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Assessing the Impact of Lifestyle Interventions on Nonalcoholic Fatty Liver Disease Progression: A Prospective Cohort Study

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ABSTRACT

In Asian adults, the prevalence of nonalcoholic fatty liver disease (NAFLD) can approach 30%., patients who are obese have a higher prevalence of NAFLD. Although difficult to accomplish, weight loss is usually advised for individuals with NAFLD or those at high risk. Our goal was to assess how a mobile app-based lifestyle intervention affected NAFLD patients' ability to lose weight. All participants were provided with a standardized model digital weighing scale (Omron HN-286, Japan) for self-monitoring of weight. All outcomes were part of routine measurements taken by trained nurses and blood tests conducted at the outpatient NAFLD clinic. Assessors were not blinded to the groups allocated to the study participants. Body weight was measured using a calibrated digital weighing machine (Seca 767, Germany) to the nearest 0.1 kg. Height was measured in meters to two decimal points using the stadiometer attached to the Seca scale and the corresponding BMI was calculated. There were a significantly greater number of participants who achieved ^{3}5% weight loss in the intervention as compared to the control group at both 3 and 6 months (Table 2). After adjustment for age, gender and ethnicity, the intention-to-treat and per-protocol analyses showed that use of the mobile-enabled lifestyle intervention program was independently associated with a higher likelihood of achieving a □5% weight loss at 3 and 6 months when compared with standard care. Patients with NAFLD may benefit from a lifestyle intervention that is made possible by a mobile app, since it can improve their liver enzyme levels and anthropometric indices. There is a chance that this therapeutic approach will be used on a broader demographic.

Key Words
Nonalcoholic fatty liver disease (NAFLD), weight loss, lifestyle intervention

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INTRODUCTION

NAFLD represents a clinicopathological spectrum that consists of hepatic steatosis and nonalcoholic steatohepatitis (NASH) and varying in degrees of inflammation and fibrosis[1,2]. Up-20% of patients with NASH progress to cirrhosis and develop end-stage liver disease and associated complications[3,4].

With the epidemic surge in obesity and type 2 diabetes, the prevalence of NAFLD is on the rise, which is increasingly being recognized as a major cause of morbidity and mortality[5]. From 2002-2012, the number of patients undergoing liver transplantation for NASH-related hepatocellular carcinoma increased by 4-fold[6]. NASH is now poised to become the leading cause of hepatocellular carcinoma and indication for liver transplantation in the United States[6].

In Asia, an estimated 20%-30% of the adult population have been diagnosed with NAFLD, with a higher prevalence among patients with obesity[7]. The increase in prevalence can be attributed to a shift in dietary and lifestyle habits due to rapid globalization[8]. Notably, Asians are more susceptible to NAFLD at equivalent levels of overnutrition as compared to their Western counterparts, in part due to differences in the adiposity-muscle composition[1]. In view of the increased risk of morbidity in the Asian population, the World Health.

Organization (WHO) recommends 23 kg/m^2 as the body mass index (BMI) cut-off point for clinical action[9], while the International Diabetes Federation recommends waist circumference cut-off points of 90 cm and 80 cm for Asian men and women, respectively[10].

It is closely linked with metabolic syndrome and its component parts including obesity, type II diabetes mellitus, and dyslipidemia. Numerous pharmacological interventions have been tested for the treatment of NAFLD with varying success. Nonetheless, no current pharmacological therapy is recommended for the treatment of this condition. Much focus has been given to the role of lifestyle intervention in NAFLD, including the role of prescribed exercise regimes and diets. This review aims to summarize the literature surrounding this approach, highlighting the impact and role these strategies have on NAFLD.

Weight reduction through caloric restriction is the most evidence-based way to improve NAFLD across the disease spectrum and therefore is the first-line treatment recommended in multiple clinical practice guidelines[11-14]. Comprehensive lifestyle change should involve simultaneous implementation of dietary changes to reduce energy intake, lifestyle and behavioral training and an increase in physical activity. Changes should also include the avoidance of smoking, which has been associated with NAFLD, fibrosis progression and hepatocellular carcinoma (HCC)[15]. Alongside a discussion about the benefits of lifestyle change for reducing NAFLD severity and overall cardiometabolic risk, patients should be advised that there are currently no licensed medications for NAFLD treatment. Of course, dietary changes and long-term weight reduction may not be achievable or might not work for patients with advanced fibrosis and concomitant pharmacological treatment may be needed once it becomes available.

