to produce the portal vein. In front of the inferior vena cava, it is situated behind the pancreas and the first section of the duodenum. The smaller omentum, which is situated below the hepatic artery and the bile duct, creates the anterior boundary of the epiploic foramen and extends virtually vertically upward in the free edge until it reaches the porta

hepatis. From this point, the right and left branches emerge and enter the respective halves of the liver. 75% of the liver's blood supply is located there [1, 2].

The right and left gastric veins, as well as the superior pancreaticoduodenal vein, are drained by the portal vein [3]. The portal vein has an 8 cm length and an 8 mm width. The five locations for portosystemic anastomosis are the perium-

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bilical region, the liver's bare area, the upper end of the anal canal, and the retroperitoneal sections [3].

The diameter of the vein and the thickness of the portal vein wall both increase when the portal vein pressure rises [4]. The transverse portal vein diameter, which is normally between 6 and 15 millimeters in size, is what determines the diagnosis of portal hypertension [5]. If the diameter exceeds 15 millimeters, the diagnosis is suggested [6].

## 2. Literature Review

According to research done in 2013 by Jayanta Bhattacharya et al. in India, the average portal vein diameter in males was  $10.37 \pm 1.03$  mm while in females, it was  $9.82 \pm 1.01$  mm. They stated that when both sexes were combined, the PVD was  $10.02 \pm 0.89$  mm [7].

In 2015, a study was undertaken in Nigeria by Usman et al. The mean age of the participants in the study was 43.78  $\pm$  12.97 years, with 187 (74.8%) males and 63 (25.2%) females between the ages of 19 and 77. The primary PV's mean diameter was 10.87 mm plus or minus 0.81. Age and respiratory phases were linked with the PV diameter ( $P < 0.05$ ). PV diameters in males and females were statistically different ( $P < 0.05$ ), with female values being higher [8].

Geleto et al in Ethiopia in 2016 came to the conclusion that

there were 195 people there. The median age of the participants was 35 years, and 121 of them (62.1%) were men. With a respirophasic variance of 25.6% and a normal mean portal vein width of 10.6 mm  $\pm$  1.8 SD, the study's findings are clear. Age and sex appeared to have a substantial impact on the normal mean portal vein diameter [9].

Luntsi et al in 2017 reported that for both sexes, the mean portal vein diameter in Nigeria was 9.60  $\pm$  1.41 mm. Males had a mean value of 9.71  $\pm$  1.42 mm while females had a mean value of 9.35  $\pm$  1.46 mm. The PV diameter and the anthropometric measurements showed a positive connection [10].

In 2017, Gareeballah et al used ultrasonography (US) to determine the portal vein diameter (PVD) in Sudanese patients. According to the survey, the average PVD in the Sudanese population is 10.7  $\pm$  1.47 mm. Males have a somewhat larger mean PVD than females have. The study discovered that there was a strong positive link between portal vein diameter and height and weight but no significant correlation between portal vein diameter and participant age or body mass index [11].

According to Jha et al in Nepal in 2023, the mean portal vein width was 9.57  $\pm$  0.66 mm for both sexes. The PV diameter and age, height, weight, and body mass index all showed positive correlations ( $P < 0.05$ ) [12].

For the reason of comparison of the results obtained by the studies mentioned. (table 1)

**Table 1.** Summarizes the PVD in different populations.

Study	Country	Mean of PVD	Comments
Bhattacharya et al [7]	India	10.02 mm $\pm$ 0.89	The PV values higher in males
Usman et al [8]	Nigeria	10.87 mm $\pm$ 0.81	Positive correlation with age. The PV diameter higher in female.
Geleto et al [9]	Ethiopia	10.6 mm $\pm$ 1.8	The normal mean portal vein diameter seemed to have varied significantly by age and sex.
Luntsi et al [10]	Nigeria	9.60 mm $\pm$ 1.41	There was a positive correlation between the PV diameter and the anthropometric variables.
Gareeballah et al [11]	Sudan	10.7 mm $\pm$ 1.47	The mean PV diameter in male is higher. There was no significant correlation between PV diameter and the age, BMI and there was significant positive correlation between PV diameter, height and weight.
Jha et al [12]	Nepal	9.57 mm $\pm$ 0.66	There was a positive correlation between the PV diameter and age, height, weight and body mass index.

## 3. Methods

This was a descriptive cross-sectional study was done at the Radiology Department, Qatar Alnada Hospital, Umbadda, Khartoum, Sudan in the period from November 2021 to October 2022 for Sudanese adults who were requested to undergo sonographic scanning for reasons other than liver or portal vein problems. Data was collected through a total

coverage of Sudanese adult referred to the radiology department of the Qatar Alnada hospital. Participants with on the following were excluded from the study; non-Sudanese patients, patients with history or symptoms or sings suggesting the presence of hepato-biliary disease, patients who had any abdominal surgery, pregnant ladies or children  $<18$  years.

