Scientific Research Publishing

Open Journal of Endocrine and Metabolic Diseases, 2023, 13, 1-16
https://www.scirp.org/journal/ojemd
ISSN Online: 2165-7432
ISSN Print: 2165-7424

A Cross Sectional Study on the Correlation between Waist Circumference and Fatty Liver on Ultrasonography among Non-Alcoholic Filipino Adults

Arriza Kryssan S. Monjardin-Soria

Chong Hua Hospital, Cebu City, Philippines
Email: aksmsoria@gmail.com

How to cite this paper: Monjardin-Soria, A.K.S. (2023) A Cross Sectional Study on the Correlation between Waist Circumference and Fatty Liver on Ultrasonography among Non-Alcoholic Filipino Adults. *Open Journal of Endocrine and Metabolic Diseases*, **13**, 1-16.
https://doi.org/10.4236/ojemd.2023.131001

Received: December 12, 2022
Accepted: January 28, 2023
Published: January 31, 2023

Abstract

Objectives: This study aimed to determine the correlation between waist circumference and fatty liver on ultrasonography among non-alcoholic Filipino adults. This will aid in detecting non-alcoholic fatty liver disease in its early course, hence improving our current therapeutic recommendations in preventing and managing the adverse health outcomes of NAFLD. **Methods and Materials:** A cross-sectional study with a total of 65 recruited participants. The data collected were age, sex, waist-circumference, co-morbidities with maintenance medications, history of alcohol intake with emphasis on the quantity and duration, and history of drug intake. Waist circumference was measured and recorded. The presence of NAFLD was determined through a review of the ultrasonography results of all subjects. The demographic profile and waist circumference of all subjects were described using descriptive statistics. The chi-square test was utilized to test the independence of the NAFLD and WC in the quartile. Pearson correlation was used to determine the linear relationship between the variables. Pearson correlation coefficient was statistically significant at $p < 0.05$. **Results:** Among the subjects, 26 (42%) presented with fatty liver based on ultrasonography, 15 (58%) and 11 (42%), males and females, respectively. The mean waist circumference of 97.5 ± 12.43 was significantly related to the fatty liver with a p-value of < 0.0001. Waist circumference showed a positive correlation with the frequency of fatty liver on ultrasonography with p-values of 0.000755 (r = 0.590083) and 3.04366E−05 (r = 0.659143523), in males and females, correspondingly. The overall correlation between waist circumference and fatty liver on ultrasonography is statistically significant with a p-value of 4.10503E−08 (r = 0.634737127). **Conclusion:** One measure used to assess central obesity is waist circumference. In addition, it

can also be utilized to assess risk for NAFLD since they are strongly correlated as reported in this study. Waist circumference cut-off values for the Filipinos proposed in this study are the following: >88 cm and >95 cm, in males and females, respectively.

Keywords

Non-Alcoholic Fatty Liver, Waist Circumference, NAFLD

1. Introduction

A) Background of the Study

Non-Alcoholic Fatty Liver Disease (NAFLD) is a serious and growing clinical problem due to the increasing prevalence of obesity and overweight [1]. It is predicted to be the next global epidemic affecting millions of people worldwide [2]. It has been recognized as the early manifestation of obesity and metabolic syndrome. Today, NAFLD is recognized as a major chronic liver disease in Asia [3]. In the Philippines, data regarding prevalence in the general population have been lacking. However, a study conducted at Philippine General Hospital in 2008 by Lusonget *et al.* showed that a total of 134 were diagnosed with NAFLD from the 1102 test subjects, 71% were female and 29% male, concluding that NAFLD is in fact common in their patients [4].

The principal risk factors for developing NAFLD are obesity and insulin resistance. More generally, any elements constituting the metabolic syndrome such as type 2 diabetes, dyslipidemia, and hypertension are linked to the development of NAFLD, and approximately 85% of patients with NAFLD have at least one such constituent [5].

