Ethiopian Medical Journal 2022, 60(3)
Open access articles distributed in terms of
Creative Commons Attribution Licence [CC by 4.0]
ISSN 0014-1755 eISSN 2415-2420
Solomon et al

Original Article

Chronic heavy katikala addiction on liver enzymes in Chencha town, Southern Ethiopia

Yerukneh Solomon[1]*, Wondyefraw Mekonen[2], Zelalem Kofole[3]

[1]Debre Berhan University, college of medicine and health sciences, Debre Berhan, Ethiopia
[2]Addis Ababa University, Collage of health science, Addis Ababa, Ethiopia
[3]Arbaminch University, collage of health science, Arbaminch Ethiopia

*Corresponding author: yeruknesolomon@gmail.com,

Abstract

Background: *Chronic alcohol consumption damages liver functions causing health problems. Because of the cold-environment, some adults in Chencha town are heavy consumers of strong local-Areki called "Katikala" (34.09% ABV). However, information concerning the impact of heavy" Katikala" intake on liver enzymes has not yet been explored.*

Objective: *To assess the impacts of chronic heavy "Katikala" intake on liver enzymes and secondly to see changes in percent of body fat level on adult subjects living in "Chencha" town and compare it with non-alcoholic controls.*

Methodology: *A group of 34-chronic heavy "Katikala" consumers were compared with 34 abstainers of comparable ages (mean age: 35 years). Information was obtained on the quantity and duration of alcohol consumed. Serum Aspartate transaminase, Alanine transaminase and Gamma Glutamyl transpeptidase levels were measured to standard laboratory procedures. Percent body fat (%BF) was recorded and SPSS (ver. 21software used to analyze data by taking p-value < 0.05 for declaring significance.*

Results: *Compared with abstainer controls, chronic "Katikala" consumers showed significantly higher Aspartate transaminase, Alanine transaminase and Gamma Glutamyl transpeptidase Serum levels with ($p<0.001$). Percent of body fat (%BF) was significantly lower in chronic drinkers than abstainers ($p<0.001$). AST to ALT ratio (> 2) was higher in chronic heavy drinkers than controls. Duration and quantity of "Katikala" consumption were uncorrelated with the concentration of Aspartate transaminase, Alanine transaminase and Gamma Glutamyl transpeptidase ($p>0.05$).*

Conclusion: *Subjects chronically consuming "Katikala" showed significantly raised serum Aspartate transaminase, Alanine transaminase and Gamma Glutamyl transpeptidase as well as lower percent body fat level compared with normal controls. Our data suggests the negative influence of "Katikala" consumption on liver function and as well as body weight affecting health.*

Keywords: *Alcoholism, Katikala (local-areki), body fat, liver enzymes, AST/ALT-ratio, Chencha*

Citation *:* Solomon Y, Mekonen W, Kofole Z, Chronic heavy Katikala addiction on Liver Enzymes in Chencha town, Southern Ethiopia. *Ethiop Med J 60(3) 257 -263*
Submission date : *10 February 2022* ***Accepted:*** *23 June 2022* ***Published:*** *1 July 2022*

Introduction

The liquor, alcohol, is an addictive substance when taken for longer durations repetitively [1]. Consequently, chronic alcohol consumption is a threat for health and provokes anti-social behaviors, crimes, loss of interest to work, and accidents that leads to death [1]. Nearly 3.8% of global deaths and 4.6% of worldwide disability occur due to alcohol consumption[2]. In developing countries, it was reported that alcohol consumption is rapidly rising [2, 3]

Ethiopia is one of the countries where traditionally fermented beverages are produced and utilized in a wide scale [4]. Among traditionally produced and fermented beverages in Ethiopia include Katikala (locally brewed Areki with 34% alcohol), Tej (wine made from honey), Tella, Borde, Keribo, Korefe (different forms of beers made from various types of cereals) [5].

Of all locally brewed beverages, Katikala (Areki) is the strongest alcohol accounting to about 34% by volume of pure ethanol [6]. In Chencha and other places of Ethiopia, it is observed that Katikala is consumed by cup known as "Dibulo".