To our knowledge, there is a paucity of research investigating the effects of integrating mobile apps into specialized weight loss programs for patients with NAFLD, with no full-sized randomized controlled trials published to date. Furthermore, a systematic review identified that none of the commercially available weight management mobile apps available included all major aspects of evidence-based strategies of self-monitoring, goal-setting, motivational strategies, healthy eating and physical activity support, social support, health or weight assessment and personalized feedback, along with the involvement of health care professionals and formal scientific evaluation[16]. Accordingly, the objectives of the present study were to evaluate the effect of a lifestyle intervention consisting of diet and physical activity enabled by a mobile app that integrates a spectrum of evidence-based strategies along with health care professional involvement in facilitating weight loss and improving relevant health indicators in patients with NAFLD.

MATERIALS AND METHODS

Following screening, clinicians referred patients from a NAFLD clinic at NUH for recruitment. The American Association for the Study of Liver Diseases guidelines[11] defined nonalcoholic fatty liver disease (NAFLD) as the presence of hepatic steatosis, as assessed by imaging or histology, without secondary causes of hepatic fat accumulation, such as heavy alcohol consumption, long-term steatogenic medication use, or monogenic hereditary disorders. The study included adults over 21 years old who had a BMI of less than 23 kg/m^2, were able to read and write in English and had a smartphone with a data plan in addition to being diagnosed with nonalcoholic fatty liver disease (NAFLD) after excluding out secondary causes of liver fat buildup. The exclusion criteria included having an infection with the hepatitis B or C virus and consuming alcohol at a rate greater than 1.5 times the daily recommended limit (15 g for women and 30 g for males). The study excluded patients with concomitant liver disease, stage 4 and above kidney disease, depression, untreated hypothyroidism, heart failure, cirrhosis, poorly controlled diabetes mellitus (HbA1c>10%), diabetes requiring insulin, diabetes requiring treatment and clinically or biochemically recognised systemic diseases. Prior to enrolment, each patient provided written informed permission. A standardised model digital weighing scale (Omron HN-286, Japan) was given to each participant so they could keep track of their own weight.

Every result was a result of standard blood tests and measures made by certified nurses at the outpatient NAFLD clinic. There was no blinding of the assessors with respect to the study participants' groups. A calibrated digital weighing machine (Seca 767, Germany) was used to measure body weight, with a precision of 0.1 kg. Using the stadiometer that was fastened to the Seca scale, height was measured in metres to two decimal places and the appropriate BMI was computed. As advised by the WHO, the waist circumference was measured with a tape measure at the halfway point between the top of the iliac crest and the bottom edge of the last perceptible rib. An automated kinetic approach was used to measure the levels of ALT and aspartate aminotransferase (AST). A blood pressure monitor (Carescape Dinamap V100., GE Healthcare, Chicago, IL, USA) was used to assess blood pressure (for individuals with hypertension). At baseline, information about the participants' age, gender, ethnicity and any relevant comorbidities that they may have had were also gathered. Data on how often apps were used was gathered by the app developer.

Statistical Analysis: Studies that provided nutrition therapy interventions targeted at weight loss in patients with NAFLD were referenced for sample size calculation. The primary unit of interest was weight loss of at least a 5% by 6 months. It was postulated that 10% of the control subjects will achieve this successful outcome and the intervention would increase this rate by 4-fold. With 90% power at a 5% significance level and allowing for a 10% dropout rate, a sample size of 100 (50 per group) would be required. Data analyses were performed using SPSS for Windows version 21.0 (SPSS Inc, Chicago, IL, USA). Results are expressed as mean and SD for normally distributed variables and as the median and interquartile range for variables that did not satisfy normality criteria.

RESULTS AND DISCUSSIONS

A total of 174 referred subjects were screened for participation. Forty-six did not meet the eligibility criteria, primarily due to refusal to participate and a lack of English literacy. The remaining 118 subjects were enrolled and randomized (60 to the intervention group and 58 to the control group).

There was a significantly greater number of participants who achieved ^{3}5% weight loss in the intervention as compared to the control group at both 3 and 6 months (Table 2). After adjustment for age, gender and ethnicity, the intention-to-treat and per-protocol analyses showed that use of the mobile-enabled lifestyle intervention program was independently associated with a higher likelihood of achieving a □5% weight loss at 3 and 6 months when compared with standard care.

