ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

ULTRASOUND MEASUREMENTOF RENAL SIZE OF CHILDREN WHO VISIT THE RADIOLOGY DEPARTMENT OF TIKUR ANBESSA SPECIALIZED HOSPITAL

TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA

INVESTIGATOR: Dr. EZEDIN MOHAMMED (RADIOLOGY RESIDENT)

ADVISORS: Dr. DANIEL ZEWDINEH (PEDIATRIC RADIOLOGIST)

Dr. YOCABEL GORFU (PEDIATRIC RADIOLOGIST)

FINAL RESEARCH PAPER SUBMITTED TO ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE DEPARTMENT OF RADIOLOGY IN PARTIAL FULLFILMENT OF THE FOR POST GRADUATE DEGREE IN RADIOLOGY

JAN2019

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AKNOWLEDGEMENT

First above all I would like to thank Almighty Allah to let me to this day in my career. There are always ups and downs in life where one struggles to stand on both feet ,one might not able to make it but should keep trying .The most important part of my life today is to able to have the courage to try things out. May the almighty help us on our way. I also want toexpress my great thanks to AAU-CHS, RadiologyDepartment for giving me this chance to conduct this research. I would like to express my sincere gratitude to my advisors Dr.DanielZewdineh and Dr.YocabelGorfu for their unlimited support and my fellow colleagues. Last but not least I would like to thank my whole family for their deep and unconditional love and support givento me to make it to this day.

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List of abbreviations

AAU-CHS- Addis Ababa University, college of health science

BMI- Body mass index

BSA-Body surface area

CT- computed tomography

IOSR- JDMS - international organization of scientific research -Journal of Dental and Medical Sciences

MRI-magnetic resonance imaging

TASH-Tikur Anbessa Specialized Hospital

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ABSTRACT

Background: Ultrasonography is widely used for assessment of renal pathologies. Measurement of renal size is one of the parameters we use to determine whether the kidneys have increased or decreased in size depending on which we suggest some differentials.

Objective: This study was conducted to meet the objective of assessing the ultrasound assessment of renal size in children visiting the Radiology Department of TASH from May2019-August 2019.

Methods: Institutional based prospective cross sectional study was conducted. A total of 110 study units were selected by using convenience non randomsampling technique. A structured data collection format was used. After completing the data collection, the data wasanalyzed by SPSS version 25software. An ethical clearance was obtained from ethical review committee of AAU-CHS department of radiology. Verbal consent is received from the parents or guardians of the patients.

Results: Out of the 110 children included in the study, 65 were male and 45 were female. There was no significant difference between the renal lengths of male and female (p=0.13). The difference in mean renal lengths between right (6.86cm) and left kidney (7.23 cm) was statistically significant (p= 0.08). There is a good correlation between age and kidney length (r = 0.972), weight and kidney length (r=0.955), body surface area and kidney length (r = 0.940) and height and kidney length (r = 0.932).

Conclusions: ultrasound measurement of the renal size in children with renal pathologies necessitates knowing the normal renal lengthranges in accordance with height of the patient.

Recommendation: - Possible recommendations will be forwarded based on the results obtained.

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CHAPTER ONE

INTRODUCTION

1.1. Background

Ultrasonography is an easy, inexpensive, noninvasive and accurate method that is commonly used to assess sizes of intra-abdominal organs. Ultrasonographic determination of abdominal organ dimension is children are utilized in different conditions including monitoring of growth pattern, diagnosis and follow up of patients with a variety of disease entities. There are numerous advantages of sonography in determining organ size including lack of ionizing radiation exposure; magnification and avoidance of contrast related side effects even sonographic contrast agents are being utilized but not routinely done. The procedure is real time, independent of organ function and respiratory phase.

Renal size measurement is important in children as it is an integral part of evaluation of renal diseases for both diagnostic and prognostic purposes. Because many current disorders with enlargement or kidney reduction, which means that renal size and function determined the health status of the kidney. Decrease in renal size due to parenchymal loss is usually associated with chronic renal disease, while increased renal size may occur in acute kidney injury and acute pyelonephritis. The kidneys continue to grow in size after birth and reach near adult size of 10cm by 12 years of age (1). In addition comparing size of the two kidneys has clinical importance at this provides means of studying the natural history of certain renal diseases (2). For example, unilateral disease in a child may result in an ipsilateral shrunken kidney and contralateral hypertrophy. Also, bilateral renal enlargement may be noted in polycystic disease and some lipid storage disorders (2). Baseline normal reference ranges are helpful to determine organ growth and deviation from the normal ranges.

Clinical assessment of changes in visceral organ size is difficult and unreliable (3) especially renal size cannot be measured by physical examination and only gross enlargement will be detected by ballottement. There are different types of imaging modalities utilized for organ size measurement especially for kidneys. Radiography, Computed tomography and radionuclide imaging expose the patients to ionizing radiation while magnetic resonance imaging is expensive

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and is not readily available. Ultrasound has completely replaced excretory urography as the primary technique for evaluating kidneys in children (4,5,6,7) as it is a simple, inexpensive, non-invasive and reliable way to visualize and measure abdominal visceral organs but is less reproducible compared to urographic measurement(4). There is much intra and inter observer variability upon scanning patients for renal pathologies (7). Renal ultrasound can be done at bedside to provide the clinician with important anatomical details of the kidneys with a low inter observer variability (8).

During renal ultrasonography, one of the parameters usually assessed is renal size. Renal size can change in a number of conditions and therefore, its assessment can aid evaluation. However, it requires prior knowledge of actual normal renal size in the population being studied (6, 8, and 9). Confirmation of grossly enlarged kidneys by sonography can be easy. However, in case of mild enlargement due to a disease processes, making decision about the size can be difficult. Therefore, it is very cumbersome to have a set of standard normal sonographic values showing upper and lower limits. It is also important to build an alternative method for examiners in remote locations where ultrasound facility is not readily available the Prediction model of kidney size estimation according to the parameter that shows the best correlation with the kidney. (10)

Age related normograms are most commonly used to interpret normal renal length. However these normograms are based on a healthy Western population (11). There are reports of some studies on renal sizes in neonates, infants and children among Caucasians, and Asians. However, reports of similar studies are rare among Africans, especially Ethiopians

In Ethiopia, there are few published data on ultrasonographic measurements of intra-abdominal organs. Even, there are local studies on spleen and liver length in childhood based on age (14) but did not come across renal sonographic measurement.

The main purpose of the study was to determine the ultrasonographic dimensions of renal size of children and to assess the relationship between the dimensions of kidneys with age, sex and somatic parameters (height, weight, BSA and BMI) among children visiting TASH. The results that are obtained from this study provide a more practical and objective evaluation during a sonographic examination of the kidneys in children.

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Key words

Nomograms

Somatic parameters

1.2. Statement of the problem

The assessment of renal size is an integral part of evaluation of renal diseases for both diagnostic and prognostic purposes. Sonography is a noninvasive modality for measuring renal size (3, 5, and 10).