A study by Clemente *et al.* in 2014 stated that an increase in Waist Circumference (WC) can reliably predict the risk of NAFLD. In that study, 72.4% and 71.9% of girls and boys with NAFLD, respectively, were classified in the highest quartile of WC (WC > 107.5 cm) [6].

Based on the International Diabetes Federation (IDF), metabolic syndrome among Asians is diagnosed using the cut-off value of waist circumference of 90 cm for men and 80 cm for women. In contrast, the Japan Society for the Study of Obesity (JASSO) has recommended that the appropriate cut-off values of WC for detecting visceral obesity are 85 cm in Japanese men and 80 cm in Japanese women from the general population, and these values are widely used for diagnosis of metabolic syndrome in Japan [7].

Measuring Waist Circumference (WC) is a simple and inexpensive tool. It has an excellent correlation with abdominal imaging and can be applied as an important anthropometric indicator of central obesity to screen patients with high risk for NAFLD [7].

B) Significance of the Study

Due to the increasing burden of NAFLD globally, and given that we have li-

mited data regarding the present trend of NAFLD in the Philippine population, it is valuable that we examine its occurrence in a given setting.

Also, populations from different ethnicity will vary in terms of genetics, body composition lifestyle, and environment. Hence, the proposed cut-off values for waist circumference in the established guidelines will not automatically be applied to all populations. This study intends to utilize the waist circumference cut-off value as proposed by the research done in the Japanese population to establish an association with the occurrence of NAFLD.

The results of this study will help us to detect NAFLD in its early course and improve our current therapeutic recommendations for preventing and managing the adverse health outcomes of NAFLD.

C) Research Question

What is the correlation between waist circumference and fatty liver on ultrasonography on non-alcoholic Filipino adults?

D) Research Objectives

1) General Objective: To determine the correlation between waist circumference and fatty liver on ultrasonography.

2) Specific Objectives

a) To identify patients with fatty liver through ultrasonography in the Executive Check-Up Department in Chong Hua Hospital, Cebu City.

b) To measure the waist circumference of patients with fatty liver and Non-fatty liver in the Executive Check-Up Department in Chong Hua Hospital, Cebu City.

c) To identify the frequency and percentile of fatty liver per quartile of measured waist circumference and by gender.

E) Operational Definition of Terms

1) Non-alcoholic fatty liver disease is defined as (a) there is evidence of hepatic steatosis, either by imaging or by histology, and (b) there are no causes for secondary hepatic fat accumulation such as significant alcohol consumption, use of steatogenic medication, or hereditary disorders [3].

2) Waist circumference measured horizontally at the midpoint between the bottom edge of the last rib and the iliac crest (at the umbilicus) [6].

3) Excessive alcohol consumption-alcohol intake > 30 g/week in men and 20 g/week in women (1 glass of wine, 1 can of beer, or 1 shot of hard liquor is estimated to have 10 - 15 g alcohol) over 2 year period [1].

F) Limitation of the Study

Due to its cross-sectional study design, the study did not demonstrate evidence of cause an effective relationship between waist circumference and frequency of fatty liver in non-alcoholics.

Since data gathering on the alcohol intake of the study population was done through interviews and questionnaires, results are biased and can be relatively inconclusive.

Cut-off values of waist circumference proposed in this study cannot be generalized to other populations and can be applicable to Filipinos only.

Diagnosis of NAFLD is limited to history, clinical features, and ultrasonography results. Also, there will be inter-observer variability in the ultrasonography findings of the liver due to the different sonographers.

G) Ethical Consideration

The study was submitted to the Institutional Review Board of Chong Hua Hospital and was formally approved thereafter. Written informed consent was obtained from all participants. All information is confidential and data gathered were used exclusively for the purpose of the study.

2. Review of Related Literature

Non-alcoholic fatty liver disease has become an important health issue worldwide in parallel with the increasing prevalence of central obesity, type 2 diabetes mellitus, dyslipidemia, and metabolic syndrome. It refers to the presence of hepatic steatosis when no other causes for secondary hepatic fat accumulation are present. It may progress to cirrhosis and is likely an important cause of cryptogenic cirrhosis [8].