Table 3 show that participants in the intervention group lost significantly more weight than those in the control group at 3 and 6 months based on the intention-to-treat and per-protocol analysis, respectively. The significantly greater improvements in both absolute and percentage weight loss in the intervention group were more pronounced at 6 months as compared to 3 months, with large between-group effect sizes in percentage weight loss at both 3 and 6 months (Cohen d>0.8 for all).

Patients enrolled in the 6-month nBuddy mobile app intervention program had a 5-fold higher likelihood of achieving ^{3}5% weight loss as compared to those receiving standard care. In addition, the mobile-enabled lifestyle intervention appeared to have a positive influence on components of surrogate markers of NAFLD such as waist circumference and BMI, along with improvements in liver enzymes (AST, ALT) and blood pressure. These positive results remained significant after an intention-to-treat approach, suggesting a notable effect among NAFLD patients. Our findings support the consensus that a modest weight loss of about 5% of baseline body weight within a 6-month period is associated with clinically meaningful reductions in liver enzymes[17-19].

Weight loss, along with control of metabolic risk factors, is the cornerstone of management of NAFLD in the absence of effective medical therapy. Current practice guidelines advocate a target weight loss of 7%-10% to achieve improvement in steatosis and inflammation[17-20]. In a Cuban study, a weight loss of ^{3}5% led to a resolution of steatohepatitis and reduction in the NAFLD activity score of at least 2 points, without worsening of fibrosis., however, regression of fibrosis occurred in those with □10% weight loss[21]. Hence, the greater the extent of weight loss with lifestyle changes, the more significant the improvement in NASH and fibrosis.

The use of mobile apps and online platforms as part of weight management in patients with noncommunicable diseases is increasingly growing in popularity. This stems partly from its ability to overcome issues faced by conventional weight management programs that require physical attendance. Health care providers observed a high nonattendance rate for patients with NAFLD requiring dietetics intervention and follow up[22,23]. Jiandani[24] reported a high attrition rate for in-house weight management programs whereby 34% of the participants discontinued after a single visit. The reasons cited included limited ability to pay for program services, limited time and transportation challenges in attending appointments with health care professionals. Other barriers included the lack of

Table 1: Baseline Characteristics of Study Participants.

Variable	Intention-to-treat			Per-protocol		
	Control (n=58)	Intervention (n=60)	P-value	Control (n=56)	Intervention (n=55)	P-value
Gender, n (%)			.32			38
Male	39 (67.2)	35 (58.3)		38 (67.8)	33 (60)	
Female	19 (32.7)	25 (41.6)		18 (32.1)	22 (40)	
Ethnicity, n (%)			.22			16
Chinese	43 (74.1)	44 (73.3)		42 (75)	41 (74.5)	
Malay	11 (18.9)	7 (11.6)		10 (17.8)	6 (10.9)	
Indian	0 (0)	5 (8.3)		0 (0)	5 (9.0)	
Others	4 (6.8)	4 (6.6)		4 (7.1)	3 (5.4)	
Diabetes, n (%)	21 (36.2)	12 (20)	.67	19 (33.9)	11 (20)	08
Hyperlipidemia, n (%)	41 (70.6)	40 (66.6)	.60	41 (73.2)	38 (69.0)	61
Hypertension, n (%)	38 (65.5)	39 (65)	.95	38 (67.8)	37 (67.2)	96
Age (years), mean (SD)	47.3 (11.2)	47.6 (12.3)	.77	47.2 (11.2)	47.1 (12.3)	97
Weight (kg)	87.2 (20.3)	82.4 (16.3)	.18	87.3 (20.5)	83.2 (16.8)	21

Table 2. Proportion of Patients with □5% weight Loss in the Control and Intervention Groups.

Analysis	Controla, n (%)	Interventionb, n (%)	Unadjusted RRc (95% CI)	P value	Adjustedd RR (95% CI)	P-value
Intention-to-treat						
3 months	6 (10)	19 (26.2)	4.6 (1.1-11.3)	.04	4.6 (1.1-11.8)	.03
6 months	6 (10)	27 (41.3)	6.2 (1.9-16.4)	.003	6.1 (1.9-16.5)	.003
Per-protocol						
3 months	6 (10)	19 (29.4)	4.8 (1.3-11.9)	.04	4.9 (1.4-12.5)	.02
6 months	6 (10)	27 (45.6)	6.7 (1.8-17.4)	.003	6.9 (3.0-17.8)	.001

Table 3: Mean (SD) Changes in Anthropometric, Biochemical, and Clinical Outcomes in Patients with Nonalcoholic Fatty Liver Disease from Baseline at 3 and 6 months after Enrolment Based on Intention-to-Treat Analysis.