The change in renal length may be an evidence of disease. So it is important that we have normal reference values in children in relation to their age, gender, height, weight and body surface area .Age related nomograms are most commonly used to interpret normal renal length. However these nomograms are based on a healthy Western population, while few studies are from Indian subcontinent and even very few studies done in Africa (much being in Nigeria) and needs more research to settle the knowledge gap on our population.

Ethiopian data regarding renal size and its correlation with other somatic parameters in normal Ethiopian children are not published as far as my knowledge is concerned. The present study will be undertaken to determine renal size in normal Ethiopian children (1 month-14 years) and the correlations between kidney length and somatic values, including age, weight, height, and body surface area will be studied.

The numerous advantages of ultrasonography in determining renal size include lack of radiation exposure, radiographic magnification and osmotic effect of the iodinated contrast material (3). The examination is real time, tridimensional, independent of organ function and respiratory phase. Previously the kidney size was accurately measured on intra venous urography which had its own disadvantages (11).

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So it would be useful to develop our own reference values regarding normal renal dimensions (nomograms) for children in our country using sufficient sample size and plausible investigation modality by ultrasonography.

1.3. Rationale of the study

Ultrasound of the kidneys has replaced standard radiography for evaluation of renal pathologies. Abnormalities of kidney size are present in many renal diseases; it is valuable to have a set of standard sonographic measurements to use when these patients are examined in accordance with age and other somatic parameters.

There are researches done in western countries on normal size measurement of the renal size but in Africa as mentioned above there is no much research conducted so far on this condition.in Ethiopia setting, so this study help us to obtain a baseline data for the other researchers with interest in the subject and be used as a source of reference for medical students, residents, seniors for teaching purpose.

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CHAPTER TWO

LITERATURE REVIEW

Renal size is most important parameter used for clinical evaluation of renal growth pattern and renal abnormalities. As there is associated kidney size variation with many renal diseases, it is valuable to have a set of standard sonographic measurements to use when these patients are examined (15).

After introduction of Ultrasound for renal evaluation it has replaced standard radiography for evaluation of renal disease. Before ultrasound was used for measuring renal size, Hodson et al in 1962 reported the renal size of 393 children based on excretory urography and presented a graph of renal length vs age (11). However, the radiographic technique itself yields some variability in the accurate size of the kidney due to magnification, respiratory phase, and osmotic effects of contrast material. Renal size was conventionally determined on X-rays or urography by measuring the renal length, distance of the 1st lumbar vertebra (L1) to (L3) or (L4), and parenchymal thickness .The measurements obtained by these methods were associated with various drawbacks as mentioned above(14).

Ultrasound measurement of renal size is non-invasive, without the risk of radiation and does not have the problem of magnification but is less reproducible compared to urographic measurement. The use of renal Sonography in children was outlined by Lyons et al (16) and was expanded by other reports (17, 18). Sonographic measurement of renal length in 30 children was reported by Tay et al(19), but the data were compared only to excretory urography data, without mention of whether the studies were normal or not, and no renal length or patient age comparison was made.

Renal size can be estimated by measuring renal length, renal thickness and volume. Renal size parameter (length, breadth, width and volume) correlates well with most commonly used somatic variables (age, weight, height, body mass index (BMI), and body surface area (BSA)).

Although the renal length is the most commonly used quantitative measure of renal size for comparison with established standards and correlated best with body height and body surface area, the calculation of body surface area is cumbersome and requires multiple measurements. In

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clinical practice, the body height can be quickly recorded to compare the actual renal length with the renal norm. Similarly, since the estimation of renal volume requires measurement of three dimensions of the kidney, the error associated with renal volume increases in geometric proportion, and observer error may approach 25%. Hence it is simpler to use renal length as a yardstick for comparing renal growth with body growth.

The method used to measure kidney volumes in ultrasound is two-dimensional in nature, is operator dependence and uses geometric assumptions about the shape of kidney to estimate kidney volumes. In contrast, CT and MRI can acquire three-dimensional (3D) data and therefore, do not rely on geometric assumptions to estimate organs volumes. The high cost and being not readily available for clinical use, CT and MRI examination are not so appealing in the study of normal reference values in children. In addition CT has high dose of ionizing radiation exposure and uses potentially nephrotoxic contrast (9).

There was a study done among 1198 normal north Indian children(15)(1 month-12 years) which was published in 2012, to measure renal size with ultrasonography revealed that the renal size is correlated with most commonly used parameters of overall body size including age, weight, and height and body surface area. Among the measured values the best correlation of renal size was seen with body length and body surface area. Renal lengths have no significant difference in males and females.

Another similar Cross-sectional observational research done on May 02, 2011 among 1000 normal northern Indian children aged 1 month – 12 years;(22) showed no statistical difference was found in renal size between sexes and between right and left kidney. A strong correlation was seen between renal sizes with various somatic parameters, the best correlation was between renal size length and body height as the above research revealed.

In another Prospective Observational Study done among 437 Normal Korean Children(0 and < 13 years)(24) for Sonographic Growth Charts of Kidney Length also revealed as there were good correlations between kidney length and somatic values, including age, weight, height, and body surface area. The rapid growth of height during the first 2 years of life was intimately associated with a similar increase in kidney length, suggesting that height should be considered an important factor correlating with kidney length. The other values of age and weight also

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showed good correlations with kidney length in children from 2 to 12 years of age in the study. On the other hand, there were no significant sex-specific differences.

Otiv et al (2012) 20 in their study of ultrasound measured renal dimensions among Indian children, reported a strong correlation of renal size and volume with various somatic parameters, the best correlation was between renal length and body height. Also, Dinkel et al 18 in 1985 studied renal dimensions measured using ultrasound and reported strong correlation between renal volume and body weight, as well as renal length and body height in both boys and girls

The other study which was done in African subcontinent in Southeast Nigeria(24) revealed similar findings with the Indian and Korean researches except there is a statistically significant difference between right and left kidney lengths among 947 children aged 6−17 years old. In this study also shows positive correlation between the measured right and left renal volume with height and weight in both sexes, though statistically significant bilaterally only in girls. The fact that this research has the age range higher than the above studies, the statistically significant result would be accepted.

The study conducted in southwest Nigeria showed gender difference in renal volumes bilaterally was in favor of females but not statistically significant on either the right ($p = 0.530$) or the left ($p=0.689$) kidney. The volumes of both kidneys in both sexes showed positive correlation with their heights. Even if body proportion and rate of growth are strikingly different between boys and girls, their renal lengths did not display a significant difference. No statistical difference was found in renal size between sexes and between right and left kidney in most the researchers reported.

In the above mentioned research correlation was made in children with growth failure and under-nourished children and will be better to correlate the renal length with the body length (23). Judged by sonography, the renal length in Indian children was lower by 11-20% as compared to American children with respect to age,probably due to the larger body size of their American counterparts (15).

In clinical practice, the body height can be quickly recorded to compare the actual renal length with the renal norm. Similarly, since the estimation of renal volume requires measurement of

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three dimensions of the kidney, the error associated with renal volume increases in geometric proportion. Hence it is simpler to use renal length as a yardstick for comparing renal growth with body growth. (21), Due to the large sample size, this study represents the population more closely

There was study done in Interobserver and Intraobserver Variations in Sonographic Renal Length Measurements in Children revealed that the observed variability in sonographic measurement of renal length is comparable to the expected annual increase in length of the kidneys during childhood (2.2-5.7 mm per year). Therefore, caution is suggested when using sonography to evaluate renal growth in children during a year's time.(7)

In our country Ethiopia, data regarding renal size and its correlation with other somatic parameters in normal children are not published as far as my knowledge is concerned even if renal ultrasound is done routinely in health facilities for pediatric patients presented with renal diseases.

