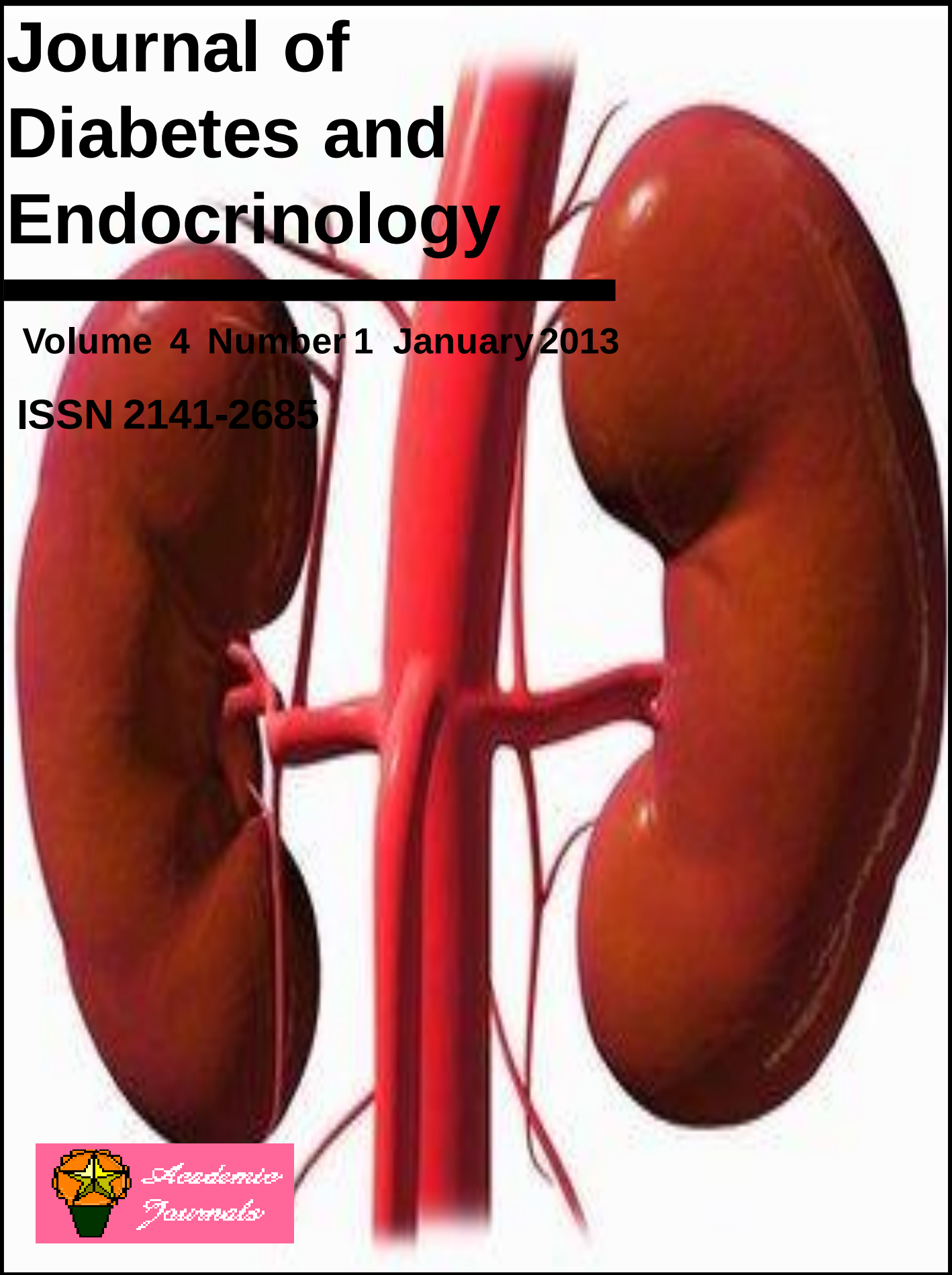
Journal of Diabetes and Endocrinology

Volume 4 Number 1 January 2013

ISSN 2141-2685



Academic Journals

ABOUT JDE

The **Journal of Diabetes and Endocrinology (JDE)** is published monthly (one volume per year) by Academic Journals.

Journal of Diabetes and Endocrinology (JDE) is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as steroid hormones, clinical chemistry and biochemistry, neuroendocrinology, hypoglycemia in diabetes etc.
The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JDE are peer-reviewed.

Submission of Manuscript

Submit manuscripts as e-mail attachment to the Editorial Office at: jde@academicjournals.org. A manuscript number will be mailed to the corresponding author shortly after submission.

The Journal of Diabetes and Endocrinology will only accept manuscripts submitted as e-mail attachments.

Please read the **Instructions for Authors** before submitting your manuscript. The manuscript files should be given the last name of the first author.

Editors

Prof. Masayoshi Yamaguchi
Division of Endocrinology and Metabolism and Lipids,
Department of Medicine,
Emory University School of Medicine,
1639 Pierce Drive, 1305 WMRB, Atlanta,
Georgia 30322-0001,
USA.

Dr. Krishna M. Boini
Department of Pharmacology and Toxicology,
Virginia Commonwealth University,
1220 East Broad Street, MSB II, Room # 3054
Richmond, VA - 23298.
USA

Dr. Mohamed A. M. Mohamed Dkhil Hamad
Zoology Dept. College of Science,
King Saud University,
Egypt.

Dr. Aliyu Mohammed
Department of Human Physiology
Ahmadu Bello University, Zaria.
Nigeria

Prof. Bhupen Chandra Behera
Gayatri College of Pharmacy,
Gayatri Vihar, Jamadarpali,
Sambalpur- 768200, Orissa
India.

Dr. Srinivas Nammi
Research Academic
Faculty of Pharmacy
The University of Sydney
NSW 2006,
Australia.

Dr. Mamdouh Moawad Ali Hassan
Biochemistry Department
Genetic Engineering & Biotechnology Division
National Research Center
El Tahrir St., El Dokki 12622
Cairo,
Egypt.

Editorial Board

Dr. Fawad Javed
Karolinska Institutet,
Department of Dental Medicine,
Huddinge,
Sweden

Prof. Hab Lidia Rudnicka
Dept. Dermatology,
Central Clinical Hospital,
MSWiA, Warsaw,
Poland

Dr. Aamir (Amer) Jalal Al Mosawi
University of Baghdad
College of Medicine
Iraq

Dr. Abbasi
Tehran University of Medical Sciences,
Tehran,
Iran

Dr. Rehab Fawzy Abdel-Rahman
Department of Pharmacology,
National Research Centre (NRC),
El- Tahrir St. Dokki, Cairo,
Egypt.

Dr. JIMOH, Ahmed Kayode
Titilayo Street, Isale Afo,
Ikirun Ifelodun LGA
Kwara State
Nigeria

Dr. Saganuwan Alhaji Saganuwan
Department of Veterinary Physiology,
Pharmacology & Biochemistry,
University of Agriculture Benue State,
Nigeria.

Dr. Alireza Shirpoor
Permanent lecturer of
Urmia University of Medical Sciences
Iran

Dr. Bassim Atta
Prof. Food Chemistry & Anaysis
Faculty of Agriculture
Tanta University
Egypt

Prof. (Dr.) Bhupen Chandra Behera
Gayatri College of Pharmacy,
Gayatri Vihar, Jamadarpali,
Sambalpur- 768200, Orissa
India

Dr. Ben-zhi Cai
Baojian Road 157#, Harbin,
150081,
China.

Dr. Chatchalit Rattarasarn
Division of Endocrinology and Metabolism
Department of Medicine
Ramathibodi hospital, Mahidol university
Bangkok,
Thailand 10400

Dr. Sónia Catarina Correia
Centre for Neuroscience and Cell Biology,
Department of Zoology,
University of Coimbra,
3004-517 Coimbra
Portugal

Mohamed A. M. M. Dkhil Hamad
faculty of science,
Helwan University,
Egypt.

