Original Research

Effects of Dietary Control, Exercise and Anti-Obesity Prescriptions on Weight Loss: An Interview-Based Study

Hala M. Demerdash, MD1,2*; Sherine Abdel Hady, PhD2; Lamia Said Kandil, PhD2

1Department of Clinical Pathology, Alexandria University Hospitals, Alexandria University, Pharmacology and Toxicology Department, Faculty of Pharmacy and Drug Manufacturing, Pharos University, Alexandria, Egypt
2Pharmacology and Toxicology Department, Faculty of Pharmacy and Drug Manufacturing, Pharos University, Alexandria, Egypt

*Corresponding author
Hala M. Demerdash, MD
Department of Clinical Pathology, Alexandria University Hospitals, Alexandria University, Pharmacology and Toxicology Department, Faculty of Pharmacy and Drug Manufacturing, Pharos University, Alexandria, Egypt; E-mail: demerdashh@yahoo.com

ABSTRACT

Obesity is a major public health problem all over the world. The objective of this work was to evaluate effectiveness of various weight management strategies.

Methods
A clinic interview-based study was accomplished in various nutrition clinics in Alexandria city and pursued the following data: demographic data, body mass index (BMI), lipid profile, comorbidities, with emphasize on the authenticity of the effectiveness of weight management strategies.

Results
The study comprised 2,240 participants following weight management strategies at nutrition clinics; 59.8% were obese (group I) and 40.2% were overweight (group II). BMI was highest among age group 30-40 years in group I and 18-20 years in group II. Weight management strategy by dietary control merely in 55.8% of group I and 59.5% of group II. 33.5% of group I implemented exercise training plan and 41.5% of group II respectively. Fourteen point seven percentage of group I responded to adjuvant anti-obesity drug versus 1.5% of group II. The most commonly adopted anti-obesity prescription was Orlistat.

Conclusion
Participants who received anti-obesity prescriptions combined with dietary control and exercise obtained the best results when compared to other strategies, therefore anti-obesity prescriptions may be beneficial in conditions that are resistant to other weight management strategies. Comorbidities, particularly dyslipidemia; may partially impede effective obesity management protocols.

Keywords
Obesity; Overweight; Body mass index; Physical activity; Anti-obesity prescriptions.

INTRODUCTION

Obesity epidemic in Middle East and North Africa region (MENA) is one of the highest worldwide. The prevalence of obesity has been estimated to affect about 19% of the people living in the MENA region.1 Moreover, in the year 2016 the World Health Organization reported a global incidence of more than 1.9 billion adults were overweight and of these over 650 million were obese.2

While in 2015, global burden of disease study group explored the global health data among the 20 most populated countries, they observed highest level of adult obesity in Egypt (35.3%).3

In addition, obesity is considered the fifth leading risk for global mortality. Thus, creating a major burden on the health care in these countries.1 Determination of body mass index (BMI) is the most convenient measure of overweight and obesity.2 Few studies
have been conducted in developing countries; with main focus on understanding the epidemiological, socioeconomic, nutritional factors and obesity related health problems.2-4

Obesity is a disease characterized by increased accumulation of body fat, the cause is not always attributable to overconsumption of calories or lack of physical activity. Obese subjects often encounter impaired metabolic pathways along with disturbed signaling for hunger and satiety.5 Obesity management includes lifestyle modification in the form of dietary restriction and other behavioral changes that can be maintained indefinitely to promote health.5 Anti-obesity prescriptions counted as lifestyle modification adjunct to enhance initiation and continuance of weight loss in obese subjects with BMI above 30 kg/m² or for those with a BMI above 27 kg/m² when comorbidities exist.5 Moreover, anti-obesity prescriptions are recommended when efforts to lose weight are encountered with resistance.6 Many anti-obesity prescriptions assist body weight reduction and promote improvement of metabolic factors.6-8

Various anti-obesity prescriptions have been approved for long-term use to manage obesity; these include sibutramine, a selective noradrenaline-serotonin reuptake inhibitor. It has the potential ability to improve metabolic factors as insulin resistance, and lipid-profiles.6 Orlistat, a potent and reversible gastrointestinal lipase inhibitor prevents dietary fat absorption. It is proven to improve cardiometabolic factors, comprising blood pressure, plasma glucose, and lipid profiles.5 Orlistat is currently the only available drug for the long-term management of obesity.7 Glucagon-like peptide-1 (GLP-1) analogues, gastrointestinal hormones that enhance insulin secretion from pancreatic β-cells: long-term use of GLP-1 analogues reduces HbA1c level and blood pressure.5 Also, Tesofensine is an inhibitor of noradrenaline, dopamine and serotonin reuptake.8

This clinic interview-based study has been conducted to:

1. Describe demographic and clinical characteristics of obese and overweight participants
2. Explore views about effectiveness of obesity management strategies including dietary control, exercise and adjuvant anti-obesity prescriptions.

METHODS AND SUBJECTS

Method and Subjects Recruitment

This is cross-sectional qualitative exploratory interview. Study participants were obese and overweight individuals attending nutrition clinics, during the period from January 2016 till April 2017. The purpose of the study was explained to all participants via plain language statement and written informed consent was taken from those who were willing to participate in the study and data confidentiality was ensured as per national ethical guidelines.

Selected participants included were adults above the age of 18-years who, attended nutrition clinics for more than 4-months and have been following weight reduction regimen. Dietary control surveyed was mainly Mediterranean diet either solely or combined with exercise depending on participants will.