In conclusion the renal size measurement is best correlated with body height and no statically significant difference noted between male and female, and also between right and left kidney except the Nigerian study which would be explained by the higher age range taken as compared to the other researches done elsewhere.

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CHAPTER THREE

OBJECTIVES

3.1. General objective

To determine ultrasound assessment of renal size in children who visit Radiology Department of TASH from May 2019- July 2019

3.2. Specific objectives

To determine ultrasound measurements of renal size in children who visit Radiology Department of TASH from May 2019- July 2019

To assess the association of renal size with body somatic parameters in children who visit Radiology Department of TASH from May 2019- July 2019

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CHAPTER FOUR

MATERIALS AND METHODS

4.1. Study area and study period

Study area

The study was conducted inTASH, which is found in Addis Ababa, Ethiopia the capital and largest city of the country. It is the seat of the Ethiopian federal government. According to 2015 estimated population, the city has 3.238 million inhabitants (17).

TASH was established in…. Currently the hospital is under the administration of AAU-CHS serving as tertiary referral hospital serving about 370,000-400,000 patients per year with 900 beds. AAU-CHS is comprised of four schools. The four schools are school of medicine, school of pharmacy, school of public health and school of Allied health sciences which include nursing, midwifery and medical laboratory technology. AAU-CHS school of medicinecomprises clinical disciplines inclusive of internal medicine, surgery, gynecology and obstetrics, pediatrics, radiotherapy, adult oncology, pediatric oncology /hematology, nuclear medicine, psychiatry, laboratory, orthopedics, pharmacy etc. The Radiology department is one of the many departments in the institution which gives radiologic medical service and academic activities. The department is equipped with high-tech imaging equipment including 128 slice CT scanner and 1.5T MR scanner.

Study period

The study was started on May 1/2019 and was completed on august 30/2019**.**

4.2. Study design

A prospective institution based cross-sectional study was conducted.

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4.3. Study population

Source population

The source population was allpediatrics who visited radiology department of TASH from May 01, 2019- July30, 2019**.**

Study population

The study population was all pediatrics who has abdominal sonography at TASH from May 01, 2019- July 30, 2019.

4.4. Inclusion and exclusion criteria

Inclusion criteria: All children between 0 month and 14 years old who visited TASH radiology department from May 01, 2019- July 30, 2019.

Exclusion criteria: children with any medical condition that can affect the renal size are excluded from the study.These are history of premature birth, malignancy, use of steroids, upper urinary tract abnormality, vesicoureteral reflux, urologic surgery, or if ultrasound of their kidneys showed any abnormality, such as hydronephrosis, dysplastic kidney, or solitary kidney.

4.5. Sample size and sampling technique

Sampling technique

Convenience non random sampling technique was employed to recruit study units and mainly done while the investigator is attached at pediatrics department and the following two months.

Sample size

Around 110 patients are selected among pediatrics patients who were scanned for abdominal sonography, those who fulfilled the inclusion criteria were selected accordingly.

4.5. DATA SAMPLING TECHNIQUE AND PROCEDURE

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Age, weight and height are taken prior to the time of examination by ultrasound. Infants were weighed on an infant weighing scale and older children on a beam balance. Weight was recorded to the nearest 100 gms. The standing height was measured on a stadiometer in children above 2 years & in children below 2 years the supine lengths were measured on an Infantometer. Height measured is rounded to the nearest 0.5 cm. These were done by two trained nurses from radiology team and in collaboration with pediatrics team of TASH. The body surface area calculated by BSA (m2) =√ [height (cm)*weight (kg)]/3600

A sonoscape real –time mechanical sector scanner of 3.5 – 5 MHZ frequency with electronic calipers are used to measure the length and width of each kidney in the sagittal and coronal planes passing through the renal hilum with subject in the supine or slightly right or left lateral decubitus positions. Older subjects are instructed to hold their breath for a short while the child placed in a supine oblique position. The maximum renal length is recorded after repositioning the probe in several angulations. Renal width is measured at the renal hilum showing the maximum dimension.

The mean length and width of the right and left kidneys±2 SD were calculated separately for age groups of <1 month, 1-3 months,3- 6 months,6- 9 months, 9months - 1 year, and thereafter every year throughout 14 years. These groups were chosenbecause of the more rapid change in kidney size during the first year of life (5)

4.5.1 DATA COLLECTION PROCEDURES (INSTRUMENT, PERSONNEL, DATA QUALITY CONTROL)

Data was collected by principal investigator and Radiology residents attached to pediatric radiology. The prepared Questionnaire was filled by the data collectors which include measurement of renal size (length and width). Thesociodemographiccharacteristics like age and sex of the patient are documented. Weight and height were recorded in order to calculate BSA.

Data will be collected mainly by the principal investigator and other residents as indicated above after adequate information about the study and contents of questioner is given.

4.5.2 DATA QUALITY CONTROL

To ensure quality of data, pre-test of data collection tools will be made on patients not included in the main and appropriate corrections will be made if needed. The purpose of the pre-testing is to ensure that the checklist is covered correctly and to know if anything can be added in the main research.

4.6. Variables

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Dependent variable

Kidney size is the dependent variable

Independent variables

Age of the patients is divided in accordance with less than one year children to be divided every 3 months and yearly then after

Height, weight, and BSA are the independent variables

4.7. Data quality assurance

In order to ensure quality of data, the data collection format was pretested on children, which was not included in the study. Data was collectedby principal investigator and Radiology residents attached to pediatric radiology.

4.8. Data collection tool and procedure

Data was collected by using pretested structured data collection format which was prepared in English.

4.9. Data processing, analysis and interpretation

After completing the data collection, the data was first checked for completeness, coded and entered using Epi-Data 3.1 and then the data exported into SPSS version-25 for regression and descriptive statistical analysis.

4.10. Operational definition

Ultrasonography-an instrument that uses sound waves to generate images and display it on the monitor

Renal size-measurement of renal length, width and thickness using ultrasound

Somatic parameters-relating to or affecting the body

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4.11. Ethical consideration

An ethical clearance was obtained from ethical review committee of the department of radiology, AAU-CHS. During data collection the purposes and importance of the study was clearly explained and verbal informed consent was obtained from each participants. A great care was taken to maintain the confidentiality and privacy of information gained from participants.

CHAPTER FIVE

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5.1. Results

A total of 110 study units were included in this study. Over half 65 (59.1%) were male and 45(40.9%) were female.The minimum and maximum age of the study units were 1 month and 14 years respectively.