Dr. Bakari Adamu Girei
Department of Medicine,
Ahmadu Bello University
Zaria,
Nigeria

Dr. Aliyu Mohammed
Adamawa State,
Nigeria

Ana Isabel Marques Duarte
Center for Neuroscience & Cell Biology
Institute of Biochemistry, Faculty of Medicine (Pólo I)
University of Coimbra
3004-504 Coimbra
Portugal

Instructions for Author

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

The **cover letter** should include the corresponding author's full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author's surname, as an attachment.

Article Types
Three types of manuscripts may be submitted:

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly.
Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process

All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Authors cannot nominate reviewers. Only reviewers randomly selected from our database with specialization in the subject area will be contacted to evaluate the manuscripts. The process will be blind review.
Decisions will be made as rapidly as possible, and the journal strives to return reviewers' comments to authors as fast as possible. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the JDE to publish manuscripts within weeks after submission.

Regular articles

All portions of the manuscript must be typed double-spaced and all pages numbered starting from the title page.

The Title should be a brief phrase describing the contents of the paper. The Title Page should include the authors' full names and affiliations, the name of the corresponding author along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The Abstract should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length.. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.
Following the abstract, about 3 to 10 key words that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Authors should use the solidus presentation (mg/ml). Standard abbreviations (such as ATP and DNA) need not be defined.

The Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors' experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section.

The Discussion should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The Acknowledgments of people, grants, funds, etc should be brief.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or Powerpoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

References: In the text, a reference identified by means of an author's name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author's name should be mentioned, followed by 'et al'. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like 'a' and 'b' after the date to distinguish the works.

Examples:

Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001)

References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

Examples:

Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. Afr. J. Biotechnol. 7: 3535-3539.

Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillinresistant Staphylococcus aureus in community-acquired skin infections. Emerg. Infect. Dis. 11: 928-930.

Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

Short Communications

Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 100 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.

Proofs and Reprints: Electronic proofs will be sent (e-mail attachment) to the corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage.

Fees and Charges: Authors are required to pay a $550 handling fee. Publication of an article in the Journal of Diabetes and Endocrinology is not contingent upon the author's ability to pay the charges. Neither is acceptance to pay the handling fee a guarantee that the paper will be accepted for publication. Authors may still request (in advance) that the editorial office waive some of the handling fee under special circumstances.

Copyright: © 2013, Academic Journals.
All rights Reserved. In accessing this journal, you agree that you will access the contents for your own personal use but not for any commercial use. Any use and or copies of this Journal in whole or in part must include the customary bibliographic citation, including author attribution, date and article title.

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

Disclaimer of Warranties

In no event shall Academic Journals be liable for any special, incidental, indirect, or consequential damages of any kind arising out of or in connection with the use of the articles or other material derived from the JDE, whether or not advised of the possibility of damage, and on any theory of liability.
This publication is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications does not imply endorsement of that product or publication. While every effort is made by Academic Journals to see that no inaccurate or misleading data, opinion or statements appear in this publication, they wish to make it clear that the data and opinions appearing in the articles and advertisements herein are the responsibility of the contributor or advertiser concerned. Academic Journals makes no warranty of any kind, either express or implied, regarding the quality, accuracy, availability, or validity of the data or information in this publication or of any other publication to which it may be linked.

Journal of Diabetes and Endocrinology

Table of Content: Volume 4 Number 1 January 2013

ARTICLES

Research Articles

The effect of white vinegar on some blood biochemical factors in type 2 diabetic patients 1
Mehdi Mahmoodi, Seyed-Mostafa Hosseini-zijoud, Gholamhossein Hassanshahi, Saeedeh Nabati, Mahboobeh Modarresi, Milad Mehrabian, Ahmadreza Sayyadi and Mohammadreza Hajizadeh

Ghrelin levels in obese children of diabetic parents 6
Fauzia Sadiq, Nadeem Hameed, Asim Mumtaz, Farzana yasmeen, Tauqqer butt and Khurshid Ahmad khan

Journal of Diabetes and Endocrinology Vol. 4(1), pp. 1-5, January 2013
Available online at http://www.academicjournals.org/JDE
DOI: 10.5897/JDE12.015
ISSN 2141-2685 ©2013 Academic Journals

Full Length Research Paper

The effect of white vinegar on some blood biochemical factors in type 2 diabetic patients

Mehdi Mahmoodi[1]*, Seyed-Mostafa Hosseini-zijoud[2], Gholamhossein Hassanshahi[1], Saeedeh Nabati[1], Mahboobeh Modarresi[1], Milad Mehrabian[1], Ahmadreza Sayyadi[1] and Mohammadreza Hajizadeh[1]

[1]Department of Biochemistry, Biophysics and Genetics, Rafsanjan Faculty of Medicine, Molecular Medicine Research Centre of Rafsanjan University of Medical Sciences, Rafsanjan, Iran.
[2]Department of Biochemistry and Nutrition, Faculty of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran.

Accepted 28 December, 2012

Type 2 diabetes is one of the most prevalent endocrine disorders worldwide. Traditionally, herbal plants and their derivatives are used to lessen complications of type 2 diabetes. The hypoglycemic and hypolipidemic properties have been reported for vinegar, but some cases of discrepant effects were also observed. In the current study, the impact of apple vinegar on some hematological and blood biochemical factors in type 2 diabetic patients was investigated. In this trial study, sixty patients with type 2 diabetes were divided into two groups. The first group took 15 ml of vinegar with their middle meal for one month. The second group received water as placebo. At the beginning and end of the study, blood samples were collected and biochemical factors including fasting blood sugar (FBS), glycated hemoglobin (HbA1c), triglycerides (TG), total cholesterol, low-density lipoprotein-cholesterol (LDL-C), high-density lipoprotein-cholesterol (HDL-C), urea, creatinine (Cr), uric acid, aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP) and complete blood count (CBC) were evaluated. Findings showed that FBS (P=0.006), HbA1c (P=0.002), MCV (P=0.0001) and mean cell hemoglobin (MCH; P=0.002) decreased where platelets (PLT) (P=0.005) increased significantly in first group. There was no significant difference in the studied parameters in placebo group. Based on the results of this study, it can be concluded that vinegar is a hypoglycemic agent that can be applied for treatment of type 2 diabetes.

Key words: Vinegar, acetic acid, type 2 diabetes, fasting blood sugar (FBS), glycated hemoglobin (HbA1c).

INTRODUCTION

Diabetes Mellitus (DM) is a globally growing health problem and has been considered as one of the five major causes of morbidity and mortality in many societies (Gispen and Biessels, 2000). According to the recent collected information worldwide, over 171 million individuals suffer from diabetes in 2000 and the number is expected to reach 366 million by 2030 (Wild et al., 2004).

Possible leading mechanisms for diabetes establishment are impaired insulin secretion, insulin resistance and over-production of hepatic glucose (fasting hyperglycemia) (Dailey, 2004). Insulin resistance not only plays pivotal role in diabetes complications, but also involved in atherosclerosis, hypertension and dyslipidemia (Adeli et al., 2001). DM usually causes several organ damage related disorders including retinopathy, cataract, neuropathy, atherosclerosis, nephropathy, embryopathy and wound healing retardation (Diabetes Control and Complications Trial Research Group, 1994).

Although, to date, insulin and other hypoglycemia reagents

*Corresponding author. E-mail: mahmoodies@yahoo.com. Tel: +98 913 191 4855. Fax: 0391 5225209.

are considered as the only medication for treatment of type 2 diabetes, but this agents have undesirable side effects. Epidemiological studies showed that application of plants and their derivatives improve chronic disease symptoms such as cardiovascular disease, cancer and diabetes (Yang et al., 2004). One of the plant derivatives is vinegar. Apple vinegar as one of the apple products contains a variety of flavonoids such as gallic acid, catechin, caffeic acid and ferulic acid (Natera et al., 2003).