The volume of Dibulo (local cup) amounts to 100 ml and one Dibulo of Katikala (100 ml) is equivalent to 27.62 grams of 100% pure ethanol as calculated by using the density of ethanol as conversion factor [7]. Liver is the primary site for alcohol detoxification [8] and it is, therefore, susceptible for alcohol induced injuries. Liver detoxifies alcohol and results in production of potentially dangerous waste products such as acetaldehydes and other highly reactive free radicals [9]. These byproducts contributes to alcohol induced liver diseases [10]. Moreover, other hematological and biochemical parameters are also affected by chronic alcohol consumption [11]. Commonly used traditional markers for alcohol consumption are liver enzymes Aspartate transaminase (AST), Alanine transaminase (ALT) and Gamma Glutamyl transpeptidase (GGT) [12]. In addition to these liver enzymes body composition, particularity fat level, is commonly examined in chronic alcohol consumers. It was shown that alcoholics exhibit lower percentage of body fat (%BF) than those with normal body weight [13].

The city "Chencha" located in southern part of Ethiopia lies 2,732 meters above sea level and manifests a cold environmental temperature throughout the year (average 15^0C). Adults consume "Katikala (local Areki)" on the assumption that alcohol helps protects them from the cold-environmental temperature. However, some adults get addicted to Katikala and drink every day. Though chronic alcohol consumption is toxic and causes many health problems, no studies have been undertaken in Chencha town, where alcohol in the form of "Katikala" consumption is highly practiced. We, therefore, aimed in assessing the effect of chronic Katikala consumption on liver enzymes on inhabitants of Chencha town. It was hypothesized that chronic Katikala consumption may raise concentrations of liver enzymes compared to non-Katikala consuming subjects.

Material and methods

Study design:

Community based comparative cross-sectional study was conducted in Chencha town from March-to-June, 2019.

Study subjects

Inclusion criteria:

Age between 18- 65 years of age. Chronic Heavy Katikala drinker includes one who drinks $\geq$ 2 ½ "dibulo" of Katikala/day in one occasion for at least 4-days in a week for the last 5 years (exposed). Comparison groups included healthy adults (age 18-65 years), who live in the same community with addicts and who don't consume "Katikala" (non-exposed).

Exclusion Criteria for:

Study subject: Obese, pregnant and "Katikala" drinker with identified cardiac problem, other chronic disease history and the terminally ill were excluded.

Sampling:

Purposive sampling method was used for selection of eligible participants. 5ml of venous blood was collected by a trained nurse from antecubital vein and collected in tubes containing no additives. The tube was allowed to clot for 30-minutes at room temperature and centrifuged at 1500g for 5 minutes. Then serum was extracted and frozen at -20^{o}C until analyses. AST, ALT and GGT serum concentrations were measured to standard laboratory procedures at Arbaminch General Hospital and finally data obtained were recorded.

Percentage of body fat is age and sex specific prediction formula which was analyzed by taking BMI, age and sex (males =1, females =0) into account [14]. In adults the prediction formula was:

BF%= 1.20*BMI+0.23*Age-10.8*Sex-5.4

Sample size determination:

The study utilized two population proportion formula technique to determine the study population sample size. The prevalence value for exposed group was 50% and for control group was 13.4%, taken from previously published article that was done in USA. Assuming a 5% level of significance and 80% power to detect the above difference, a sample of 34 exposed and 34 non-exposed study participants were required.

Ethical clearance:

Our study has been approved by departmental research and ethical committee (DRC) of college of health sciences, Tikur-Anbessa Hospital, Addis Ababa University with reference number of Anat/Phy/253/2018. All participant were informed on the objective of the study and provided a written approval of the study.

Data analysis

SPSS (version 21) was used to analyze the results. Data were described in mean, standard deviation, frequency and percentage. Independent sample test was used to compare serum mean concentration of liver enzymes. Pearson correlation was used for correlations of different variables.

Results:

Table 1: Sociodemographic characteristics and basic health information of our study participants