The mean height increased from 44 cm at 1 month to 158 cm at 14 yrs. of age with a standard deviation of 28.3 cm. The mean weight increased with age from 3.6 kg at 1 month to 47 kg at 14 yrs. of age with standard deviation of 10.04kg. The mean body surface area (BSA) increased with age from 0.22 m2 (described as **Wt*ht**/3600 m2 at 1 month to 1.43 m2 at 14 yrs. of age with a standard deviation of 0.62

The mean renal length increased steadily with age from 4.5 ± 0.8 cm at 1 month to 10.3 ±1.2cm in 14 years. The mean renal width increased steadily with age from 2.2 ± 0.386 at <1 month to 4.25±0.689cm

Table 1 .Age and gender distribution of the subjects

Age	Male	Female	Total
0-0.25	6	6	12
0.25-0.5	1	4	5
0.5-0.75	2	4	6
0.75-1	5	0	5
1-2year	7	4	11
2-3years	7	3	10
3-4years	2	3	5
4-5years	5	3	8
5-6years	9	1	10
6-7years	5	4	9
7-8years	5	4	9
9-10years	2	1	3
10-11years	3	1	4
11-12	3	1	4
12-14	3	6	9
Total	65	45	110

Table 2.decriptive statics of the study population

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	N	Minimum	Maximum	Mean	Std. Deviation
age in years and months	110	1	14	7.7455	4.54627
height in cm	110	44.00	158.00	92.0091	28.36217
weight in kg	110	3.50	47.00	15.5982	10.04001
Body surface area in m	110	.22	1.43	.6221	.29059
Right renal length	110	3.00	10.90	6.8664	1.70822
Right renal width	110	1.60	4.90	2.9891	.70037
left renal length	110	3.00	11.90	7.2327	1.77537
left renal width	110	1.60	5.50	3.3291	.83878

Out of the 110 children included in the study, 65 were male and 45 were female. There was no significant difference between the renal lengths of male and female ($p=0.13$). The difference in mean renal lengths between right (6.86cm) and left kidney (7.23 cm) was statistically significant ($p= 0.08$). There is a good correlation between age and kidney length ($r = 0.895$), weight and kidney length ($r=0.820$), body surface area and kidney length ($r = 0.865$) and height and kidney length ($r = 0.884$).

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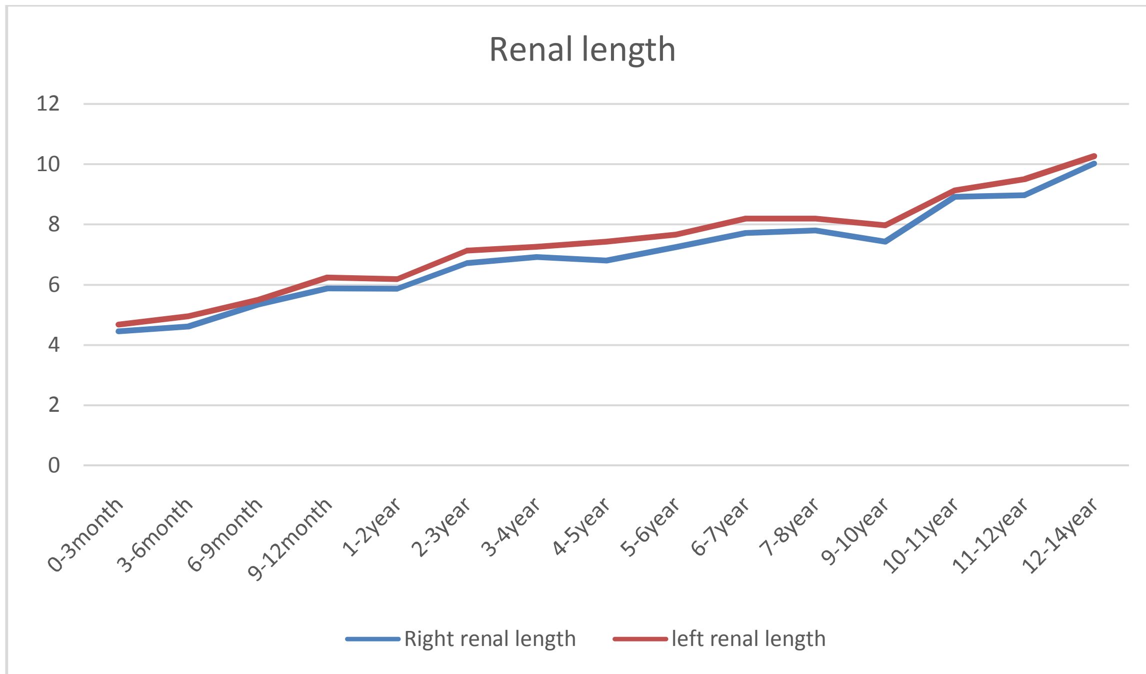