Vinegar is a merged format of French words “vin aigre”, meaning “sour wine”, and can be made from almost any fermentable carbohydrate source, including dates, sorghum, apple, grapes, etc. Acetic acid, the volatile organic acid that identifies the product as vinegar consist of about 3 to 9% of vinegar content and is responsible for the tart flavor and pungent, biting odor of vinegars (Ren et al., 1997). The antiglycemic properties of vinegar were firstly reported by Ebihara and Nakajima (1988). In animal studies, it has been revealed that a diet containing acetic acid or vinegar at concentrations found in traditional diets has varying effects from enhancement of glycogen repletion (Fushimi et al., 2001), prevention of hypertension (Kondo et al., 2001) to stimulation of calcium (Ca) absorption (Kishi et al., 1999).

In a study, it was shown that white vinegar reduced both postprandial blood glucose and insulin levels. It also increased and prolonged satiety in healthy subjects (Ostman et al., 2005). The hypoglycemic impacts of acetic acid have been shown to be mediated by enhanced glycogen repletion in liver and skeletal muscles (Fushimi et al., 2001) and in the suppression of disaccharidase activity in human intestinal cells (Ogawa et al., 2000). In insulin resistant subjects, apple cider vinegar indicated to improve postprandial insulin sensitivity (Johnston et al., 2004).

In another rat model, acetic acid reduced triglycerides (TG) level in hyperlipidemic rats (Fushimi et al., 2006), in parallel risk of cardiovascular disease (Iso et al., 2001). Due to the high cost of drug remedy and their unwanted side effects, finding of some natural components for treatment of diabetes and its complications is considered.

Actually, simple, inexpensive diet strategies to help blood glucose are greatly needed to delay the progression of diabetes. Accumulating evidence indicates that a single dose of apple vinegar may attenuate postprandial glycaemia. Since postprandial glycaemia is a strong predictor of hemoglobin A1C, particularly in well controlled diabetic patients (Carol et al., 2009).

Apple vinegar is remarkably more regarded for its beneficial effects. Therefore, in the present study, the impacts of oral apple vinegar consumption on some hematological and blood biochemical factors in type 2 diabetic patients were investigated.

MATERIALS AND METHODS

The present study was a double-blind trial study done in 2011. Duration of treatments was one month. Type 2 diabetic patients, aging 30 to 60 years possessing the entrancing criterion (fasting blood sugar (FBS) more than 126 mg/dl, did not have any digestional, hepatic, renal, cardiovascular, asthma disease and using anti-diabetic drugs (Glibenclamide 1 daily)) were entered into the study. Also, exclusion criteria (vinegar intolerance, digestional disorder and using other drugs) were also imposed for choosing patients.

All of the enrolled patients either placebo or vinegar receiving group filled out written consent form which was designed specifically for this study. Patients with type 2 diabetes were divided into two groups. In each group, 30 persons including 15 males and 15 females were matched for body mass index (BMI).

The first group received 15 ml vinegar with middle meal for one month, without mixing with food or salad. Furthermore, they did not change their lifestyle during the study. In the second group, patients received water as placebo.

At the beginning and end of the study, blood samples were collected and hematological and blood biochemical factors including: FBS, glycated hemoglobin (HbA1c), TG, total cholesterol, low-density lipoprotein-cholesterol (LDL-C), high-density lipoprotein-cholesterol (HDL-C), urea, creatinine (Cr), uric acid, aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP) and hematological parameters including white blood cell (WBC), red blood cell (RBC), mean cell volume (MCV), mean cell hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), hematocrit (HCT) and platelets (PLT) were evaluated.

Statistical analysis

Data were expressed as mean±standard deviation of mean. Collected data were analyzed using one way analysis of variance (ANOVA) in Statistical Package for Social Sciences (SPSS) software and paired T-test. Probability level of <0.05 indicates significant difference.

RESULTS

The findings of this study indicate that FBS (P=0.006) and HbA1c (P=0.002) reduced significantly in the first group, while TG, total cholesterol, LDL-C, HDL-C, urea, Cr, uric acid, AST, ALT, ALP did not show significant differences. In placebo group, there was no significant difference in the studied factors (Table 1). It was also observed that the MCV (P=0.0001) and MCH (P=0.002) significantly reduced, while PLT (P=0.005) increased significantly in the first group and WBC, RBC, hemoglobin, HCT and MCHC did not change significantly. In placebo group, no significant differences were observed in the hematological parameters (Table 2).

DISCUSSION

The related results for biochemical factors and hematological parameters in the first (vinegar treated) and second (water treated) groups are completely illustrated in Tables 1 and 2, respectively.

In this study, it was observed that vinegar significantly reduced FBS and HbA1c in type 2 diabetic patients. Acetic acid is the active ingredient of vinegar and several

Table 1. Illustrated biochemical parameters in vinegar treated and placebo type 2 diabetic patients (results shown as mean±SD).

Factor	Group			
	Vinegar treated		Placebo treated	
	Pre-treatment	Post- treatment	Pre-treatment	Post- treatment
FBS (mg/dl)	174.67±63.52	156.23±60.04*	198.7±28.18	203.23±28.5
HbA1c (%)	7.56±3.01	7.03±2.97**	8.75±0.92	8.64±1.41
Cholesterol (mg/dl)	201.029±32.84	197.47±34.92	218.575±54.51	216.787±48.84
TG (mg/dl)	211.05±121.22	213.79±92.92	232.87±136.53	219.48±146.322
LDL-C (mg/dl)	111.97±26.39	115.52±22.54	127.6±35.86	124.12±31.46
HDL-C (mg/dl)	45.47±10.14	47.2±1.95	46.21±2.61	46.69±3.34
AST (IU/L)	22.61±6.27	22.67±5.77	20.84±6.69	22.21±7.51
ALT (IU/L)	17.117±8.07	17.235±7.93	17.54±8.07	16.9±7.49
ALP (IU/L)	256.23±64.53	249.5±65.01	250.15±58.35	242.27±57.64
Blood urea	31.41±8.46	30.50±8.12	36.96±23.57	36.36±22.25
Creatinine	0.885±0.157	0.885±0.145	1.009±0.601	1.036±0.659
Uric acid	5.15±1.55	5.19±1.65	5.42±1.26	5.45±1.49

Number of individuals=30; *P=0.006; **P=0.002; SD: Standard deviation.

Table 2. Illustrated hematological parameters in vinegar treated and placebo type 2 diabetic patients (results shown as mean±SD), Number of individuals=30.

Factor	Group			
	Vinegar treated		Placebo treated	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
WBC (n/ml)	9023.07±1519.02	8715.38±1917.64	8051±1490	8740±2221.86
RBC (mil/ml)	5.311±0.573	5.409±0.534	5.5±0.33	5.56±0.48
Hemoglobin(g/dl)	14.71±2.44	14.33±2.96	15.01±1.6	15.57±1.64
HCT (%)	46.27±3.846	45.82±3.802	46.82±4.11	47.34±3.58
MCV (fl)	88.07±7.101	85.41±5.748***	85.57±3.21	84.15±14.5
MCH (pg)	28.78±2.9	27.61±2.27**	28.32±1.41	28.21±1.24
MCHC (%)	32.73±1.59	32.32±0.797	32.3±0.698	32.18±0.811
PLT (n/ml)	266076±49795.5	308307±78586.9*	267760±68606±52	2684400±69731.62

Number of individuals=30; *P=0.005; **P=0.002; ***P=0.0001; SD: Standard deviation.

mechanisms have been suggested to explain anti-glycemic effects of vinegar. Acetic acid may control these factors via different manners like slowing down of gastric emptying (Liljeberg and Fjorck, 1998), inhibition of disaccharides activity in the small intestine, blocking the complete digestion of starch molecules (Ogawa et al., 2000) and also promotion of glucose uptake by muscle performance (Fushimi et al., 2001).