Over the past 2 decades, there is substantial evidence to suggest that NAFLD is highly prevalent, and represents a spectrum of diseases with some patients developing cirrhosis and Hepatocellular Carcinoma (HCC). The majority of subjects with NAFLD are asymptomatic and diagnosed incidentally [2].

The diagnosis of NAFLD requires all of the following: a) demonstration of hepatic steatosis by imaging or biopsy, b) exclusion of significant alcohol consumption and c) exclusion of other causes of hepatic steatosis [8].

Significant alcohol consumption is defined as history of alcohol intake > 30 g/week in men and 20 g/week in women (1 glass of wine, 1 can of beer or 1 shot of hard liquor is estimated to have 10 - 15 g alcohol) [1].

The following grading of the degree of fatty infiltration was mentioned in the study by Manuel *et al.*, using a 3.5 MHz transducer: 1) Grade 1 (mild), echogenicity is slightly increased, with normal visualization of the diaphragm and the intra-hepatic vessel borders; 2) Grade 2 (moderate), echogenicity is moderately increased, with slightly impaired visualization of the diaphragm or intra-hepatic vessels; 3) Grade 3 (severe), echogenicity is markedly increased, with poor or no visualization of the diaphragm, the intra-hepatic vessels and posterior portion of the right lobe. Compared with CT and liver biopsy, the overall accuracy of sonography in detecting fatty infiltration is 85% to 89%, and the specificity is 56–93%, on the hands of competent sonologist. If the patient is asymptomatic with elevated transaminases and with the presence of fatty liver by ultrasound, the predictive value for NAFLD approaches 96%.

Previous studies through the years have shown strong correlation between the development of NAFLD and obesity. In fact, it was demonstrated that each 1-cm increase in visceral adiposity was associated with a two-fold greater risk of NAFLD in obese adolescent. Hence, obesity is the most important risk factor for the development of NAFLD [1]. Due to the limitations of methods for measuring visceral obesity such as through ultrasonography and magnetic resonance

imaging, waist circumference has been proven to be a simple and cost-effective alternative tool [6].

Waist circumference has been considered as a potential screening tool for liver steatosis and cardiovascular risk, being the most cost-effective and feasible replacement for ultrasound and magnetic resonance in the assessment of NAFLD in obese adolescents. According to Clemente *et al.*, they suggested that WC > 99 cm (3rd quartile) as a cut-off or detection of NAFLD and metabolic alterations. In addition, the study demonstrated that the obese adolescents in the 3rd and 4th quartiles of WC presented higher prevalence of NAFLD when compared with those on the 1st quartile for both genders. These results show the importance of this anthropometric measurement to detect incremental risk of steatosis in the analyzed population [6].

The criteria for diagnosis of metabolic syndrome in adolescents adopted from the International Diabetes Federation (IDF) considers WC greater than 80 cm for girls and 94 cm for boys have high sensitivity for screening adolescents at risk of metabolic disorders. Another study showed that appropriate cut-off points of WC for detecting NAFLD were 89 cm for men and 84 cm for women with high negative predictive values for NAFLD. These results confirm the importance of using WC in clinical practice, as it may contribute to evaluating the risk of NAFLD and insulin resistance. In this way, the identification of threshold values for WC in children and adolescents is a crucial component in developing a strategy for the prevention of metabolic diseases as NAFLD in overweight subjects. Therefore, the major finding of this study is that WC is a convenient measure of abdominal obesity associated with the risk of NAFLD development in obese adolescents [9].

According to Tsukiyama *et al.*, they proposed 85 cm for Japanese men and 80 cm for Japanese women as the WC values identifying metabolic syndrome. The Joint Scientific Statement published in 2009 recommended that separate cut-off values of WC should be set for different ethnic groups. The Statement also mentioned that several different WC values have been proposed in Japan, ranging from > 85 - 90 cm for men and > 80 cm for women in recent studies [7].