Figure 1.renal length vs age of the patients in months and years

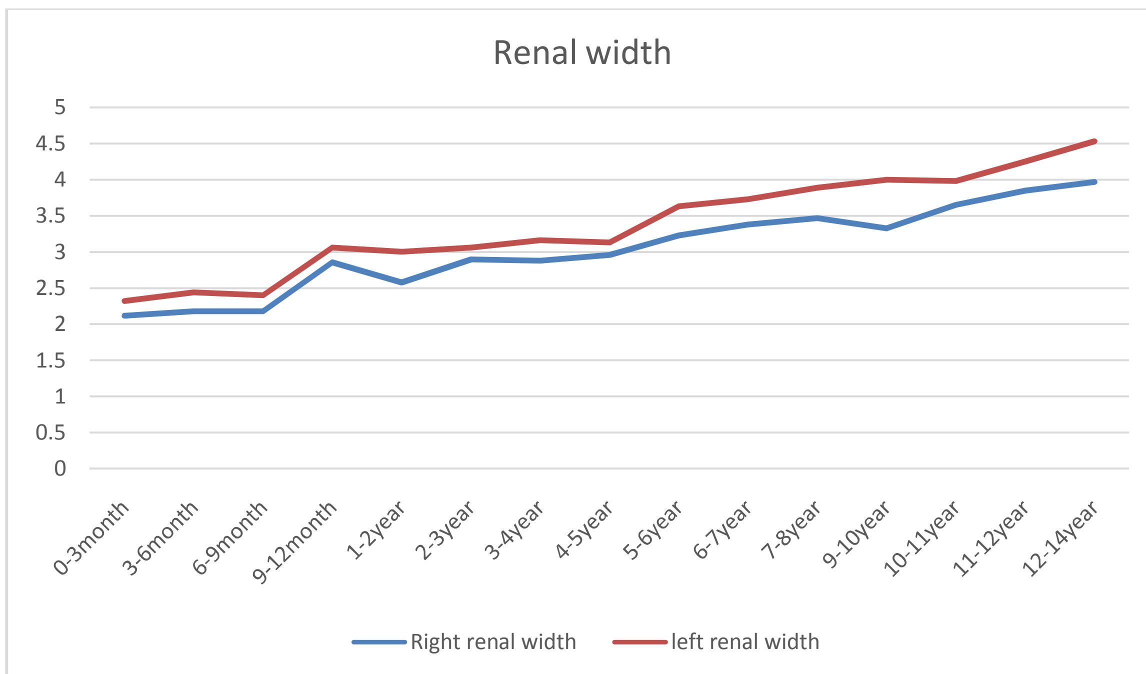

Figure 2 renal width vs age of the patients in months and years

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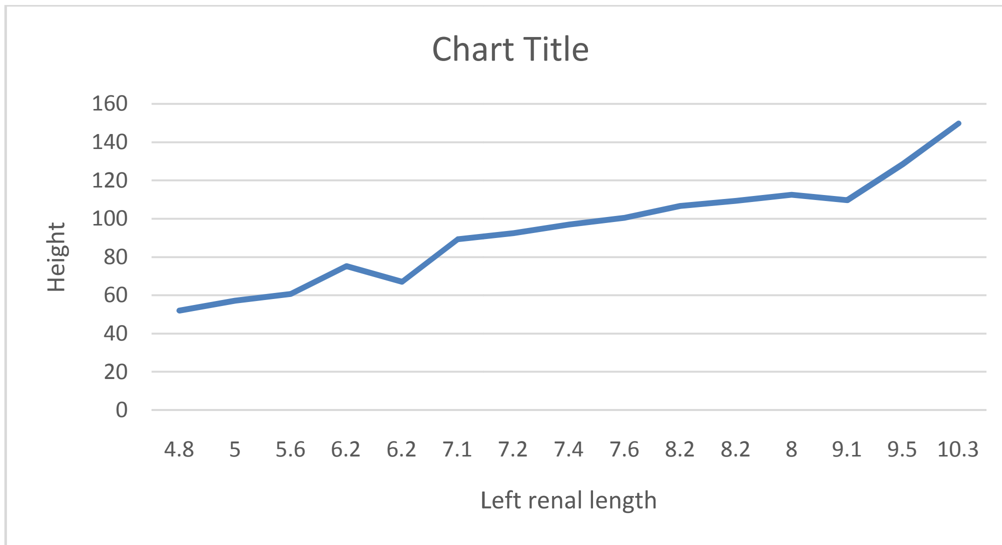

Figure 3: left renal length vs height of the patient

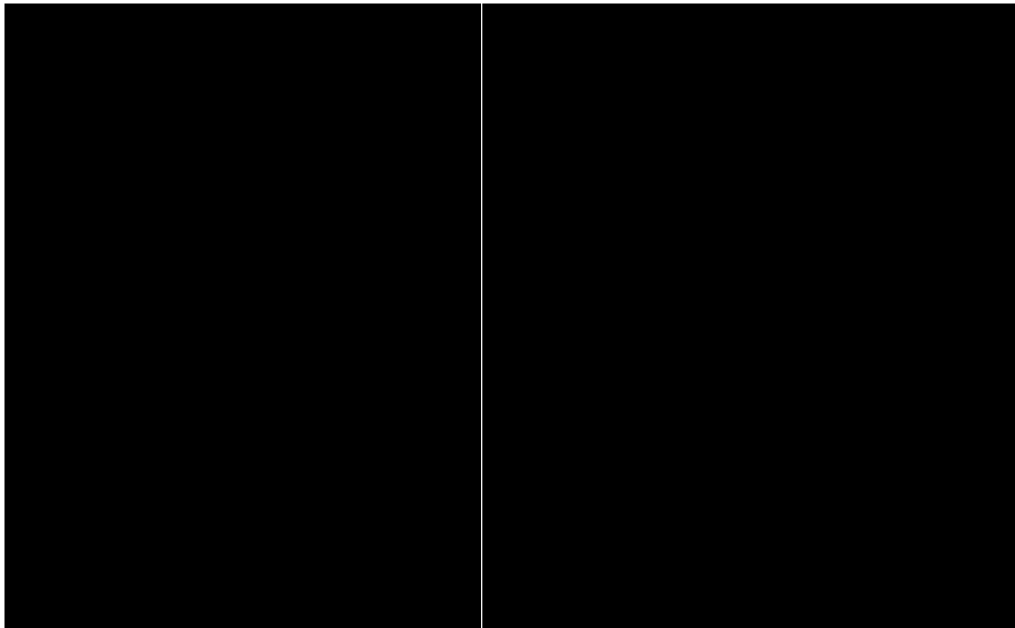

Figure 4: Right renal length vs height of the patient

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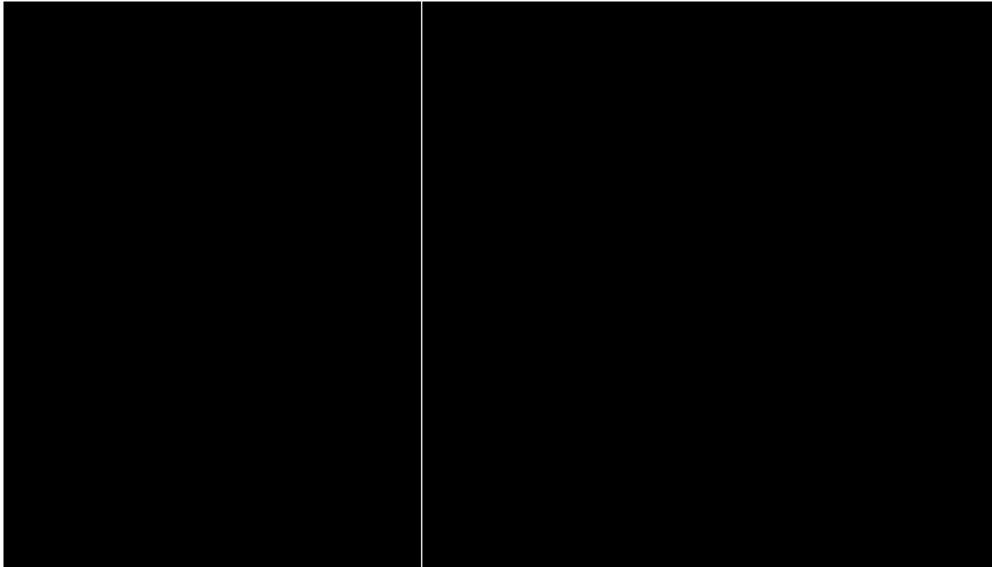

Figure 5 Right renal length vs weight of the patient

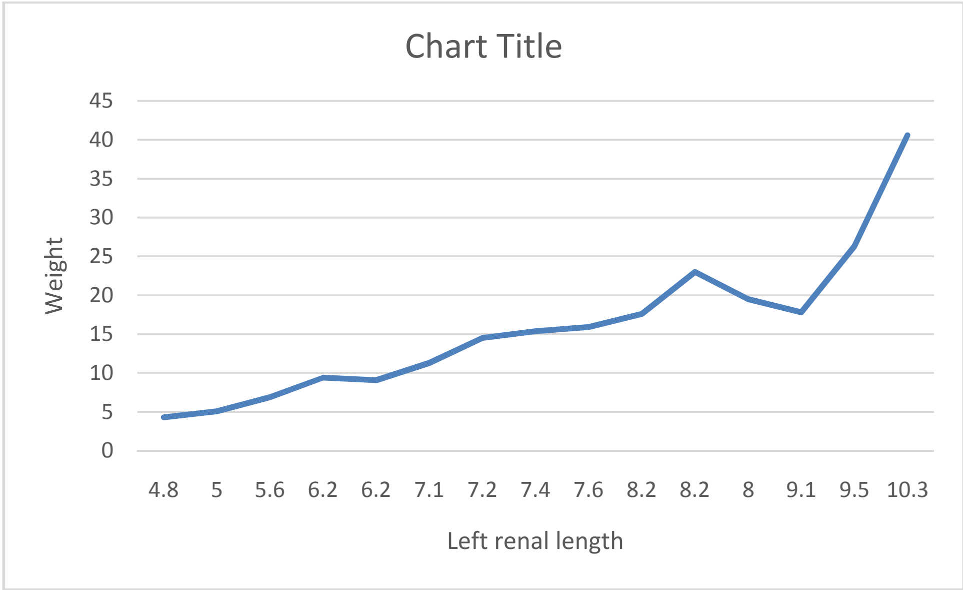

Figure 6 left renal length vs weight of the patient

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Figure 7: Box Plot showing the distribution of kidney size (length and width) by side and gender