Variable		Drinkers (n=34)		Non-alcoholics (34)	
		Frequency	Percent	Frequency	Percent
Gender	Male	34	100%	34	100%
	Female	0	0%	0	0%
Religion	Orthodox	30	88.2%	14	41.18%
	Protestant	2	5.88%	19	55.88%
	Muslims	0	0%	1	2.94%
	Other	2	5.88%	0	0%
Marital Status	Married	17	50%	17	50%
	Not Married	14	41.2%	17	50%
	Divorced	3	8.82%	0	0%
Age	21-27	4	11.7%	7	20.58%
	28-35	15	44.1%	13	38.2%
	36-42	9	26.4%	11	32.4%
	43-50	2	5.88%	2	5.88%
	50+	4	11.7%	1	2.94%
Educational level	An illiterates	0	0%	0	0%
	Read and write only	8	23.52%	1	2.94%
	Formal school	6	17.64%	8	23.52%
	College	12	35.3%	10	29.41%
	University	8	23.52%	15	44.1%
Occupation	Employed	16	47.05%	17	50%
	Unemployed	14	41.18%	10	29.41%
	Trade	4	11.76%	3	8.82%
	Student			4	11.76%
AST to ALT ratio	AST/ALT<1	5	14.7%	24	70.6%
	1≤AST/ALT<2	13	38.2%	10	29.4%
	AST/ALT≥ 2	16	47.1%	0	0%

A total of 68 male adults were interviewed and serum Liver enzymes particularly AST, ALT and GGT test was done, of which 68 participants had completed both the interview and measurements making the response rate of 100%. Among the 68 study participants, 50% were chronic heavy "Areki/Katikala" drinkers and 50% were non- drinkers. Of the drinkers, 100% were males, 50% were married, and 30 (88.2%) were Orthodox religion followers.

While the two groups were comparable in most socio-demographic characteristics, the non-drinkers were mostly (55.8%) Protestants. About 47.1% of exposed group individuals (drinkers) showed AST/ALT greater than or equal to two. Majority (70.6%) of non-exposed group individuals showed AST/ALT <1(as shown in Table 1).

Table 2: Comparison of anthropometric parameters of chronic "Katikala/Areki" drinkers and abstainers (i.e., controls).

Parameters	Mean ± SD		P value
	Abstainers (Controls)	Chronic Katikala drinkers	
Age (yrs.)	35.68 ± 8.79	34.47 ± 6.24	0.052*
Height (cm)	166.20 ± 8.06	169.00 ± 8.12	0.452
Weight (Kg)	63.21 ± 9.17	59.80 ± 9.63	0.046*
BMI (Kg/M^2)	22.69 ± 1.17	20.94 ± 1.50	0.000*
%BF	18.82 ± 2.80	16.86 ± 1.83	0.001*

Based on the above anthropometric result there was no significant difference in mean age of drinkers and non-drinkers with mean of 34.47± 6.24 and 35.68± 8.79 respectively. Comparing of the mean BMI between the two groups showed chronic Katikala drinkers (exposed groups) had lower BMI. There was no significant difference in mean height between the groups. The average (mean ± SD) of %BF among chronic drinking group was lower (16.86 ± 1.83) as compared to non-alcoholic abstainers (18.82 ± 2.80).

Table 3: Mean ± SD liver enzymes (IU/L) of chronic heavy "Katikala" drinkers and non-alcoholic controls.

Parameters	Abstainers (n=34)	Katikala Addicts (n=34)	Derangement by fold	P-value
AST	20.41 ± 6.1	178.18 ± 82	8.7	0.000*
ALT	23.26 ± 5.8	128.03 ± 59	5.5	0.000*
GGT	26.5 ± 6.5	162.4 ± 91.5	6.1	0.000*

As the above table showed chronic heavy Katikala drinkers' average (mean ± SD) of serum aspartate aminotransferase, alanine aminotransferase, and Glutamyl transaminase was 178.18 ± 82, 128.03 ± 59 and 162.4 ± 91.5 respectively. And those of non -exposed group had average (mean ± SD) 20.41 ± 6.1, 23.26 ± 5.8 and 26.5 ± 6.5 of AST, ALT and GGT respectively. Among chronic drinkers 8-fold rise for AST, 5-fold rise for ALT, and 6-fold rise for GGT was observed as compared with non-alcoholic controls (non-exposed)

Table 4: Pearson's correlation coefficient of liver enzymes, quantity and duration of alcohol consumption and % Body fat level

	ALT	AST	GGT	%BF
Quantity	0.804(r =0.044)	0.584(r = 0.097)	0.277(r =0.192)	0.052(r = -0.336)
Duration	0.260(r = 0.199)	0.77(r = 0.051)	0.31(r = 0.179)	0.870(r = -0.280)
ALT	-	0.01(r =0.434)	0.354(r = 0.164)	0.922(r = -0.017)
AST	0.01(r =0.434)	-	0.00(r =0.769)	0.001(r = -0.529)
GGT	0.354(r = 0.164)	0.00(r =0.769)	-	0.00(r = -0.723)

Pearson's correlation test for %BF with quantity, duration, ALT, AST and GGT was (-0.336), (0.28), (-0.017), (-0.529) and (-0.723) with p value of 0.052, 0.87, 0.922, 0.001 and 0.00 respectively. Which was negatively correlated. On the other hand Pearson's correlation test for ALT with quantity and duration of alcohol intake was 0.044 and 0.199 with p value of 0.804 and 0.260 respectively.