3. Research Methodology

A) Study Design

A prospective cross sectional study was conducted to establish a correlation between waist circumference and non-alcoholic fatty liver disease.

B) Study Setting

The study was conducted in Chong Hua Hospital, Cebu City, Philippines.

C) Sample Size

The sample size of 62 was computed with an alpha value of 0.05, beta value of 0.80 and correlation coefficient from a previous study of 0.35 [6].

D) Study Population

The study population included a total of 65 outpatients in Executive Check-Up Department in Chong Hua Hospital, Cebu City from May to July 2017. Howev-

er, 3 outpatients were excluded from the study based on the exclusion criteria of intake of antihypertensive medications.

Inclusion Criteria:

- All adult Filipino male and female patients (18 years old and above) diagnosed with non-alcoholic fatty liver disease through ultrasonography.

Exclusion Criteria:

- Patients with history of significant alcohol consumption as defined above.
- Patients with evidence of liver disease (Hepatitis C Virus (HCV) antibody or Hepatitis B surface (HBs) antigen, autoimmune liver disease, biliary disease).
- Patients with liver cirrhosis or malignant disease.
- Patients with intake of antihypertensive, anti-diabetic, lipid-lowering medications (any maintenance medications).
- Elderly patients (age > 75 years).

E) Data Collection

Data were collected during the patient's visit at the Executive Check-Up Department through interview and questionnaire. The data included the following: age, sex, waist circumference, co-morbidities with maintenance medications, history of alcohol intake with emphasis on the quantity and duration, and history of drug intake. In a standing position with the abdomen relaxed and arms placed alongside the body, waist circumference were measured horizontally at the midpoint between the bottom edge of the last rib and the iliac crest (at the umbilicus) using a tape measure (1 tape measure used during the entire study). The measurements were then recorded, Presence of NAFLD was determined through review of ultrasonography results of all subjects. Liver findings on ultrasonography were conveniently classified as mild, moderate, or severe utilizing the classification as stated by Manuel *et al.* [1].

F) Data Analysis

The demographic profile and waist circumference of all subjects were described using descriptive statistics such as means and standard deviations for continuous variables and frequencies and percentile for nominal variables. Chi square test was utilized to test the independence of the NAFLD and WC in quartile. Pearson correlation was used to determine the linear relationship between the variables. Pearson correlation coefficient was statistically significant at $p < 0.05$.

4. Results and Interpretation

The study included 65 subjects, 3 were excluded due to intake of anti-hypertensive medications; 33 females (53%) and 29 males (47%). Among the subjects, 26 (42%) presented with fatty liver based on ultrasonography, 15 (58%) and 11 (42%), males and females respectively. The mean age of 52.42 ± 10.58 was significantly associated with NAFLD with p-value of < 0.001. The mean waist circumference of 97.5 ± 12.43 was significantly related to fatty liver with p-value of < 0.0001. For the males and females, the mean waist circumference of 88.57 ± 9.5 and 95 ± 8.76, respectively were significantly associated with fatty liver with

p-values of 0.0463 and 0.0022, respectively. The baseline characteristics of the study population are presented in Table 1.

The overall frequency distribution of fatty liver by waist circumference in quartile is showed in Table 2. Among the subjects with fatty liver on ultrasonography, they were distributed as follows: by gender, 11 (42%) females and 15 (58%) males; by severity 17 (65%) mild, 9 (35%) moderate and 0 (0%) severe; and by WC in quartile, 2 (7%) 1st quartile (66 - 81 cm), 6 (23%) 2nd quartile (82-88 cm), 9 (35%) 3rd quartile (89 - 98 cm), and 9 (35%) 4th quartile (99 - 122 cm).

As shown in Table 3, among the male study population 29 (47%), 5 (17%) belonged to the 1st quartile of WC (low), 3 (10%) of which had non-fatty liver and 2 (7%) had mild fatty liver; 7 (24%) belonged to the 2nd quartile of WC (moderate), 4 (14%) of which had non-fatty liver and 3 (10%) had mild fatty liver; 9 (31%) belonged to the 3rd quartile of WC (high), 5 (17%) of which had non-fatty liver and 4 (14%) had mild fatty liver; and 8 (28%) belonged to the 4th quartile of WC (very high), 2 (7%) of which had non-fatty liver, another 2 (7%) had mild fatty liver and 4 (14%) had moderate fatty liver.