3 months	118	-0.9 (3.2)	-4.1 (4.2)	4.1 (1.5-5.5)	<.001	<.001	0.92
6 months							
Weight, %	118	-0.6 (3.8)	-4.1 (5.3)	3.7 (1.4-5.0)	<.001	<.001	0.77
3 months	118	-0.8 (3.4)	-4.6 (4.8)	4.0 (1.9-5.1)	<.001	<.001	0.96
6 months	118	-0.7 (4.7)	-5.1 (6.7)	4.7 (3.0-6.4)	<.001	<.001	0.82
BMIb, kg/m2							
3 months	118	-0.5 (0.9)	-2.1 (2.3)	0.8 (0.6-1.3)	<.001	<.001	0.67
6 months	118	-0.4 (2.3)	-2.4 (2.3)	1.0 (0.6-1.7)	<.001	<.001	0.80
Waist circumference, cm							
3 months	115	0.5 (5.6)	-4.6 (6.2)	4.7 (1.8-6.6)	<.001	<.001	0.78
6 months							
ALTc, IU/L	115	0.8 (5.3)	-3.8 (6.1)	4.7 (1.9-6.4)	<.001	<.001	0.77
3 months	85	-21.5 (33.1)	-38.1 (38.5)	17.4 (0.5-33.8)	.046	.04	0.48
6 months							
ASTd, IU/L	113	-12.4 (36.1)	-34.4 (41.5)	23.0 (8.3-37.9)	.004	.007	0.59
3 months	86	-12.3 (20.2)	-21.3 (27.8)	10.2 (-1.8-20.8)	.12	.07	0.40
6 months	114	-8.3 (18.5)	-18.3 (28.4)	11.0 (2.0-20.0)	.04	.03	0.44
Systolic blood pressure (mmHg)							
3 months	73	2.3 (12.6)	-14.6 (15.6)	15.7 (8.6-22.7)	<.001	<.001	1.08
6 months	82	-3.5 (13.3)	-13.5 (15.7)	11.2 (4.8-17.4)	.003	.009	0.75
Diastolic blood pressure (mmHg)							
3 months	73	3.1 (8.6)	-7.2 (8.7)	9.5 (5.1-15.1)	<.001	<.001	0.99
6 months	82	0.8 (11.0)	-7.5 (9.8)	8.2 (4.1-13.2)	.001	.004	0.82

motivation and both patient and physician time constraints. In this study, the attrition rate of the intervention group using the mobile app (5%) was markedly lower than that of conventional face-to-face dietetics intervention cited in the literature[25]. This novel approach is also effective in addressing health behavior changes, thus leading to weight loss and beneficial outcomes[26]. The use of mobile apps similarly benefits health care practitioners through facilitating relationships with patients by enhancing the speed and ease of communication[27]. Use of a mobile app further provides practitioners with additional information in a timely manner that can improve patient care[28].

Included studies were compared to their published protocols when available to identify omissions of outcome data. Alternatively, the methods section of each report was compared to the results section to assess reporting bias. The International Clinical Trials Registry, EU Clinical Trial Register and meta Register of Controlled Trials were searched using the key words fatty liver and steatohepatitis to identify trials described as completed. Studies registered prior to 2009 with records not updated in the past 12 months were assumed to be completed. A literature search using the relevant principle investigator was conducted to identify publications resulting from relevant registered trials. Histological examination of biopsy samples can assess the presence of necro-inflammation and fibrosis and can differentiate between macro-and micro-vesicular steatosis., it remains the reference standard for the grading and staging of NAFLD[28]. However, it is subject to sampling error due to histological heterogeneity[29,30], scoring is semi-quantitative limiting its ability to detect modest changes and scoring systems vary between reports precluding direct comparisons.