In another study performed on human subjects, the use of a starchy meal with vinegar was reported to cause suppression of postprandial increments in serum glucose and insulin by a delayed gastric emptying rate (Kondo et al., 2001). Therefore, continuous acetic acid consumption may lead to chronically decreased serum insulin level.

Several investigations examined the fact that whether delayed gastric emptying aid the hypoglycemic effects of vinegar (Liljeberg and Fjorck, 1998). Using non-invasive ultrasonography, Brighenti et al. (1995) did not observe any difference in gastric emptying rates in healthy subjects consuming bread (50 g carbohydrate) in association with acetic acid (that is, vinegar) versus sodium acetate (that is, vinegar neutralized by the addition of sodium bicarbonate); however, post-meal glycaemia was noted by the acetic acid treatment (1995).

Johnston et al. (2004) reported that vinegar could significantly improve insulin sensitivity in insulin resistant patients. There are some evidences that showed vinegar consumption can reduce postprandial glycaemia (Ostman et al., 2005). In agreement with our findings, Johnston et al. (2009) showed that regular vinegar intake by type 2 diabetic patients in a period of 12-weeks reduced HbA1c to 0.16% of its baseline as compared to a related control group.

Despite of these hypoglycemic effects, vinegar has

hypolipidemic effects as well. Although, such an effect was not observed for vinegar and cholesterol, TG, LDL-C and HDL-C levels did not change significantly in our studied patients.

More recent investigations showed that a daily diet containing vinegar induced intestinal calcium absorption (Kishi et al., 1999). Hypokalemia in parallel with hyperreninemia and osteoporosis was evidenced in a 28-year-old lady who had consumed approximately 250 ml apple cider vinegar daily for 6 years (Lhotta et al., 1998). Fushimi et al. (2006) showed that vinegar consumption with diet containing 1% cholesterol for 19 days significantly reduced TG and total cholesterol (Fushimi et al., 2006).

Several investigations revealed that vinegar positively affected lipid profile in diabetic rats, but not FBS and HbA1c (Shishehbor et al., 2007) while 10 ml/day intake of apple vinegar decreased LDL-C and cholesterol in rabbit model (Setorki et al., 2010).

The association between hepatic enzymes and some metabolic syndromes confirmed increased proportion of AST to ALT leading to atherosclerosis (Setorki et al., 2010). In this study, no significant differences were observed in ALT, AST and ALP activity in diabetic patients consuming vinegar. But the activity of liver AST and ALP in the animals treated with the vinegar decreased and elevated, respectively (Mohamed et al., 2001). No significant differences were found neither in the activity of hepatic ALT nor in hepatic acid phosphatase (ACP). Treated groups also showed statistically significant increases in both mean liver and spleen weight. Kidney weight did not show significant change. High dose of cider vinegar also induced histopathological alterations in liver, stomach and duodenum (Mohamed et al., 2001).

Current findings displayed no significant changes in the number of WBC, RBC count and its related indices such as MCHC and Hb, while MCH and MCV were reduced and the numbers of platelets were increased. In Mohammad et al. (2001), the study Hb, total RBC counts and total WBC counts were above the normal in all treated groups.

As mentioned earlier, vinegar reduced glucose level significantly as included in some previous findings and could be related to the effects of some flavonoids that are found in vinegar. Flavonoids are antioxidant components that can reduce glucose absorption and modulate the activity and expression of rate limiting enzymes involved carbohydrate metabolism (Cazarolli et al., 2008). Some studies confirmed the inhibitory effects of acetic acid on some enzymes in carbohydrates metabolism (Ogawa et al., 2000).

Considering the therapy of lipidemic disorders in diabetes, intake of vinegar affects lipid profile in diabetic patients was investigated. Evidences showed that the prevalence of type 2 diabetes is increasing globally. Simple, applicable and inexpensive diet strategies are greatly needed to help and manage blood glucose in type 2 diabetes patients for either delay or control of the progression of complications (Fushimi et al., 2001). Vinegar which is used traditionally as a folk medicine is believed to have several beneficial effects including hypoglycemic and hypolipidemic (Fushimi et al., 2001).

It is clear that these findings are consistent with previous studies in some extent and about some factor, there are contradictory results.

Conclusion

Conclusively, based on the previous reports and current results, it can be concluded that vinegar is useful as a therapeutic target in diabetes, but more studies are needed to explore both its advantages and disadvantages as a tool for controlling type 2 diabetes and other metabolic disorders like hyperlipidemia.

REFERENCES

Adeli K, Taghibiglou C, VanIderstine SC, Lewis GF (2001). Mechanisms of hepatic very low-density lipoprotein overproduction in insulin resistance. Trends Cardiovasc. Med. 11:170-176.

Brighenti F, Castellani G, Benini L, Casiraghi MC, Leopardi E, Crovetti R, Testolin G (1995). Effect of neutralized and native vinegar on blood glucose and acetate responses to a mixed meal in healthy subjects. Eur. J. Clin. Nutr. 49:242-247.

Carol S, Andrea M, Shannon M (2009). Preliminary evidence that regular vinegar ingestion favorably influences hemoglobin A1C values in individuals with type 2 diabetes mellitus. Diabetes Res. Clin. Pract. 84:615-617.

Cazarolli LH, Zanatta L, Alberton EH, Figueiredo MS, Folador P (2008). Flavonoids: Cellular and molecular mechanism of action in glucose homeostasis. Mini Rev. Med. Chem. 8:1032-1038.

Dailey G (2004). New strategies for basal insulin treatment in type 2 diabetes mellitus. Clin. Ther. 26(6):889-901.

Diabetes Control and Complications Trial Research Group (1994). Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes control and complications trial. J. Pediatr. 125:177-188.

Ebihara K, Nakajima A (1988). Effect of acetic acid and vinegar on blood glucose and insulin responses to orally administered sucrose and starch. Agric. Biol. Chem. 52:1311-1312.

Fushimi T, Suruga K, Oshima Y, Fukiharu M, Tsukamoto Y, Goda T (2006). Dietary acetic acid reduces serum cholesterol and triacylglycerols in rats fed a cholesterol-rich diet. Br. J. Nutr. 95(5):916-924.

Fushimi T, Tayama K, Fukaya M, Kitakoshi K, Nakai N, Tsukamoto Y, Sato Y (2001). Acetic acid feeding enhances glycogen repletion in liver and skeletal muscle of rats. J. Nutr. 131(7):1973-1977.

Gispen WH, Biessels GJ (2000). Cognition and synaptic plasticity in diabetes mellitus. Trends Neurosci. 23(11):542-549.

Iso H, Naito Y, Sato S, Kitamura A, Okamura T (2001). Serum triglycerides and risk of coronary heart disease among Japanese men and women. Am. J. Epidemiol. 153:490-499.

Johnston CS, Kim CM, Bullerm AJ (2004). Vinegar improves insulin sensitivity to a high-carbohydrate meal in subjects with insulin resistance or type 2 diabetes. Diabetes Care 27(1):281-282.

Johnston S, White A, Kent M (2009). Preliminary evidence that regular vinegar ingestion favorably influences hemoglobin A1C values in individuals with type 2 diabetes mellitus. Diabetes Res. Clin. Pract. 84:15-17.

Kishi M, Fukaya M, Tsukamoto Y, Nagasawa T, Takehana K, Nishizawa N (1999). Enhancing effect of dietary vinegar on the intestinal absorption of calcium in ovariectomized rats. Biosci. Biotechnol. Biochem. 63:905-910.

Kondo S, Tayama K, Tsukamoto Y, Nagasava T, Ikeda K, Yamori Y (2001). Antihypertensive effects of acetic acid and vinegar on spontaneously hypertensive rats. Biosci. Biotechnol. Biochem. 65:2690-2694.

Liljeberg H, Fjorck I (1998). Delayed gastric emptying rate may explain improved glycaemia in healthy subjects to a starchy meal with added vinegar. Eur. J. Clin. Nutr. 52:368-371.