Pearson's correlation test for AST with quantity and duration of alcohol intake was 0.097 and 0.051 with p value of 0.584 and 0.77 respectively. Pearson's correlation test for GGT with quantity and duration of alcohol intake was 0.192 and 0.179 with p value of 0.277 and 0.31 respectively.

Table 5: Association between Habit of drinking Katikala and AST to ALT ratio

Groups	AST to ALT ratio category			Total	X^2	p-value
	AST/ ALT≤ 1	1<AST/ ALT<2	AST/ ALT≥ 2			
Drinkers	5	13	16	34	27.9	0.000**
Abstainers	24	10	0	34		

About 47.1% of exposed group individuals (drinkers) showed AST/ALT greater than or equal to two. Majority (70.6%) of non-exposed group individuals showed AST/ ALT <1. About 85% of exposed group individuals (drinkers) showed AST/ALT greater than 1.

Discussion:

The comparative study performed in our investigation has shown that the local alcohol "Katikala" addiction demonstrated a significant rise in liver enzymes including AST, ALT, and GGT compared with abstainers (as shown in Table 3)As the liver is an organ where different metabolic reaction takes place, normal circulating levels of serum liver enzymes commonly considered as an indicator of good health status [8]. The metabolic chart for normal ranges in serum levels for AST is (0-35 U/L), for Alt is (7-56 U/L) for GGT is (9-85U/L) [15]. In our present study a significant 8-fold rise for AST, 5-fold rise for ALT, and 6-fold rise for GGT was observed as compared with non-alcoholic controls (Table 3) clearly indicates that heavy Katikala consumption has a higher risk of developing liver abnormalities.

Our findings are in line with Marghoob et al [16], Alatalo et al [17] and Katherine M. Conigrave, et al. [12], who also registered a significant increase in liver enzymes after consuming different alcohols of high strengths similar to locally fermented alcohol "Katikala", >20% by volume alcohol.

ALT: Elevated level of serum could be caused by many different substances like Alcohol, medications, fats, heavy metals, or even excessive amount of meat intake [18]. Small amount of ALT may be obtained in normal range of 18-85U/L in our blood. Clinically high level of ALT in serum have been associated with stroke risk and cardiovascular mortality [19]. Our current study showed a significant correlation between levels of serum ALT in alcoholics (128.03 ± 59) when compared with the abstainer controls (23.26 ± 5.8) with $p < 0.05$ (as shown in Table 3). Similar to the current study, Marghoob et al [16] and Alatalo et al [17] have reported significantly increased ALT concentration in alcohol addicts than abstainers controls.

AST: Present study showed a significant rise of serum level of AST in alcoholics (178.18 ± 82) when compared with the abstainer controls (20.41 ± 6.1) with $p < 0.05$ (as shown in Table 3). Similar to the current study, Jang et al. [20], Alatalo et al. [21]and Walter A, and Mohammed Ashraf [3] have reported significantly increased serum AST concentration in alcohol addicts than abstainer controls. When both ALT and AST enzymes are elevated, a comparison of patterns of elevation can provide information about the specific liver disease and its causes. When AST elevated more than ALT, this commonly shows that the cause liver condition is alcohol related [22]. The ALT and AST enzymes pattern of elevation could be diagnostically helpful to differentiate the causes of liver disorders [22]. Most acute hepatocellular disorders shows higher level of ALT rather than AST; whereas Alcoholic liver diseases shows AST: ALT ratio of greater than or equal to 2 [23]. This may due to both enzymes require vitamin B6 (pyridoxal -5'-phospate) to function well [23]. In heavy drinkers vitamin B6 is much lower due to their poor appetite and this has relatively much higher effect on ALT production than AST production with correspond changes in serum concentration causing AST/ALT to be greater than other liver diseases [23].