Second, the intervention continued to require the expertise of dietitians in coaching participants via the dashboard. However, the enablement of one dietitian in supporting multiple patients remotely may render the intervention more cost-effective as compared to face-to-face consultations. There is potential to scale up the solution considering the automated features such as provision of alternative healthier food options in the app, which can facilitate behavior change without the costs associated with intensive face-to-face counseling. Moreover, the delivery of advice by different health care practitioners in both groups also limits the ability to attribute the results solely to the mobile app. Nevertheless, this trial offers insight into the feasibility of introducing a combined dietitian and mobile app model in outpatient care settings where dietitians may not yet have a clear role. Finally, it would have been preferable for all patients enrolled in the study to have biopsy-proven NASH and an end-of-treatment biopsy. However, this was limited by funding and time constraints.

CONCLUSIONS

Patients with NAFLD may benefit from a lifestyle intervention that is made possible by a mobile app in terms of weight loss, anthropometric improvements, and clinical indices. This study offers fresh perspectives on the viability and efficiency of mobile apps in supporting lifestyle modifications in nonalcoholic fatty liver disease (NAFLD) as well as additional recommendations for the use of this therapeutic approach in treating other chronic illnesses. Healthcare providers that are interested in offering weight loss interventions to patients with non-alcoholic fatty liver disease (NAFLD) may now think about utilising a mobile application to facilitate behavioural modifications, such as self-monitoring. Subsequent research endeavours may delve into the efficacy of this therapeutic approach across a broader demographic and assess significant histology consequences such hepatic fibrosis.

REFERENCES

1. Farrell, G.C., V.W.S. Wong and S. Chitturi, 2013. NAFLD in asia—as common and important as in the West. Nat. Rev. Gastroenterol. And Hepatology, 10: 1-10.0.
2. Loomba, R. and A.J. Sanyal, 2013. The global NAFLD epidemic. Nat. Rev. Gastroenterol. and Hepatology, 10: 686-690.
3. Wong, M.C.S. and J. Huang, 2018. The growing burden of liver cirrhosis: Implications for preventive measures. Hepatology Int., 12: 1-10.0.
4. Vernon, G., A. Baranova and Z.M. Younossi, 2011. Systematic review: The epidemiology and natural history of non-alcoholic fatty liver disease and non-alcoholic steatohepatitis in adults. Aliment. Pharmacol. and Ther., 34: 1-10.0.
5. Preiss, D. and N. Sattar, 2008. Non-alcoholic fatty liver disease: An overview of prevalence, diagnosis, pathogenesis and treatment considerations. Clin. Sci., 115: 1-10.0.
6. Wong, R.J., R. Cheung and A. Ahmed, 2014. Nonalcoholic steatohepatitis is the most rapidly growing indication for liver transplantation in patients with hepatocellular carcinoma in the U.S.. Hepatology, 59: 1-10.0.
7. Wah-Kheong, C. and G. Khean-Lee, 2012. Epidemiology of a fast emerging disease in the Asia-Pacific region: non-alcoholic fatty liver disease. Hepatology Int., 7: 1-10.0.
8. Wong, M.C.S., J.L.W. Huang, J. George, J. Huang and C. Leung et al., 2019. The changing epidemiology of liver diseases in the asia–Pacific region. Nat. Rev. Gastroenterol. and Hepatology, 16: 1-10.0.
9. WHO Expert Consultation 2004. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 363: 1-10.0.
10. Alberti, K.G.M.M., P. Zimmet and J. Shaw, 2006. Metabolic syndrome-A new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabetic Med., 23: 1-10.0.
11. Plauth, M., W. Bernal, S. Dasarathy, M. Merli, L.D. Plank, T. Schütz and S.C. Bischoff, 2019. ESPEN guideline on clinical nutrition in liver disease. Clin. Nutr., 38: 1-10.0.
12. Francque, S.M., G. Marchesini, A. Kautz, M. Walmsley and R. Dorner et al., 2021. Non-alcoholic fatty liver disease: A patient guideline. JHEP Rep., Vol. 3 .10.1016/j.jhepr.2021.100322 1-10.0.
13. Cusi, K., S. Isaacs, D. Barb, R. Basu and S. Caprio et al., 2022. American Association of Clinical Endocrinology Clinical Practice Guideline for the Diagnosis and Management of Nonalcoholic Fatty Liver Disease in Primary Care and Endocrinology Clinical Settings. Endocr. Pract., 28: 1-10.0.
14. Rinella, M.E., B.A. Neuschwander-Tetri, M.S. Siddiqui, M.F. Abdelmalek and S. Caldwell et al., 2023. AASLD Practice Guidance on the clinical assessment and management of nonalcoholic fatty liver disease. Hepatology, 77: 1-10.0.
15. Marti-Aguado, D., A. Clemente-Sanchez and R. Bataller, 2022. Cigarette smoking and liver diseases. J. Hepatology, 77: 1-10.0.
16. Rivera, J., A. McPherson, J. Hamilton, C. Birken and M. Coons et al., 2016. Mobile Apps for Weight Management: A Scoping Review. JMIR mHealth