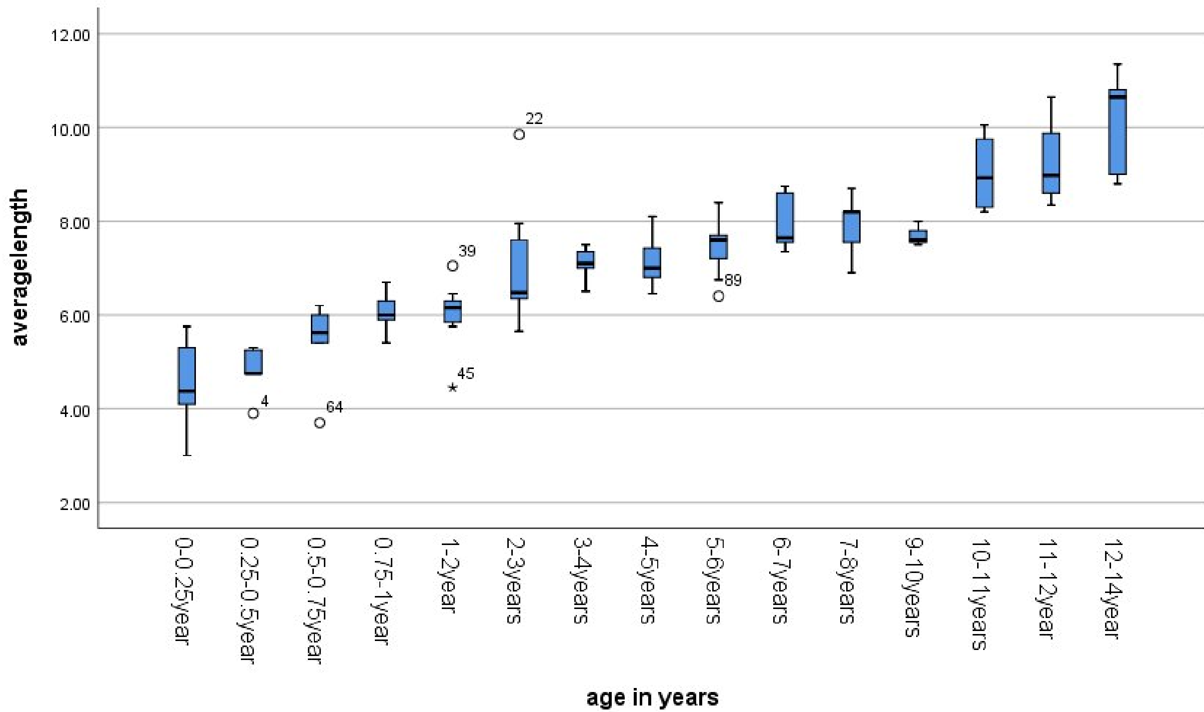
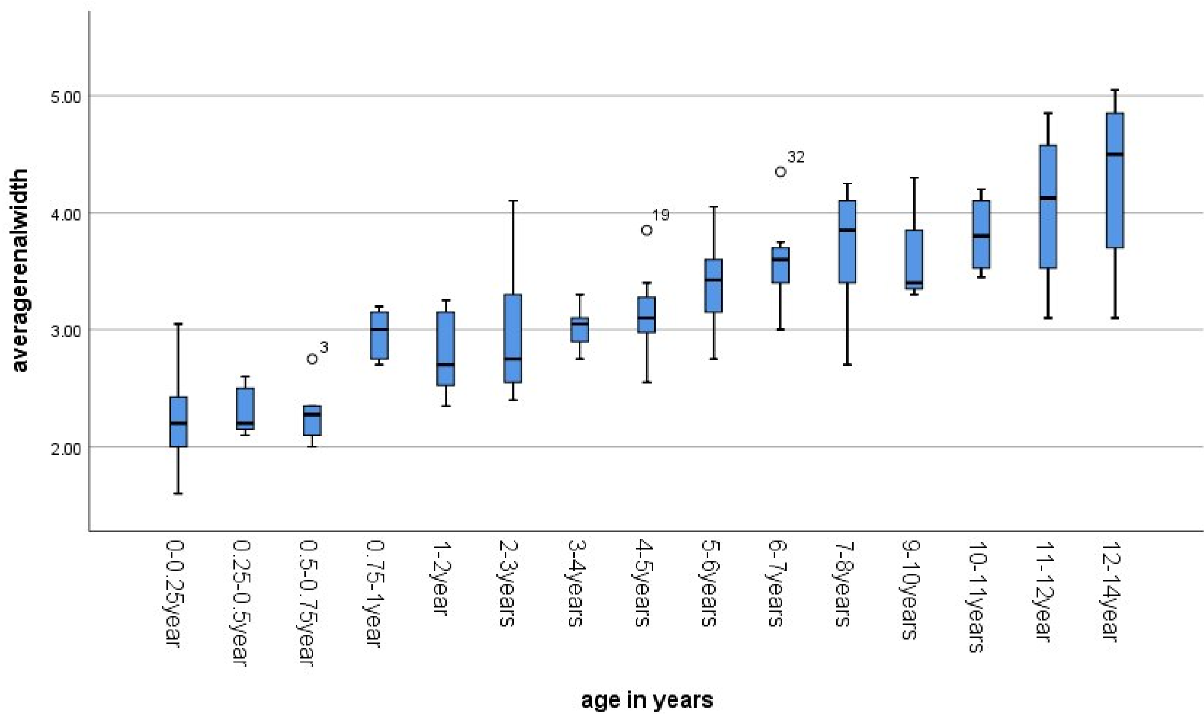


Figure 8 Box Plot showing the distribution of kidney size (length and width) by side and gender



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5.2 Discussions

In Ethiopian health facilities ultrasound is commonly being used in the initial evaluation of abdominal visceral organs in children. Measurement of one or more of an abdominal viscera size is a routine practice during abdominal sonographic assessment to determine variations from normal (1) .Before ultrasound has come into the routine practice, excretory urography was used for measuring renal size, Hodson et reported and presented a graph of renal length vs. age after he measured the renal size of 393 children (11). But as there was some variability in the apparent size of the kidneys in radiography due to differences in centering of the tube and its distance from the patient, phase of respiration, and osmotic effects of the iodinated contrast material ultrasound has avoided these limitations and helped routine measurements of the renal size. (4, 5, 13) Ultrasonographic measurement is an easy, inexpensive, noninvasive, non-use of ionizing radiation and accurate method that is commonly used to assess sizes of intra-abdominal organs. It has also an advantage, as it is independent of organ function and does not have the problem of magnification but is less reproducible compared to urographic measurement.(4)