Lhotta K, Hofle G, Gasser R, Finkenstedt G (1998). Hypokalemia, hyperreninemia and osteoporosis in a patient ingesting large amounts of cider vinegar. Nephron 80:242-243.

Mohamed M, Mohamed SM, Mohamed KA (2001). The effect of cider vinegar on some nutritional and physiological parameters in mice. J. Egypt. Public Health Assoc. 76(1-2):17-36.

Natera R, Castro R, Garcia-Moreno M, Hernandez M, Garcia-Barroso C (2003). Chemometric studies of vinegars from different raw materials and processes of production. J. Agric. Food Chem. 51:3345-3351.

Setorki M, Nazari B, Asgary S, Eidi A, Haeri RA (2010). Acute effects of apple cider vinegar intake on some biochemical risk factors of atherosclerosis in rabbits fed with a high cholesterol diet. Qom Univ. Med. Sci. J. 3(4):11-18.

Ogawa N, Satsu H, Watanabe H, Fukaya M, Tsukamoto Y, Miyamoto Y, Shimizu M (2000). Acetic acid suppresses the increase in disaccharidase activity that occurs during culture of caco-2 cells. J. Nutr. 130(3):507-513.

Ostman E, Granfeldt Y, Persson L, Bjorck I (2005). Vinegar supplementation lowers glucose and insulin responses and increases satiety after a bread meal in healthy subjects. Eur. J. Clin. Nutr. 59(9):983-988.

Ren H, Endo H, Watanabe E, Hayashi T (1997). Chemical and sensory characteristics of Chinese, Korean and Japanese vinegars. J. Tokyo Univ. Fish. 84:1-11.

Shishehbor F, Mansouri A, Sarkaki A, Jalali M, Latifi M (2007). The effect of white vinegar on fasting blood glucose, glycosylated hemoglobin and lipid profile in normal and diabetic rats. Iran. J. Endocrinol. Metab. 9(1):69-75.

Wild S, Roglic G, Green A, Sicree R, King H (2004). Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care 27(5):1047-1053.

Yang J, Meyers K, van der Heide J, Liu RH (2004). Varietal differences in phenolic content and antioxidant and anti-proliferative activities of onions. J. Agric. Food Chem. 52:6787-6793.

Journal of Diabetes and Endocrinology Vol. 4(1), pp. 6-11, January 2013
Available online at http://www.academicjournals.org/JDE
DOI: 10.5897/JDE12.018
ISSN 2141-2685 ©2013 Academic Journals

Full Length Research Paper

Ghrelin levels in obese children of diabetic parents

Fauzia Sadiq[1], Nadeem Hameed[2], Asim Mumtaz[1], Farzana yasmeen[1], Tauqqer butt[1] and Khurshid Ahmad khan[3]*

[1]Pathology Department, Shalamar Medical College, Lahore, Pakistan.
[2]Pediatrics Department, Shalamar Hospital, Lahore, Pakistan.
[3]Allama Iqbal Medical College, Lahore, Pakistan.

Accepted 17 January, 2013

Obesity beginning in childhood often leads to hyperinsulinemic state. Ghrelin, a recently discovered growth hormone (GH) secretagogue with orexigenic effects, is proposed to be a regulator of energy balance. It is thought to be associated with obesity and metabolic syndrome. Increased abdominal fat may lead to the development of metabolic syndrome in children and has been strongly associated with insulin resistance. The aims of this study were to determine fasting ghrelin levels of obese children of diabetic parents and obese children of non-diabetic parents and to investigate possible correlations between ghrelin hormones with insulin levels. This was a cross sectional study. Eighty obese children ranging from 5 to 18 years of age were recruited from the Pediatric Clinic of Shalamar Hospital, Lahore. These children were divided in two groups. Group A consists of forty obese children of diabetic parents and Group B having forty obese children of non-diabetic parents. A significant increase in the mean level of insulin, insulin resistance, triglycerides and fasting blood glucose were observed with concomitant significant decrease in the mean level of ghrelin. Fasting ghrelin levels were negatively correlated with insulin, homeostatic model assessment-insulin resistance (HOMA-IR), body mass index (BMI) and waist circumference. The results suggest that the down regulation of ghrelin secretion may be a consequence of higher insulin resistance associated with visceral fat accumulation. Ghrelin might prove to be a useful tool to identify obese children at risk for developing insulin resistance, diabetes or metabolic syndrome.

Key words: Ghrelin, obesity, insulin resistance, metabolic syndrome.

INTRODUCTION

Childhood obesity acquires its importance as a predictor of obesity in adult life. In Pakistan, where over 43% of the population comprises of children (<15 years of age), it has been observed that children are adopting more and more unhealthy eating habits and physical activities. Khuwaja et al. (2003) found that majority (58%) of the school children had at least one modifiable risk factor for cardiovascular diseases like physical inactivity, unhealthy dietary habits, overweight and obesity. The factor which gained importance regarding obesity worldwide is the ghrelin hormone. Ghrelin is a peptide hormone with activity in modulating feeding behavior and energy balance. Ghrelin is a peptide principally secreted from oxyntic cells in the stomach. It consists of 28 amino acids. Lower levels of ghrelin were found in obese individuals (Tschop et al., 2001) with the exception of patients with Prader-Willi syndrome (Haqq et al., 2003) and were found raised in anorexia nervosa (Otto et al., 2001). It is thought to play a role in causing obesity and was initially discovered as an endogenous ligand for the growth hormone secretagogue receptor (GHS-R) (Kojima et al., 1999).

Bacha and Arslanian (2005) reported an inverse relationship between fasting ghrelin level and fasting insulin

*Corresponding author. E-mail: dockhan@live.com.

in childhood obesity. Recent literature suggests that in addition to food intake and energy balance, ghrelin also controls glucose metabolism (Poykko et al., 2003). Furthermore, current evidence suggests that ghrelin could contribute to the metabolic syndrome. It has been shown that ghrelin concentrations are reduced in different diseased conditions including obesity, type 2 diabetes and other conditions with metabolic disturbances (Østergård et al., 2003). The relationship between ghrelin secretion to insulin sensitivity and insulin secretion has been under research till present time. High levels of insulin and glucose due to insulin resistance are believed to be the origin of metabolic syndrome and type 2 diabetes (Boden et al., 2005). Clinical studies are insufficient to reveal whether ghrelin level is a physiological response or a causative factor for the insulin resistance. The aim of this study was to determine the ghrelin levels in obese children having parents with type 2 diabetes mellitus.

MATERIALS AND METHODS

In this cross sectional study, 80 obese children ranging from 5 to 18 years were included in the study. 40 obese children had diabetic parents and 40 obese children had non-diabetic parents. Ethical approval was obtained from the Ethical Committee of University of Health Sciences, Lahore. A written consent was obtained from all the parents of children included in this study. All study cases were recruited from Pediatric Clinic of Shalamar Hospital, Lahore. The children enrolled in this study were classified according to their body mass index (BMI) which was ≥95th percentile. Their anthropometric measurements mainly waist and hip circumference measurements were taken. All the obese children were screened on the basis of medical history and physical examination. Ghrelin, insulin, blood glucose, and lipid profile were then performed on their blood samples. Insulin resistance was calculated by using homeostatic model assessment (HOMA) model. The obese children of diabetic parents were labeled as group A, and obese children of non-diabetic parents were labeled as group B.

Height (cm) was measured using wall-mounted stadiometer and weight (kg) was measured using a weighing balance to calculate BMI (as an expression of obesity). All the subjects were lightly clothed and without shoes. BMI was calculated by the following formula:

$$BMI = Weight\ (kg)/Height\ (m^2)$$

The waist circumference was measured at a level midway between the lowest rib and the iliac crest, in the standing position, using a non elastic flexible tape and recorded to nearest centimeters and the hip circumference at the level of the greater trochanters (Han et al., 1995) with the legs close together.