As reported in Table 4, among the female study population 33 (53%), 10 (30.3%) belong to the 1st quartile of WC (low) and all had non-fatty liver; 10 (30.3%) belonged to the 2nd quartile of WC (moderate), 7 (21.2%) of which had non-fatty liver and 3 (9.1%) had mild fatty liver; 5 (15.15%) belonged to the 3rd quartile of WC (high), 2 (6.05%) of which had non-fatty liver and 3 (9.1%) had mild fatty liver; and 8 (24.6%) belonged to the 4th quartile of WC (very high), 3 (9.1%) of which had non-fatty liver, and 5 (15.15%) had moderate fatty liver.

The frequency of fatty liver on ultrasonography is dependent on waist circumference divided in quartile with p-value of 0.015131.

Waist circumference showed positive correlation with frequency of fatty liver on ultrasonography with p-values of 0.000755 (r = 0.590083) and 3.04366E−05 (r = 0.659143523), in males and females, correspondingly. Overall correlation

Table 1. Baseline characteristics of the study population.

Demographic Profile	Non-Fatty Liver N = 36 (58%)	Fatty Liver N = 26 (42%)	Total n = 62	p-value
Gender				
• Female	22 (61%)	11 (42%)	53% (33)	0.143126
• Male	14 (39%)	15 (58%)	47%(29)	
Age (year), Mean ± SD		52.42 ± 10.58		
• Female	35.75 ± 11.5	56.9 ± 9.08	42.3 ± 14.01	<0.001
• Male		49.13 ± 10.66		
Waist Circumference (cm)	84.53 ± 11.04	97.5 ± 12.43	89.97 ± 13.23	<0.0001
• Female, n = 33	81.95 ± 11.38	95 ± 8.76	87.12 ± 13.50	0.0022
• Male, n = 29	97.53 ± 13.4	88.57 ± 9.5	93.20 ± 12.35	0.0463

Table 2. Overall frequency distribution of fatty liver on ultrasongraphy by severity on ultrasonography by waist circumference in quartile.

Parameters	Severity of Fatty Liver on Ultrasonography									
Waist Circumference (cm) in Quartile	Normal		Mild		Moderate		Severe		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1st Quartile 66 - 81 cm	13	21	2	3	0	0	0	0	15	24
2nd Quartile 82 - 88 cm	11	17	6	10	0	0	0	0	17	27
3rd Quartile 89 - 98 cm	7	11	9	15	0	0	0	0	16	26
4th Quartile 99 - 122 cm	5	8	0	0	9	15	0	0	14	23
Total	36	57	17	18	9	15	0	0	62	100

Table 3. Frequency distribution of fatty liver by severity on ultrasonography by waist circumference in quartile in male study population.

Parameters	Severity of Fatty Liver on Ultrasonography							
Waist Circumference (cm) Category in Quartile	Normal		Mild		Moderate		Severe	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1st Quartile, Low (66 - 81 cm)	3	10	2	7	0	0	0	0
2nd Quartile, Moderate (82 - 88 cm)	4	14	3	10	0	0	0	0
3rd Quartile, High (89 - 98 cm)	5	17	4	14	0	0	0	0
4th Quartile, Very High (99 - 122 cm)	2	7	2	7	4	14	0	0

Table 4. Frequency distribution of fatty liver by severity on ultrasonography by waist circumference in quartile in female study population.