uHealth, Vol. 4 .10.2196/mhealth.5115 1-10.0.
17. Chalasani N, Z. Younossi, J.E. Lavine, M. Charlton, K. Cusi and M. Rinella, et al. 2018. The diagnosis and management of nonalcoholic fatty liver disease: Practice guidance from the American Association for the Study of Liver Diseases. Hepatology 67: 1-10.0.
18. Méndez-Sánchez, N., M. Arrese, D. Zamora-Valdés and M. Uribe, 2007. Treating nonalcoholic fatty liver disease. Liver Int., 27: 1-10.0.
19. Mazzotti, A., M.T. Caletti, L. Brodosi, S.D. Domizio and M.L. Forchielli et al., 2018. An internet-based approach for lifestyle changes in patients with NAFLD: Two-year effects on weight loss and surrogate markers. J. Hepatology, 69: 1-10.0.
20. European A.S.L. (EASL), A.S.D. European, (EASD) and A.S.O. European, (EASO) 2016. EASL-EASD-EASO Clinical Practice Guidelines for the Management of Non-Alcoholic Fatty Liver Disease. Obes Facts 9: 1-10.0.
21. Vilar-Gomez, E., Y. Martinez-Perez, L. Calzadilla-Bertot, A. Torres-Gonzalez and B. Gra-Oramas *et al*., 2015. Weight Loss Through Lifestyle Modification Significantly Reduces Features of Nonalcoholic Steatohepatitis. Gastroenterology, 149: 1-10.0.
22. Lazo M, S.F. Solga, A. Horska, S. Bonekamp, A.M. Diehl, F.L. Brancati and L.S.L.A.R.G. Fatty 2010. Effect of a 12-month intensive lifestyle intervention on hepatic steatosis in adults with type 2 diabetes. Diabetes Care 33: 1-10.0.
23. Reis, T.O., S.M. Ferolla, M.L.P. Lima, M.A. Fausto and A.C.L. Albricker et al., 2015. Nonalcoholic fatty liver disease: A cohort study focusing on treatment response to nutritional counseling. Med. Express, Vol. 2 .10.5935/medicalexpress. 2015.02.04 1-10.0.
24. Jiandani, D., S. Wharton, M.A. Rotondi, C.I. Ardern and J.L. Kuk, 2016. Predictors of early attrition and successful weight loss in patients attending an obesity management program. BMC Obesity, Vol. 3 .10.1186/s40608-016-0098-0 1-10.0.
25. Moroshko, I., L. Brennan and P. O'Brien, 2011. Predictors of dropout in weight loss interventions: A systematic review of the literature. Obesity Rev., 12: 1-10.0.
26. Hall, A.K., H. Cole-Lewis and J.M. Bernhardt, 2015. Mobile Text Messaging for Health: A Systematic Review of Reviews. Annual Rev. Public Health, 36: 1-10.0.
27. Gagnon, M.P., P. Ngangue, J. Payne-Gagnon and M. Desmartis, 2015. m-Health adoption by healthcare professionals: A systematic review. J. Am. Med. Inf. Assoc., 23: 1-10.0.
28. Practice G.D.M.N.F.L.D., 2010. A decalogue from the Italian Association for the Study of the Liver (AISF) Expert Committee. Dig Liver Dis 42: 1-10.0.
29. Merriman, R.B., L.D. Ferrell, M.G. Patti, S.R. Weston, M.S. Pabst, B.E. Aouizerat and N.M. Bass, 2006. Correlation of paired liver biopsies in morbidly obese patients with suspected nonalcoholic fatty liver disease. Hepatology, 44: 1-10.0.
30. Larson, S.P., S.P. Bowers, N.A. Palekar, J.A. Ward, J.P. Pulcini and S.A. Harrison, 2007. Histopathologic Variability Between the Right and Left Lobes of the Liver in Morbidly Obese Patients Undergoing Roux-en-Y Bypass. Clin. Gastroenterol. Hepatology, 5: 1-10.0.