Laboratory investigations

After 10 to 12 h fasting, samples were drawn from all subjects in the study. All the samples were centrifuged (10 min at 3000 rpm) and sera were separated. Ghrelin, insulin, and blood glucose was performed on the same day. Serum for lipid profile was stored at -20°C until assayed. Fasting blood glucose level was performed using GOD-pap method.

The quantitative determination of serum ghrelin was conducted by enzyme-linked immunosorbent assay (ELISA) technique, using commercially available reagent kit (IBL Ghrelin Sandwich by SPI BIO) with ELISA having Catalogue number A05106. Insulin was assessed using chemiluminescence method. Insulin resistance (IR) was assessed using the HOMA-IR according to the formula of fasting insulin (µIU/ml) × fasting glucose (mmol/L)/22.5 (Matthews et al., 1985).

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), Version 16 (SPSS Inc., Chicago, IL, USA).

For each variable, mean, standard deviation (SD), and ranges were calculated. The categorical variables were expressed in frequencies. Results are given as means ± SD. Two sample t-test was applied and P values for comparison of serum ghrelin, insulin, blood glucose, lipid profiles levels, BMI, and waist circumference (abdominal obesity), and insulin resistance were determined in healthy obese children of diabetic parents and obese children of non-diabetic parents. The significance of difference between the two groups was also tested. For correlation between serum ghrelin and insulin resistance in obese children of type 2 diabetic parents and obese children of non-diabetic parents, r-values were determined by Pearson's correlation test. A p value <0.05 was taken as statistically significant.

RESULTS

Demographic data is presented in Table 1. There were 20 females (50%) and 20 males (50%) in both groups. serum ghrelin levels were observed to be lower in group A as compared to group B which was statistically significant (p<0.0001). However, there was no statistically significant gender difference regarding serum ghrelin levels found between the two groups (p=0.937). Mean serum ghrelin levels in males of both groups were 8.7±6.7 pg/ml and in females of both groups were 8.8±7.0 pg/ml. The lipid profile values were on the higher side in group A as compared to group B. The differences of cholesterol, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) between the two groups were statistically significant (p<0.001). BMI had a strong positive correlation with serum insulin concentration (r=0.252, p=0.024) and insulin resistance (r=0.241, p=0.031). BMI had a significant negative correlation with ghrelin levels (r=-0.366, p=0.001). BMI positively correlated with waist circumference (r=0.769, p<0.001). There was significant negative correlation between serum ghrelin concentrations and insulin levels (r=-0.254, p=0.023). There was also significant negative correlation between serum ghrelin levels and insulin resistance (r=-0.300, p=0.007) as shown in Figure 1. There was also a significant negative correlation between ghrelin levels and age of patients (r=-0.278, p=0.013). There was also a negative correlation between ghrelin levels and waist circumference (r=-0.255, p=0.022). It was noteworthy that there was no correlation between the fasting serum ghrelin and fasting blood glucose concentrations in these groups.

Waist circumference positively correlated with BMI,

Table 1. Baseline characteristics of obese subjects in groups A and B.

Parameter	Group A (Mean±SD) Obese (diabetic parents) (n=40)	Group B (Mean±SD) Obese (non-diabetic parents) (n=40)	p-Value
Age (years)	12.4±3.5	11.9±2.6	0.438
Height (cm)	150±14.6	149±15.1	0.837
BMI (kg/m^2)	29.9±4.0	28.1±4.4	0.065
Weight (kg)	69±19.6	65±19.1	0.328
Waist circumference (cm)	91.6±12	91.1±11.9	0.878
Serum ghrelin (pg/ml)	4.7±1.7	12.8±7.6	0.000*
Fasting blood glucose (mg/dl)	105.2±8.6	101±12.7	0.079
Fasting insulin (IU/L)	30.5±15.0	22.4±11.4	0.009*
Insulin resistance (HOMA-IR)	7.8±4.1	5.0±2.1	0.000*

*Significant at p<0.05.

Table 2. Correlation of ghrelin with risk parameters of metabolic syndrome.

Parameter	Serum ghrelin levels (r value)	p value
BMI	-0.366	0.001*
Waist circumference (>90th percentile)	-0.255	0.022*
Fasting insulin	-0.254	0.023*
HOMA-IR values	-0.300	0.007*
Fasting glucose	-0.167	0.138

*****Means statistically significant.

insulin levels (r=0.387, p=0.014), and insulin resistance (r=0.398, p=0.011) and this correlation was statistically significant. Insulin resistance also positively correlated with the triglycerides (r=0.332, p=0.036). A significant increase in the mean level of ghrelin, insulin, insulin resistance, cholesterol and triglycerides was observed in the group of children having parents with type 2 diabetes. Concomitantly, significant decrease in the mean level of ghrelin and insulin levels upon comparing the two groups was found. Ghrelin was found to correlate negatively with insulin and insulin resistance showing that ghrelin and insulin are inversely related. Also, ghrelin concentrations were lower in both obese groups and a negative relationship with BMI was found (Table 2). Only healthy obese subjects of diabetic parents were included and were compared with obese children of non-diabetic parents.

DISCUSSION

Nowadays, obesity and diabetes are considered as the twin epidemic and so are the dangers of childhood obesity and its hazardous consequences. The incidence of childhood obesity has tripled over the past three decades. Nearly 16% of children and adolescents between the ages of 6 and 19 years are currently overweight and an additional 15% are considered at risk for becoming overweight (Han et al., 2010).

The aim of the present study was to determine serum ghrelin levels in obese children of type 2 diabetic and non-diabetic parents. We also determined the correlation of ghrelin with insulin levels. This cross sectional study in 80 obese children described the significant correlation of serum ghrelin concentrations with insulin, insulin resistance and BMI.

The ghrelin levels in our study had negative correlation with age (r=-0.278, p=0.013) (Figure 2). In our study, the children with increasing age had lower ghrelin levels. These results are in accordance with Ikezaki et al. (2002) who reported that ghrelin levels are more in prepubertal age, as compared to pubertal age. Circulating ghrelin concentrations progressively increased during the first 2 years of life and then decreased during late childhood and adolescence. Secondly, ghrelin is a growth hormone secretagogue, and growth velocity decreases with rising age and puberty, so ghrelin levels decreases with increasing age (Kelishadi et al., 2008).

We found out that BMI was negatively correlated with ghrelin levels in these obese children (r=-0.366, p=0.001). This finding is consistent with the study by Zou et al. (2008),