Paramaters	Severity of Fatty Liver on Ultrasonography							
Waist Circumference (cm)	Normal		Mild		Moderate		Severe	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1st Quartile, Low (66 - 81 cm)	10	30.3	0	0	0	0	0	0
2nd Quartile, Moderate (82 - 88 cm)	7	21.2	3	9.1	0	0	0	0
3rd Quartile, High (89 - 98 cm)	2	6.05	3	9.1	0	0	0	0
4th Quartile, Very High (99 - 122 cm)	3	9.1	0	0	5	15.15	0	0

between waist circumference and fatty liver on ultrasonography is statistically significant with p-value of 4.10503E−08 (r = 0.634737127) (Tables 5-7).

5. Discussion

Non-alcoholic fatty liver disease is becoming a global burden due to its rapidly increasing prevalence in association with the growing epidemic of obesity, metabolic syndrome and diabetes mellitus. On the other hand, waist circumference is a simple and practical tool for assessing central adiposity. And recent studies have shown that waist circumference is strongly associated with obesity-related health risks such as metabolic syndrome, insulin resistance and NAFLD. In this study it supported that waist circumference is in fact positively correlated with NAFLD. Majority of those with NAFLD are classified in the 3rd and 4th quartile of waist circumference. Thus, higher waist circumferences have higher risk for NAFLD.

Bertolloti *et al.* stated that NALFD occurs more often in the middle-aged and the elderly given that the risk factors for its development tend to increase in prevalence with advancing age. Also, as reported in this study, the mean age of 52.42 ± 10.58 is associated with occurrence of NAFLD. Previous studies showed that NAFLD is more common in males than in females due to the protective role of estrogen. Although some of the studies have not examined in detail the influence of gender differences in waist circumference in patients with NAFLD. However, as for the role of gender for the occurrence of NAFLD, this study shows no significant correlation. During the fertile period of females, they are usually spared from NAFLD. However, they tend to develop the disease approximately 10 years later than men, approximately in the post-menopausal years. In this study, the mean ages of the NAFLD group are 49.13 ± 10.66 and 56.9 ± 9.08, males and females, respectively.

The mean waist circumference of 88.57 ± 9.5 cm and 95 ± 8.76 cm in males and females respectively showed significant association to NAFLD. In contrast to previous studies, waist circumference of more than 90 - 94 cm and 80 cm in

Table 5. Overall independence of frequency of fatty liver on ultrasonography on waist circumference in quartile.

Waist Circumference (cm) Category	Non-Fatty Liver n = 36		Fatty Liver n = 26	
	Frequency	%	Frequency	%
1st Quartile (66 - 81 cm)	15	24.19355	2	7.692308
2nd Quartile (82 - 88 cm)	17	27.41935	6	23.07692
3rd Quartile (89 - 98 cm)	14	22.58065	7	26.92308
4th Quartile (99 - 122 cm)	16	25.80645	11	42.30769
Total	62	100	26	100
p-value	0.015131			

Table 6. Overall correlation of waist circumference and frequency of fat on ultrasonography and its significance by covariance and Pearson formula.

	Pearson Correlation Coefficient
	0.634737127
Significance	p-value 4.10503E−08

Table 7. Correlation of waist circumference and frequency of NAFLD by gender and its significance by covariance and Pearson formula.

	Pearson Correlation Coefficient	p-value
Males	0.590083	0.000755
Females	0.659143523	3.04366E-05

Western males and females respectively, and more than 80 cm and 85 cm in Japanese males and females respectively, showed significant correlation.

Hence, NAFLD occurs commonly in the middle-aged group. Gender has no clear role in the occurrence of NAFLD. Waist circumference can be utilized to assess not only central obesity but as well as the risk for NAFLD due to their positive correlation. However, cut-off values for waist circumference will vary per ethnicity.

6. Conclusions

Non-alcoholic fatty liver disease is rapidly becoming the major cause of liver disease worldwide. It is considered to be one of the phenotypes of metabolic syndrome which is characterized by central obesity, type 2 diabetes mellitus, hyperlipidemia, and hypertension. And to date, there are no approved treatments for NAFLD, except for lifestyle modifications.