Ratio of AST to ALT: Although the normal range of AST and ALT values varied all over the world, ratio of AST to ALT is key for diagnosing liver diseases [22]. In health individuals ratio of AST to ALT would be around 1.15 U/L and if AST/ALT greater than 2 this denotes alcoholic liver disease [24]. In our study, ratio of AST to ALT >2 was higher in chronic heavy "Katikala" drinking group as compared with control non-Katikala consuming subjects (as shown in Table

Our study results support the previous studies involved in assessing the relation between severe alcohol intake and ratio values by Subir Kumar Das and D.M.Vasudevan[25], H. Nyblom et al. [22] and Walter A, and Mohammed Ashraf [3].

Gamma Glutamyl transpeptidase: most sensitive and commonly employed biochemical marker of alcohol ingestion [26]. Consequently, increased levels of GGT indicate antioxidant deficiency and several community based studies have shown that in addition to alcoholic liver diseases, GGT associated is associated with cardiovascular mortality[19, 27]. Current study revealed chronic heavy alcohol consumption as a significant independent factor for high level of serum GGT in alcoholics (162.4 ± 91.5) when compared with the abstainer controls (26.5 ± 6.5) with $p < 0.05$ as (shown in Table 3). Similar result had been reported by Alatalo et al, Sara A & Mahmoud Omer and Marghoob et al [16, 17, 26].

Body Mass: In this study Chronic heavy Areki/ Katikala drinking group had shown significantly lower Body mass index and percent of body fat as compared with non-alcoholic group (Table 2). Reduced adipose tissue in chronic drinker may occur due to simultaneous decreased intake of nutrition with alcohol [28]. In general alteration in body composition occur in alcoholics as ethanol supply more than 50% of dietary energy that cannot be stored [28]. Our current study shows Pearson correlation test for %BF with quantity and duration of alcohol consumption; which was (r= -0.336) and (r= -0.280) with p-value of 0.052 and 0.870 respectively (as shown in Table 4).

This negatively correlated association is consistent with another studies in which it was reported that the amount of alcohol consumed by an individual was found to an independent factor to for lower percent of body fat [28-30]. The current study result was unlikely with study report from Wannamethee et al. [31] in which it was reported that men who consumed high alcohol showed higher levels of central adiposity than non-drinkers and lighter drinkers.

Limitations of the study

Female participants were not obtained during data collection and the total participants were males. So, this result may not represent chronic Katikala (local-alcohol) addicted females. On the other hand some other biochemical parameters like ALP and lipid profiles are not assessed due budgetary issues.

Conclusion

Subjects chronically consuming Katikala/Areki showed significantly raised serum AST, ALT, and GGT that may cause abnormal liver function. Chronic "Katikala/Areki" drinking group showed significantly lower %BF compared with non-alcoholic controls, implying that fat metabolism is negatively affected with Katikala addiction. Not only long-term (>1 year), even short-term intake of local alcohol (Katikala) consumption is bad for health.

Aknowledgement

We would like to thank our study participants and laboratory assistants for their priceless cooperation.

References

1. Moss H.B, The impact of alcohol on society: a brief overview. Social work on public health, 2013. 28(3-4): p. 175-177.
2. WHO, Global status report on alcohol and health 2016, World Health Organization: Geneva 27, Switzerland.
3. Walter A and Mohammed Ashraf, A study correlating the quantity and duration of alcohol consumption with function tests IOSR journal of Dental and Medical Sciences (IOSR-JDMS) 2014. 13(3): p. 70-75.
4. Guesh Mulaw and Anteneh Tesfaye, Technology and microbiology of traditionalfermented foof and beverage products in Ethiopia. Afri journal of microbiology research 2017. 11(825-844).
5. Getachew Tafere, A Review on traditional fermented beverages of Ethiopian. journal of natural sciences research, 2015. 5: p. 94-102.
6. Belachew Desta, A survey of the alcoholic contents of traditional beverages Ethiopian Medical journal, 1977. 15: p. 65-68.
7. Roem, E. Alcoholic drinks and Grams of Alcohol. 2011 [cited 2019 29/7]; Available from: http:// www.nutritionheart.com/alcohol-drinks-grams-of-alcohol/
8. Chiang J, Liver physiology, in metabolism and detoxification, Linda M, et al., Editors. 2014, Elsiever: san diego. p. 1770-1782.
9. Simon Hazeldine, Theresa Hydes, and Nick Sheron, Alcoholic liver disease- the extent of the problem and what you can do about it. clinical medicine, Apr 2015. 15(2): p. 179-185.
10. Jacquelyn J and Maher, Exploring alcohol's effect on liver function. Alcohol health Res world, 1997. 21: p. 5-12.function test? Ulster Med J, 2012. 81(1): p. 30-36.