The purpose of our study was to measure renal dimensions (length and width) by sonography in children visiting radiology department of TASH and to compare with various somatic variables (age, weight, height and body surface area (BSA)). In our study, children ranging from 1month−14 years were studied which is in keeping with pediatrics patients visiting the radiology department of TASH. To the best of our knowledge, literature review Showed that this study covers pediatric kidney dimensions by sonography involving the pediatrics age range of in Ethiopian population even if not representative . Over half 65 (59.1%) were male and 45(40.9%) were female. The minimum and maximum age of the study units were 1 month and 14 years respectively. The mean values of the body parameters include: age = 7.83 ± 0.45 years, height = 92.5 ± 2.83 cm, weight = 15.6 ± 0.99 kg, BSA = 0.622±0.29M2. The average renal length ranges from 4.6 ± 0.8 cm in 1 month and 10.3 ±1.2cm in 14 years.

In the study done by Ravikumar et all in Indianilfoure hospital (n = 250), mean renal length (SD) increased steadily from 4.4 (0.5) cm at 1 month to 8.7 (0.9) cm at 12 yrs of age which is comparable with our study but the upper age in our study is 14 years and the specific age range comparison is9.2(0.9) cm at 12years which is more than this study. In another study done by Otiv et al, the mean renal length (SD) increased steadily

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with age from 4.3 (0.6) cm at 1 month to 8.6 (0.8) cm at 12 years of age. In a study done by Rosenbaum et al (n = 203), mean renal length (SD) increased from 5.28 (0.66) cm at 2 months of age to 10.42 (0.87) cm at 12.5 years of age.

In the present study the renal size correlated well with most commonly used parameters of overall body size including age, body weight, body height and body surface area. Among the measured body parameters, height was the one best correlated with the kidney dimensions followed by BSA, age,weight and gender. Many studies have shown that height is the strongest factor related with kidney length (1, 2, 5, 8).The possible explanation for this correlation could be during the growth and maturation process from infancy through adolescence, growth of visceral organs shows a high correlation with an increment in height, weight and BSA even if the morphology of visceral organs varies from individuals to individuals (1, 6)Eze et al reported that kidney dimensions showed the best correlation with the body height among measured body parameters in Nigerian school aged children and similar findings are found in by konus et al (5) research done in a Caucasian children population. This is supported by a study done by Otiv et al, which also showed a good correlation of renal length with body height (0.9) and renal length with body surface area (r 0.89). But the best correlation of renal length was with body height (r 0.932) in the present study as compared to Otiv et al, who proved the best correlation of renal length with body surface area (r 0.89).ROSENBAUM ET AL.have also found the sonographic “renal length vs. patient age” graph useful as a screening tool in patients specifically referred for renal sonography as well as in those whose kidneys are incidentally imaged. Thus it is easy to predict renal size reliably on the basis of these variables, especially height, in this population. Therefore, when deciding if sonographically obtained dimensions of kidneys are normal, patient height should be the primary concern.

There is significant correlation of the measured renal length with BSA ($P>0.05$) and this finding is supported by many researches done on sonographic measurement of the renal dimensions (2, 5, 8). Although renal size correlates best with BSA, the calculation of BSA is tiresome and itself requires measurements of both height and weight with difficult calculation. As a result, height and weight are usually used rather than BSA.

There was a statistically significant difference between right and left kidney lengths ($p < 0.05$) and also kidney widths ($p < 0.05$).The left renal length is larger than the right contour part and similar findings are also seen in the other researches (10) But a

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research done by Rosenbaum et al studies found that the length was equal in right and left kidneys and the difference is no significant and also similar findings are seen by Otiv et al

Our study has shown that there were no significant differences in measured organ size with respect to gender ($p > 0.05$). This finding is similar to the findings of other previous authors (1, 2, 9, 10, and 11) A study by OTIV, et al. showed there is no significant difference in renal length in boys and girls. Gender certainly is not a determining factor for kidney dimensions in children visiting our hospital and also suggests that special tables based on gender are not necessary for comparison between males and females.

Soyupak et al (15) and Safak et al (10), however, reported that kidney dimensions showed the best correlation with body weight among the children population they studied. These differences with the present study may be due to variations in race or different ethnic origins. The normal limits of the kidneys were, therefore, defined according to height in the present study. Even if it showed age is more correlated with renal length than BSA it has practical point to compare the renal length with age of the patient than the length.

Limitations of the study

- Intrerobserver variation, the difference in US techniques, patient positioning, and cursor placement can affect the reproducibility of measurements on renal length.
- Renal function may be impaired in the morphologically normal kidneys however renal function tests were not done and documented (serum creatinine level or glomerular filtration rate.) even if several researches showed renal function affects size.
- Due to the small sample size, this study may not represent the population more closely.

Conclusion

This study provides values of renal length and width (mean + SD) in normal children. The renal size norms developed by this study provide normal kidney length range for children according to age and body size. In clinical practice, the body height and weight can be quickly recorded to compare the actual renal length with the renal norm.

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The best correlation was of kidney length with body height and the best correlation was of renal volume with BSA. Renal length as measured by ultrasonography is a simple, practical and reproducible measurement and widely accepted to monitor renal size and growth. A growing kidney in a child is a healthy kidney, whereas a kidney static in size over time may be an early indicator of chronic kidney disease.

Recommendation

- To pediatrics department to document anthropometry measurements in those patients who are sent for abdominal ultrasound
- To radiology department to conduct large scale study in pediatrics normal patints specially in primary school to have normal standards
- To radiology residents have proper way of measurement as size matters most in follow up of patients

CHAPTER SIX: BUDGET

Manpower

Person	Person x days	Cost for each	Total
Principal investigator	1x40	1x200x30	12000
Supervisor	2x15	2x15x400	12000
Secretary	1	1x1500	1500
Total			25500

Stationary cost

Item	Unit	Quantity	Price for each unit	Total
Duplication paper	Pack	10	120 birr	1200
Pens	Number	20	5	100
Pencils	Number	20	1	20
Rewritable disk	Number	10	50	500
Duplication ink	Bottle	8	70	480
Eraser	Number	6	10	60
Ruler	Number	2	50	100
Binding		10	30	300
Total cost				**2760**

Personal cost + stationary cost =25500 + 2760 = 28,260

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Contingency= 10%=10*28260/100=2826

Total budget= 31,086

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ANNEX - I

ENGLISH VERSION QUESTIONNAIRE

INFORMED CONSENT SHEET

ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE SCHOOL OF POST GRADUATE STUDIES DEPARTMENT RADIOLOGY

Good morning/afternoon, my name is ------------- and I am a data collector. The principal investigator is Dr. Ezedin Mohammed, student in Addis Ababa University for partial fulfillment in requirement post graduate degree in Radiology.