One measure used to assess central obesity is waist circumference. Hence, it can also be utilized to assess risk for NAFLD since they are strongly correlated as reported in this study. Waist circumference cut-off values for the Filipinos proposed in this study are the following: >88 cm and >95 cm, in males and females respectively. Hence, at an earlier stage, lifestyle modifications can be applied to prevent NAFLD and its possible complications.

7. Recommendations

Since the study design is cross-sectional, the researcher cannot establish cause an effective relationship between the variables for a longer period of time. Hence, a longitudinal study is recommended for future research studies.

Also, other data, such as weight, height, BMI, smoker/non-smoker, etc., can be added to the baseline profile of the study population, so as to establish more associations of NAFLD to other factors.

The researcher also recommends utilizing computed tomography or liver bi-

opsy to specifically measure and detect NAFLD instead of ultrasonography for future studies.

Researchers can also conduct more studies on gender roles and differences in the prevalence of NAFLD.

In addition, to prevent the emerging burden of NAFLD, studies on other treatments of NAFLD can be conducted.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Manuel, J.J., Elaine Palugod, M.D., *et al.* (2007) The Association of Risk Factors in the Development of Non-Alcoholic Fatty Liver Disease (NAFLD) in Filipino Patients with Type 2 Diabetes Mellitus in a Tertiary Center. *Philippine Journal of Internal Medicine*, **45**, 135-143.

[2] Younossi, Z.M, *et al.* (2017) The Economic and Clinical Burden of Nonalcoholic Fatty Liver Disease in the United States and Europe. *Hepatology*, **64**, 1577-1586. https://doi.org/10.1002/hep.28785

[3] Kasper, D., *et al.* (2012) Harrison's Principles of Internal Medicine. Vol. 2, 19th Edition, The McGraw-Hill Companies, Inc., New York, 2054-2057.

[4] De Lusong, M.A., Labio, E., Daez, L. and Gloria, V. (2008) Non-Alcoholic Fatty Liver Disease in the Philippines: Comparable with Other Nations? *World Journal of Gastroenterology*, **14**, 913-917.

[5] Agrawal, R., Mishra, S., Dixit, V.K. and Rai, S. (2009) Association of Non-Alcoholic Liver Disorder with Obesity. *Indian Journal of Preventive and Social Medicine*, **40**, 127-129.

[6] Clemente, A.P., Netto, B.D., *et al.* (2015) Waist Circumference as a Marker for Screening Nonalcoholic Fatty Liver Disease in Obese Adolescents. *Revista Paulista de Pediatria*: *Orgao Oficial da Sociedade de Pediatria de Sao Paulo*, **34**, 47-55.

[7] Tsukiyama, H., *et al.* (2015) Proposed Cut-Off Values of the Waist Circumference for Metabolic Syndrome Based on Visceral Fat Volume in a Japanese Population. *Journal of Diabetes Investigation*, **7**, 587-593. https://doi.org/10.1111/jdi.12454

[8] Sheth, S.G. and Chopra, S. (2016) Epidemiology, Clinical Features, and Diagnosis of Nonalcoholic Fatty Liver in Adults. https://www.uptodate.com/contents/epidemiology-clinical-features-and-diagnosis-of-nonalcoholic-fatty-liver-disease-in-adults

[9] Ishibashi, E., *et al.* (2008) Waist Circumference Correlates with Hepaticfat Accumulation in Male Japanese with Non-Alcoholic Fatty Liver Disease, But Not in females. *Journal of Gastroenterology and Hepatology*, **23**, 908-913.

Appendix 1

Consent Form

I, _____, _____ years old, living in _____; am fully consenting to be a part of the study entitled **"Correlation Between Waist Circumference and Fatty Liver on Ultrasonography among Non-alcoholic Filipino Adults in Executive Check-up Department in Chong Hua Hospital from May-July 2017"**

This study will be done by the Dr. Arriza Kryssan S. Monjardin-Soria. **Any questions and concerns regarding the study can be addressed to the author through phone no. 09988422944.**

The following were explained to me clearly, and I fully understand them before attaching my signature to this consent form:

1) That this study aims to determine correlation between waist circumference and fatty liver on ultrasonography.