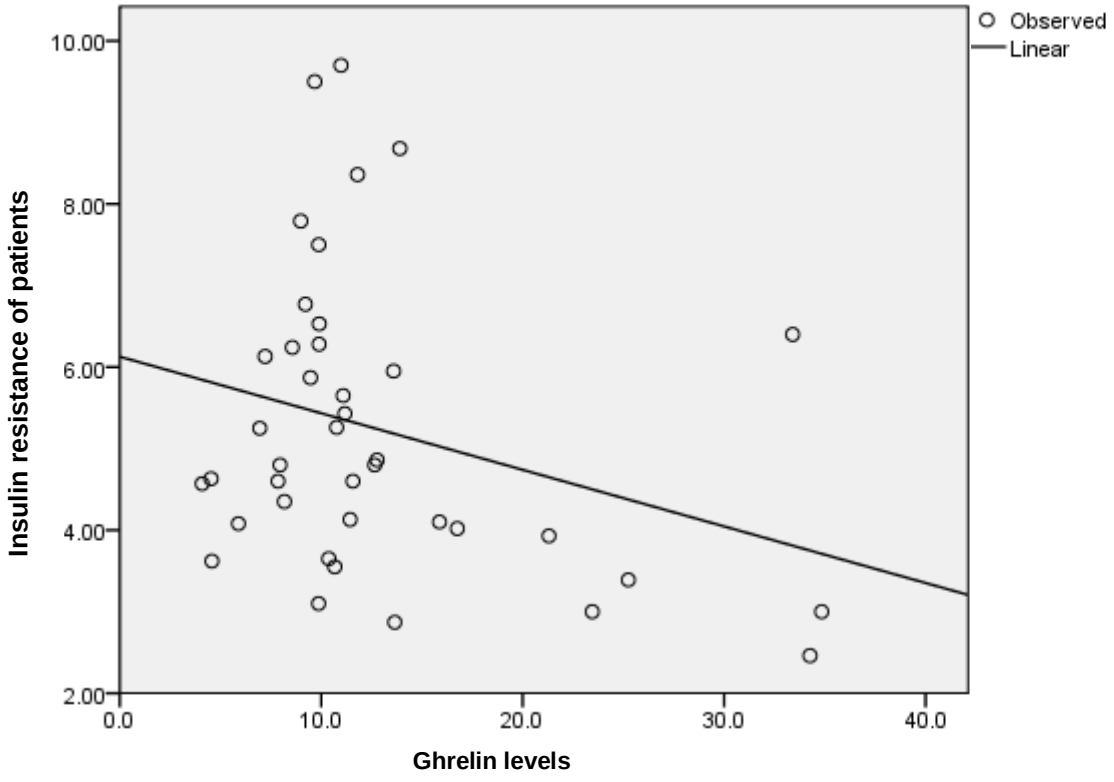


Figure 1. Correlation of serum ghrelin and insulin resistance in obese children.

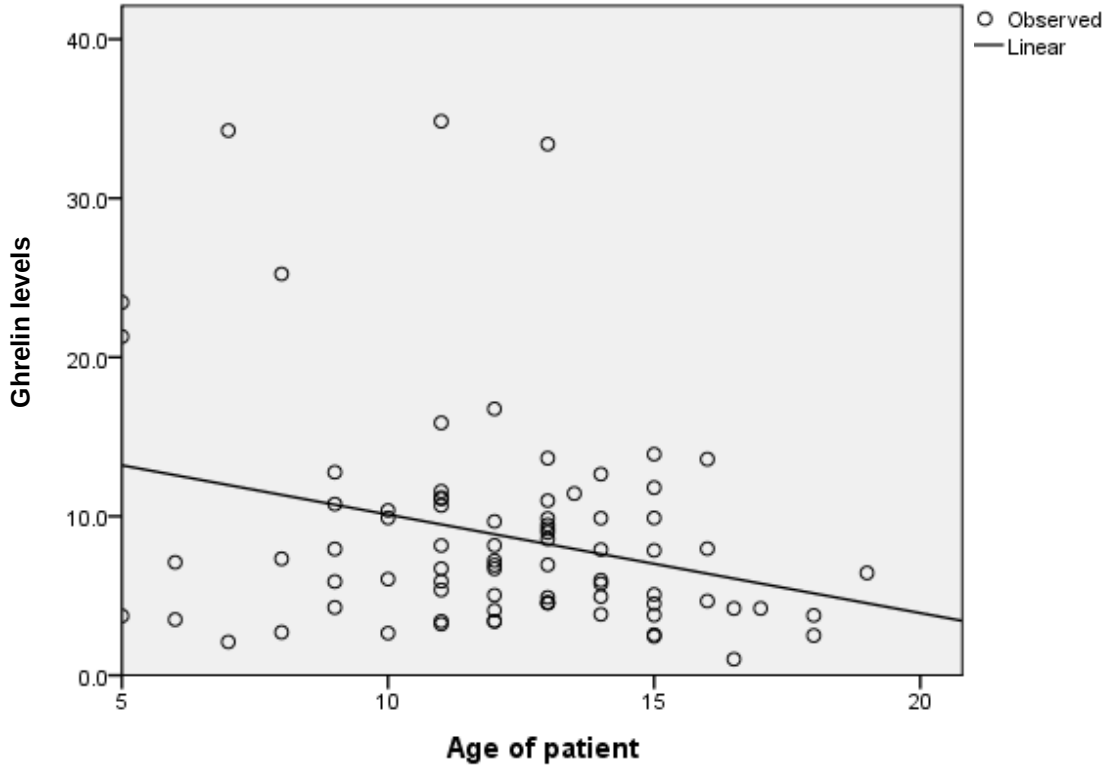


Figure 2. Correlation of serum ghrelin and age of obese children.

showing that ghrelin concentrations are lower in obese children and has a negative correlation with BMI in these obese children. As ghrelin secretion induces the accumulation of lipids in visceral fatty tissue, located in the abdominal zone and thus leads to increase in obesity and BMI. It has been shown in research that with increasing obesity, ghrelin levels decrease and with the loss of weight, ghrelin levels increase (Erdmann et al., 2005; Zou et al., 2009).

This study had lower serum ghrelin levels in both groups; however, it was significantly lower in the obese children of diabetic parents as compared to the obese children of non-diabetic parents ($p<0.0001$). Our study comprised 80 obese children with BMI more than 95th percentile, all equally obese, with central obesity (increased waist circumference). It is likely that genetic factors may be the cause of lower ghrelin levels in children of diabetic parents as compared to those having non-diabetic parents. Another factor which contributes to the down-regulation of ghrelin levels in obese subjects seems to be a consequence of elevated insulin levels, because fasting ghrelin levels were inversely correlated with fasting levels of insulin (Murphy et al., 2006). Notably, insulin could play a pivotal role in regulating body weight through its down-regulating effects on plasma ghrelin concen-trations. In the present study, serum insulin levels and HOMA-IR increased significantly ($p<0.0001$) in the obese children of diabetic parents as compared to the obese children of non-diabetic parents. These results are in agreement with study conducted by Van Guilder et al. (2008) who mentioned that insulin resistance and hyper-insulinemia are the hallmarks of obesity, and individuals with truncal obesity exhibit the greatest degree of insulin resistance and hyper-insulinemia. In our study, genetic component is possibly involved in causing raised insulin resistance in group A.

We also found a significant negative correlation between serum insulin levels and serum ghrelin levels in the obese subjects including both groups ($r=-0.254$, $p=0.023$). The negative relationship between fasting ghrelin concentration and obesity might be explained by an inhibitory effect of insulin on ghrelin, since a higher insulin resistance is associated with visceral fat accumulation. Our findings are also in agreement with those of other studies conducted in children by Amina et al. (2011) suspecting that insulin resistance may play an important role in the release of ghrelin.

The present study showed that obesity (BMI) had a strong relation with insulin resistance ($r=0.241$, $p=0.031$), which is in accordance with the studies by Wang et al. (2001) who observed that obesity had central role in the development of insulin resistance. The selected subjects in our present study were healthy, not suffering from diabetes mellitus, cardiovascular disease, but still had high insulin resistance, which seems to be entirely related to obesity. Insulin resistance is a well recognized risk factor for the development of type 2 diabetes mellitus and cardiovascular disease (Mokdad et al., 2003). These children also had elevated triglycerides, elevated insulin levels, more of insulin resistance and low HDL levels. Work done by Hirschler et al. (2005) showed that in obese youth with similar BMI, insulin sensitivity is lower in those with high visceral adipose tissue and high waist circumference.

This study highlighted that there was a significant increase in fasting blood glucose levels in both groups of obese children. Approximately, 63% of children of diabetic parents and 37% of children of non-diabetic parents had impaired fasting glucose, that is, >100 mg/dl (5.6 mmol/L) according to International Diabetes Federation (IDF) definition of metabolic syndrome in children (IDF, 2007). The findings were in agreement with Alberti et al. (2006) claiming obesity as the major risk factor for the development of type 2 diabetes. This moderate hyperglycemia therefore draws attention to the preclinical sign of disturbed glucose metabolism and insulin resistance. We also found no significant correlation between serum ghrelin levels and levels of fasting blood glucose in these groups. Similar results were reported in the studies conducted by Ikezaki et al. (2002) and Amal et al. (2012) who found no correlation between ghrelin and fasting glucose in obese children.