Interview of the participants was done individually after obtaining his informed consent and explanation of the ad-

vantages of the research. Confidentiality in handling patient information was reassured.

Anthropometric measurements were recorded first after reporting the sex and age. Height of the participant was measured with the patient standing on his feet looking forward to identify the highest point of the head. While the weight was measured with weighing scale. BMI was calculated and divided into six groups according to WHO classification.

The ultrasonography device used was Mindray® model DC-N3 (China). The measurements were done by the primary investigator after having training to measure the portal vein diameter by a certified sonographer. The transverse diameter of the portal vein was measured from the outer wall of the vein to the other outer wall and the point of measurement was 1 cm from the point of entrance into the hepatic hilum. (Figure 1)



**Figure 1.** Shows portal vein measurement.

Data were analyzed using Statistical Package for Social Sciences –SPSS version 20 [SPSS. IBM®].

Descriptive and comparative tests were used and results were displayed in tables and figures.

#### **Ethical consideration:**

Ethical clearance obtained from the Ethical Review Board of the Hospital.

Informed consent was obtained from the patients who met the inclusion criteria, patients were met individually to explain the nature and the justification of the study.

All the information of the participants was handled with confidentiality, voluntary non rewarded contribution.

## **4. Results**

376 people were enrolled in this study. Table 2 displays the fundamental characteristics of the population under investigation.

**Table 2.** Frequency of the basic characteristics.

	Mean	Median	Mode	St. deviation
Sex	-	-	Female	-
Age	38.12	34	30	15.577

	Mean	Median	Mode	St. deviation
Weight in kg	64.8	64	65	13.94
Height in cm	163.3	163	165	8.62
PV diameter in mm	10.79	10.95	11	1.27
BMI	24.35	23.9	19.6	5.31

More than half of the participants were females (56.1%, n=211), while 165 (43.9%) were males. The ranged from 18 years to 71 years while the mean age of the distribution of the participants was  $38.12 \pm 15.57$  years. Regarding the weight of the participants, the mean was  $64.88 \pm 13.94$  kilograms. While for the height, the mean was  $163.38 \pm 8.62$  centimeters. The mean BMI was  $24.36 \pm 5.32$ . The mean portal vein diameter was  $10.79 \pm 1.27$  millimeters.

Independent t-test was applied to assess the difference of mean Portal vein in males and females, and found a statistically significant difference as the p-value = 0.000.

The portal vein diameter had positive correlation with age (p value = 0.000), weight (p value = 0.002), height (p value = 0.000) and sex (p value = 0.000). Portal vein diameter is not related to BMI (p value = 0.3). (table 3)

**Table 3.** Correlations between PVD and age, weight and height PVD.

	Pearson Correlation	P-value
Age	0.192 **	0.000
Weight	0.161 **	0.002
Height	0.190 **	0.000
BMI	0.069	0.0183

\*\* mean significant correlation

## 5. Discussion

The goal of this study was to evaluate the portal vein diameter and how it relates to factors including age, sex, weight, height, and body mass index. Patients who had no complaints about the portal vein or liver had ultrasound imaging for the measurement.

Given that Gareeballah et al study had a smaller sample size, the findings of this study are comparable to those of that study. Both studies came to the same conclusion: the portal vein fluctuates with height and weight but is unrelated to BMI [11]. The similarity in the reported results could be the consequence of these studies' similar methodologies.

Similar findings were revealed by studies carried out in

Ethiopia and Nigeria, two other regional nations. For Geleto et al. in Ethiopians and Luntsi et al. in Nigerians, the typical portal vein diameters (PVD) were 10.8  $\pm$  1.8 mm and 10.5  $\pm$  1.6 mm, respectively [9, 10]. Due to the prevalence of shared tribes between Sudan and these nations, this similarity may be genetic in nature or the result of migration. The same assessment techniques were used in both of these investigations, which may also account for the identical outcomes. Additionally, the findings of these investigations showed that PVD varied with age, sex, and BMI [9, 10].

The portal vein diameter was found to be  $9.57 \pm 0.66$  mm in other international studies, which is consistent with the results of our investigation [12, 13]. The BMI exhibited a positive correlation, which is the opposite of what this study found [12, 13], but the PV diameter and age, height, and weight all showed positive correlations [12].

## 6. Conclusion

According to this study, the portal vein diameter positively correlates with a person's age, sex, height, and weight but not with their BMI. Clinicians and anatomists alike should pay attention to the study's findings. They must consider how sex, age, height, and weight can affect the portal vein.

## Abbreviations

CT	Computed Topography
US	Ultrasonography
PV	Portal Vein
PVD	Portal Vein Diameter
BMI	Body Mass Index
SPSS. IBM®	Statistical Package for Social Sciences

## Data Availability

Data available on request from authors.

## Conflicts of Interest

The authors declare no conflicts of interest.

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