Currently we are conducting a study on renal size measurement among pediatric patients visiting TikurAnbesa specialized hospital. We believe that the study findings will help to have standard renal size of children in our country according to their age and other somatic parameters. The information that you give using this questionnaire used only for research purpose and all information you provide to me will be strictly confidential. The study has no risk to you and your family members but mild time consuming. Therefore I politely request your cooperation to respond at all or to withdraw in the meantime, but your input has great value for the success of my objective. Do you agree? Now please tell me if you agree to participate in the filling of the questionnaire.

Yes continue No good bye

Thank you for your cooperation!!

Interviewer name __________ signature _____Date _______ month______ year___________

Supervisor name __________ signature _____Date ________ month______ year__________

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ANNEX - II

Questionnaires MRN:

1. Age of the patient

A. In months is less than a year (< 1 month, 1- 3 months, 3- 6 months,6- 9 months,9-12months)

Please specify ---------

B. every year throughout 14 years (eg 1year,3years

Please specify---------

2. Sex of the patient (circle the mentioned options or fill the blank space)

A .male --------- B. female --------

3. Measured height in centimeters ------

4. Measured weight in kilogram -------

5. Calculated BSA on m2 or BMI BSA=WEIGHT *HEIGHT /3600 m2-----------------

6. Any congenital anomaly (CHD, VACTER…..

A. Yes B. No

C. If yes specify --------

If yes specify (e.g congenital heart disease,VACTER---------------------------------

Exclusion criteria-Hydronephrosis, PUJ obstruction, posterior urethral valve,cystic renal lesions

7. Use of any medical treatment like steroids

A. Yes B. No

8. Any previous history major medical illness(especially renal associated conditions or abdominal surgery

A. Yes B. No

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9. Length of the kidneys in centimeters

Right ---- and left-------

10. Kidney width in centimeter

Right ---- and left------

Figure 1.Normal right kidney demonstrated on supine longitudinal view showing measurement of length (1) and width (2).

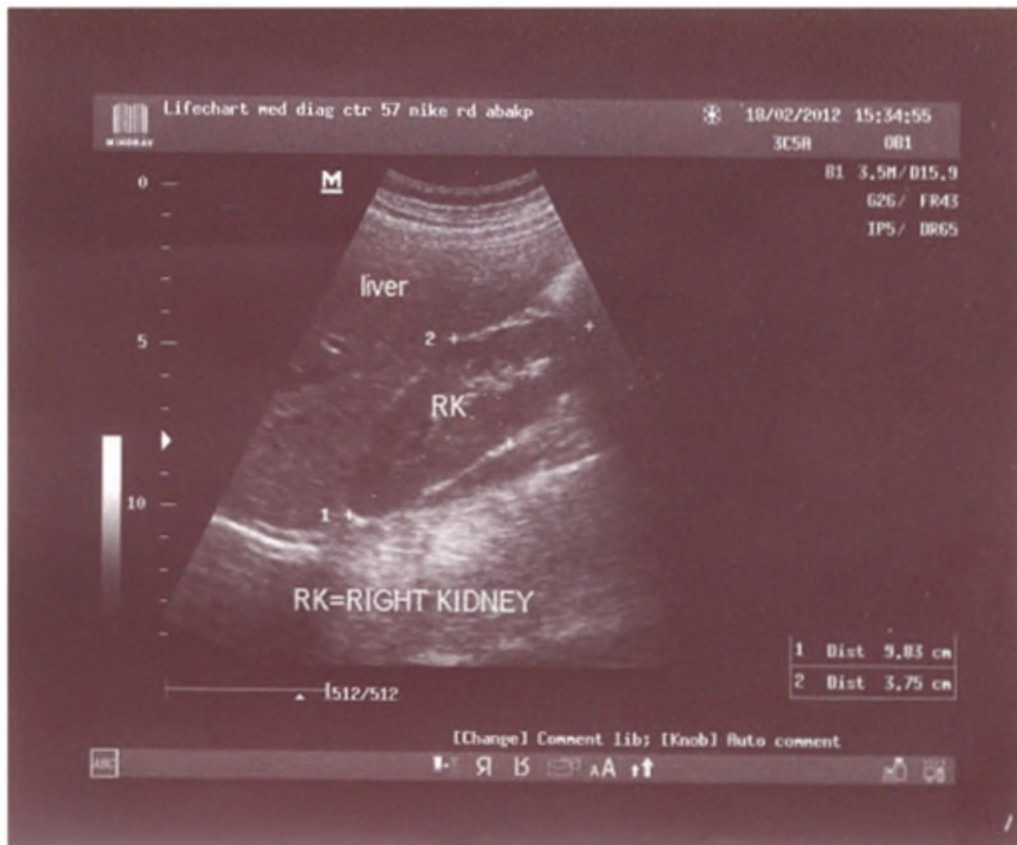

Figure 2: Maximum longitudinal length of the left kidney passing through the renal hilum (arrow).

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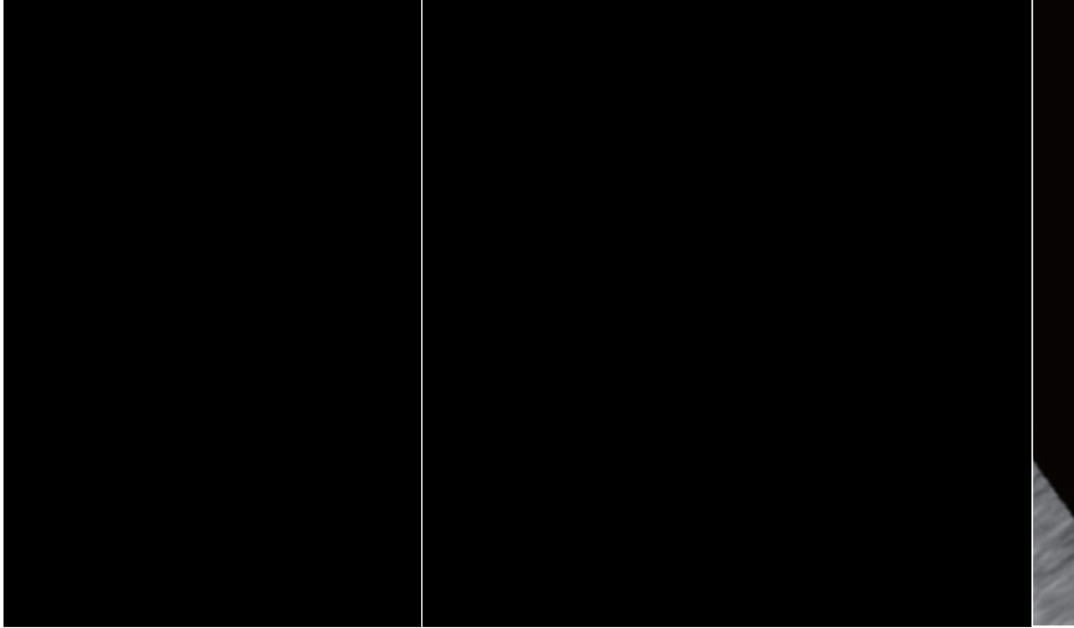

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