The findings of this study show that ghrelin is negatively correlated with insulin and insulin resistance. In adolescents, ghrelin is negatively correlated with insulin resistance, independent of obesity. This study also highlights that low ghrelin concentrations are associated with tendency to develop insulin resistance syndrome and its components. This can be explained by all the obese children having lower ghrelin levels and having higher BMI. Obesity influences all features of the metabolic syndrome and genetic component may play a role in causing lower ghrelin levels in obese children of type 2 diabetic parents more as compared to obese children of non-diabetic parents. This study has shown that they are more prone to develop diabetes and metabolic syndrome later in life.

Conclusion

This study will help to establish the use of ghrelin as one of the early markers to predict the onset of insulin resistance and metabolic syndrome in these children. Obese children of type 2 diabetic parents should be investigated once they start getting obese to prevent them from entering into metabolic syndrome. It also emphasize that ghrelin may be useful in risk assessment of obese children with family history of diabetes. Its levels can be used as a screening tool for developing diabetes mellitus, cardiovascular disease and it may prove an important marker for the diagnosis of metabolic syndrome. Secondarily, screenings for obese children with diabetic parents should include testing for ghrelin and insulin resistance.

Early intervention by physicians should be encouraged to improve their quality of life.

Limitations of the study were that small sample size was used in this study due to budget constraints. Only healthy obese subjects of diabetic parents were included and were compared with obese children of non-diabetic parents. We could not include non obese group in our study due to financial constraints. So, another study may be planned to further explore the relationship between serum ghrelin, insulin resistance (MS) and obesity in obese and non obese groups.

REFERENCES

Alberti KG, Zimmet P, Shaw J (2006). Metabolic syndrome, a new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabetes Med. 23:469-480.

Amal I, Hassanain A, Amer F, Marwa M, El-Sonbaty A, Hassan K, Samar MS, William M (2012). Relation of plasma ghrelin levels with leptin in Obese children and adolescents. Int. J. Acad. Res. 4:119-124.

Amina HA, Hanaa AW, Amal IH, Mehrevan MAM, Sherif O, Iman HK (2011). Changes of serum ghrelin levels and some other related hormones in obese children and adolescents. Int. J. Acad. Res. 3:133-138.

Bacha F, Arslanian SA (2005). Ghrelin suppression in overweight children: A manifestation of insulin resistance. J. Clin. Endocrinol. Metab. 90:2725-2730.

Boden G, Sargrad K, Homko C, Mozzoli M, Stein TP (2005). Effect of a low-carbohydrate diet on appetite, blood glucose levels, and insulin resistance in obese patients with type 2 diabetes. Ann. Intern. Med. 142:403-411.

Erdmann J, Lippl F, Wagenpfeil S, Schusdziarra V (2005). Differential association of basal and postprandial plasma ghrelin with leptin, insulin and type 2 diabetes. Diabetes 54:1371-1378.

Han JC, Lawlor DA, Kimm SY (2010). Childhood obesity. Lancet 375:1737-1747.

Han TS, Van Leer EM, Seidell JC, Lean MEJ (1995). Waist circumference action levels in the identification of cardiovascular risk factors: Prevalence study in a random sample. BMJ 311:1401-1405.

Haqq AM, Farooqi IS, O'Rahilly S, Stadler DD, Rosenfeld RG, Pratt KL, LaFranchi SH, Purnell JQ (2003). Serum ghrelin levels are inversely correlated with body mass index, age, and insulin concentrations in normal children and are markedly increased in Prader-Willi syndrome. J. Clin. Endocrinol. Metab. 88:174-178.

Hirschler V, Aranda C, Calcagno Mde L, Maccalini G, Jadzinsky M (2005). Can waist circumference identify children with the metabolic syndrome? Arch. Pediatr. Adolesc. Med. 159:740-744.

Ikezaki A, Hosoda H, Ito K, Iwama S, Miura N, Matsuoka H, Kondo C, Kojima M, Kangawa K, Sugihara S (2002). Fasting plasma ghrelin levels are negatively correlated with insulin resistance and PAI-1, but not with leptin, in obese children and adolescents. Diabetes 51:3408-3411.

Wang J, Obici S, Morgan K, Barzilai N, Feng Z, Rossetti L (2001). Overfeeding rapidly induces leptin and insulin resistance. Diabetes 50(12):2786-2791.

Kelishadi R, Hashemipour M, Mohammadifard N, Alikhassy H, Adeli K (2008). Short- and long-term relationships of serum ghrelin with changes in body composition and the metabolic syndrome in prepubescent obese children following two different weight loss programs. Clin. Endocrinol. 69(5):721-729.

Khuwaja AK, Fatmi Z, Soomro WB, Khuwaja NK (2003). Risk factors for cardiovascular disease in school children. J. Pak. Med. Assoc. 53:369-400.

Kojima M, Hosoda H, Date Y, Nakazato M, Matsuo H, Kangawa K (1999). Ghrelin is a growth-hormone-releasing acylated peptide from stomach. Nature 402(6762):656-660.

Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC (1985). Homeostasis model assessment: Insulin resistance and b-cell function from fasting plasma glucose and insulin concentration. Diabetologia 28(7):412-419.

Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, Marks JS (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors. JAMA 289:76-79.

Murphy KG, Dhillo WS, Bloom SR (2006). Gut peptides in the regulation of food intake and energy homeostasis. Endocrinol. Rev. 27:719-727.

Østergård T, Hansen TK, Nyholm B, Gravholt CH, Djurhuus CB, Hosoda H, Kangawa K, Schmitz O (2003). Circulating ghrelin concentrations are reduced in healthy offspring of Type 2 diabetic subjects, and are increased in women independent of a family history of Type 2 diabetes. Diabetologia 46(1):134-136.

Otto B, Cuntz U, Fruehauf E, Wawarta R, Folwaczny C, Riepl RL (2001). Weight gain decreases elevated plasma Ghrelin concentrations of patients with anorexia nervosa. Eur. J. Endocrinol. 145(5):669-673.

Poykko SM, Kellokoski E, Hörkkö S, Kauma H, Kesäniemi YA, Ukkola O (2003). Low plasma ghrelin is associated with insulin resistance, hypertension, and the prevalence of type 2 diabetes. Diabetes 52(10):2546-2553.

Tschop M, Weyer C, Tataranni PA, Devanarayan V, Ravussin E, Heiman ML (2001). Circulating ghrelin levels are decreased in human obesity. Diabetes 50(4):707-709.

Van Guilder GP, Stauffer BL, Greiner JJ, Desouza CA (2008). Impaired endothelium dependent vasodilatation in overweight and obese adult humans is not limited to muscarinic receptor agonists. Am. J. Physiol. Heart Circ. Physiol. 294(4):1685-1692.

Zou CC, Liang L, Wang CL, Fu JF, Zhao ZY (2009). The change in ghrelin and obestatin levels in obese children after weight reduction. Acta Paediatr. 98:159-165.

Zou CC, Liang L, Zhao ZY (2008). Factors associated with fasting plasma ghrelin levels in children and adolescents. World J. Gastroenterol. 14:790-794.

UPCOMING CONFERENCES

14th Annual Scottish Conference of the Diabetic Foot

20th World congress on Parkinson's Disease and Related Disorders, Geneva, Switzerland, 8 Dec 2013

Conferences and Advert

October 2013
7th World Congress on Diabetes & Obesity, Riga, Latvia, 24 Oct 2013

November 2013
4th International Diabetic Foot Conference

December 2013
20th World congress on Parkinson's Disease and Related Disorders, Geneva, Switzerland, 8 Dec 2013

Journal of Diabetes and Endocrinology

Related Journals Published by Academic Journals

- *African Journal of Pharmacy and Pharmacology*
- *Journal of Dentistry and Oral Hygiene*
- *International Journal of Nursing and Midwifery*
- *Clinical Reviews and Opinions*
- *Journal of AIDS and HIV Research*
- *International Journal of Nutrition and Metabolism*

academicJournals