2) That this paper hopes to guide practitioners on early detection fatty liver and prevention of its complications.

3) That my clinical data and ultrasonography results related to the study and done as outpatient will be open for evaluation by the author of the study.

4) That the documents gathered about me in this study will be confidential and will be exclusively used for research purposes only.

5) That my participation of this study is of my own free will and that I can withdraw from this study anytime and for whatever reason.

SUBJECT:

_____ _____

NAME IN PRINT AND SIGNATURE DATE

Contact #: _____

WITNESS:

_____ _____

NAME IN PRINT AND SIGNATUREDATE

Appendix 2

Consent Form (Bisaya)

Ako, si, _____, _____ ang edad, taga _____; nagmatuud nga sa akong kaugalingon' gkabubut'on, ako nagtugot na ma apil sa tinunan-an na **"Correlation Between Waist Circumference and Fatty Liver on Ultrasonography among Non-alcoholic Filipino Adults in Executive Check-up Department in Chong Hua Hospital from May-July 2017".**

Ang niiningtinun-an gihimo ni Dra. Arriza Kryssan S. Monjardin-Soria. **Para sa mga pangutana ug kalabutan sa nianingtinun-an, palihugug tawag sa tagsulat sa 09988422944.**

Ako nagmatuudu sab nga ako nakabasa ug nakasabut sa nganaunang pahayag ug gawasnon'g modawat sa responsibilidad sa akong desisyon sa pagpirma ni iining pag'uyon:

1) Nga kani natinun-an magsusi sa korelasyon sa sukod hawak ug "fatty liver".

2) Nga kani na reserts nag hinaotnamutabangsamga doctor sa sayu na pag-ila sa "fatty liver" ug pag pugong sa iyang mga komplikasyon.

3) Nga ang klinikal na impormasyon ug ang mga resulta sa ultrasound nabinuhat gawas sa pagka admit ma susi sa tagsulat ni aning reserts.

4) Nga ang akong mga document iglabot niiningtinun-an gamiton lamang para sa reserts.

5) Nga ang akong panghinlabot niini kaysaa kong pagbuot, ug pwede kong mu pilinadilina mu apil, bisanunsa pa angrason.

PASYENTE:

_____ _____

NGALAN (PATIK) UG LAGDA O PIRMA PITSA

Telepono/Selpon #: _____

TESTIGO:

_____ _____

NGALAN (PATIK) UG LAGDA O PIRMA PITSA

Appendix 3

Information Sheet

Date: _____

Name: _____

Gender: ☐ Male ☐ Female

Age: _____ Waist Circumference: _____ cm

☐ Co-morbidity:

☐ Hypertension

☐ Diabetes Mellitus Type I or II

☐ Cancer (please specify: _____)

☐ Acute or Chronic Hepatitis Infection

☐ Biliary Disease e.g. Cholecystitis/Cholelithiasis

Are you taking any prescribed or over the counter medications:

☐ Yes

☐ No

If yes, please specify the medications and for how long you've been taking the medication/s:

_____

_____

Do you drink alcoholic beverages?

☐ Yes

☐ No

If yes, how many times in a week/month? What type of alcoholic beverage and how much do you consume (Please quantify the amount, like in bottles or glass)?

_____

_____

AppendiX 4

MALES	
Age	Waist Circumference (cm)
39	79
60	88
41	90
58	98
55	107
73	81
59	105
30	86
44	79
39	109
47	90
49	114
62	95
53	85
45	103
48	95
28	96
20	89
57	88
34	76
32	97
37	96
30	82
34	71
30	84
30	116
34	120
33	99
42	85

Appendix 5

FEMALES	
Age	Waist Circumference (cm)
69	96
66	110
30	102
55	104
46	85
48	92
46	85
59	85
53	92
56	99
59	122
59	83
69	103
68	76
18	71
30	82
27	82
43	98
36	94
37	99
32	87
47	70
33	85
34	85
31	69
44	101
22	67
28	77
27	66
24	71
26	85
27	74
30	78