11. Asaad Ahmed Mustafa and AbdElkarim A. Abdrabo, Assessment of liver function tests among alcoholism in Sudan. Pyrex Journal of Biomedical research, 2017. 3(4): p. 29-33.
12. Katherine M, et al., Traditional markers of excessive alcohol use. Society for the study of addiction to alcohol and other drugs, 2003. 98(2): p. 31-43.
13. World MJ., et al., Differential effect of chronic alcohol intake and poor nutrition on body weight and fat store. Alcohol & Alcoholism, 1984. 19(4): p. 281-290.
14. Deurenberg P, Weststrate J, and Seidell J, Body mass index as measurement of body fatness: age and sex specific prediction formulas. Br J Nutr, 1991 mar. 65(2): p. 105-114.
15. Diana Nicoll C, Current medical diagnosis and treatment, in Therapeutic drug monitoring and laboratory reference ranges, Stephen JM and Maxine AP, Editors. 2007, Mc Graw hill. p. 1767-1775.
16. Mohd Azam Hyder, Marghoob Hasan, and M. AH.. Comparative levels of ALT, AST, ALP and GGT in liver associated diseases. European journal of experimental biology, 2013. 3(2): p. 280-284.
17. Paivikki Alatalo, et al., Biomarkers of liver status in heavy drinkers, moderate drinkers, and abstainers. Alcohol and alcoholism 2009. 44(2): p. 199-203
18. L. Purkins, et al., The influence of diet upon liver function tests and serum lipids in healthy male volunteers resident in phase I units. British journal of clinical pharmacology, 2003. 57(2): p. 199-208.
19. Kunutsor, et al., Liver enzymes and risk of cardiovascular diseases in general population a meta-analysis of prospective cohort studies. Atherosclerosis 2014. 236(1): p. 7-17.
20. Eun Sung Jang, et al., Effects of coffe, smoking and alcohol on liver function tests: a comprehensive cross-sectional study. BMC gastroenterology, 2012. 12(145).
21. Paivikki Alatalo, et al., Biomarkers of liver status in heavy drinkers, moderate drinkers, and abstainers. Alcohol and alcoholism, 2009. 44(2): p. 199-203.
22. H. Nyblom, et al., High AST/ALT ratio may indicate advanced alcoholic liver disease rather than heavy drinking. Alcohol and alcoholism 2004. 39(4): p. 336-339.
23. Cohen JA and Kaplan MM, The SGOT/SGPT ratio: An indicator of alcoholic liver disease. Dig Dis Sci, 1979. 24(11): p. 835-838.
24. Philip Hall and Johnny Cash, What is the real function of the liver function test? Ulster Med J, 2012. 81(1): p. 30-36.
25. Subir Kumar Das and DM Vaudevan, Biochemical diagnosis of alcoholism. Indian journal of clinical biochemistry. Indian Journal of Clinical Biochemistry,. 2005. 20(1).
26. Sara A and Mohamed Omer, Study activity of serum gamma Glutamyl transferase enzyme as a diagnostic biomarker in alcoholic hepatitis. Asian journal of biomedical and pharmaceutical sciences, 2016. 6(52).
27. Mason JE, Strake RD, and V.K. JE.. Gamma Glutamyl transferase: a novel cardiovascular risk biomarker. . Prev cardiol, 2010 winter. 13(1): p. 36-41.
28. Addolorato G, et al., Influence of chronic alcohol abuse on body weight and energy metabolism: is excessive ethanol consumption a risk factor for obesity or malnutrition? J intern med, 1998. 244(5): p. 387-395.
29. Suthat Liangpunsakul, David W, and R Qi, Relationship between alcohol intakes, body fat, and physical activity- a population based study. Ann Epidemiol, 2010. 20 (9): p. 670-675.
30. Addolorato G, Capristo E, and Marini M, Body composition changes induced by chronic ethanol abuse: evaluation by dual energy X-ray absorptiometry Am J Gastroenterol, September, 2000. 95(9): p. 2323-2327.
31. Wannamethee, AG Shaper, and PH Whincup, Alcohol and adiposity: effects of quantity and types of drink and time relation with meals. International journal of obesity, 2005. 29(1): p. 1436-1444.