Mediterranean diet followed was a hypocaloric regimen with low-carbohydrate less than 50% and low-fat content 30% mostly obtained from olive oil; limited amounts of dairy products and meat, with a considerable contribution of fruits and vegetables as lentils and beans.6 For each participant, daily consumption was calculated by a nutritionist ranging from 1,200 to 2,000 calories per day.

Physical activity level was assessed using a Physical Activity Questionnaire scores and were categorized into 3 levels: (1) low inactive state “sedentary life”, (2) moderate activity: 3 days of vigorous activity for about 20 minutes per day (3) high activity: daily exercise of more than 5 days of moderate activity as walking for about 30 minutes per day, and or combination with vigorous activities.6 Accordingly, participants who had performed daily physical exercise were assigned level.3

Adjuvant pharmacotherapy; was considered in participants who failed to reduce body weight at least 0.5 kg per week after three months of implementing Mediterranean diet either alone or combined with exercise or subjects who had associated comorbidities such as diabetes.

Prescriptions frequently adopted in nutrition clinics included one of the subsequent agents:

1. Drugs that diminishes fat absorption as Orlistat (brand name: Xenical).
2. Drugs that potentiate insulin action as Chromax® is a patented salt of trivalent chromium (Cr3+) and tripicolinic acid, also known as chromium picolinate/or Glucophage, a cofactor for insulin, it promotes activation of insulin receptors on cells and thus increases insulin sensitivity.
3. Prescriptions that enhance intestinal motility (Laxatives) thus, decrease net amount of nutrients absorbed as Senna and Plantago. Breakdown products of Senna act directly as irritants on the colonic wall to induce fluid secretion and stimulate colonic motility.

Data Collection

Participants were interviewed by trained interviewers using a pre-tested questionnaire at nutrition clinics. The interview was conducted in a semi-structured format, consisted of 50 questions allowing participants to contribute their personal experiences in attempting to reduce body weight.

The questionnaires were developed by a committee which included academics (Pharmacology staff members) and nutritionists with expertise in obesity, physical activity, and community department in Alexandria Faculty of Medicine. Questionnaire...
was created to collect information regarding the following points of interest:

1) Demographic variables of the participant such as age, sex, socioeconomic status and presence of family factors as obesogenic home environment, eating habits, physical activity and presence of comorbidities.
2) Participants’ beliefs about weight control and healthy eating behaviors. Type of weight management strategy followed and individual body response.

**Anthropometric Measurements**

BMI was determined using height and weight standardized procedure. Weight was measured in Kilogram (kg) using accurate scales checked regularly using known standardized weight, and height was measured using standardized measuring boards with accuracy to 0.1 cm. BMI was calculated by dividing body weight (kg) by squared height (m²).

Assessment of obesity concurred with recommendations of the World Health Organization (WHO) consultation on obesity: normal, BMI <25 kg/m²; overweight, 25-29.9 kg/m ²; class I obesity, 30–34.9 kg/m²; class II obesity, 35-39.9 kg/m²; and class III obesity, ≥40 kg/m².

**Biochemical Parameters Measured**

Blood samples were collected for serum lipid profile tests. The biochemical estimations were carried out in licensed and accredited laboratories.

The following biochemical parameters were determined:

Serum total Cholesterol, low density lipoprotein-Cholesterol (LDL-Cholesterol), high density lipoprotein-Cholesterol (HDL-Cholesterol) and triglyceride (TG).

**STATISTICAL ANALYSIS**

The data was collected and entered into the personal computer. Statistical analysis was done using Statistical Package for Social Sciences (SPSS/version 20) software. Arithmetic mean, standard deviation, for categorized parameters, chi square test was used while for numerical data T-test was used to compare two groups while for more than two groups ANOVA test was used. To find the association between two variables, spearman correlation coefficient test was used the level of significant was 0.05.

**RESULTS**

The present study included 2,240 participants who were sampled from nutrition clinics in different districts in Alexandria city. Participants were classified according to BMI into: group I obese subjects and included 59.8% of studied participants, the mean age was 38.2±9.88years and group II overweight subjects and included 40.2% of studied participants, with mean age 29.1±11 years.

Table 1 demonstrated the demographic data of enrolled participants. Among participants in both groups; significantly greater number of females compared to males. The highest age group frequency was among age group 30-40 years in group I and 18-20 years in group II.

Moreover, 33.5% of group I engaged in daily physical exercise and 41.5% of group II respectively, in which they were assigned level 3 physical activity.

The main cause of weight gain as reported by, 44.3% of participants (992) was due to dietary habits that started early in childhood, while 29.2% claimed presence of a genetic factor (594 participant); they declared a positive family history of obesity. On the other hand, 26.5% of participants (654) reported that the weight gain was due to life-stresses as indicated in (Figure 1).

Table 2 showed that dietary control regimen solely was adopted in 55.8% of group I and 59.5% of group II of participants. Also, intake of adjuvant anti-obesity prescriptions was significantly higher among group I participants. Interestingly, a considerable number of participants complained from fluctuating weight regain; the percentage was about 19.4% group I and 23.6% in group II.

Figure 2 showed that 14.7% of Group I (197 participants) received anti-obesity prescriptions, mostly received Orlistat 75.2% (148 participant); followed by laxatives (Senna, Royal Regime tea) were19.2% (38 participant) and least Glucophage were 5.6%(11 participants). while the remaining 28.6% Group II received Orlistat (4 participants).

The percentage decrease in body weight as obtained from interview data was significantly highest among participants who followed (Dietary control plus both exercise and anti-obesity prescriptions) strategy compared to other strategies in both groups as shown in (Table 3).

Blood samples were withdrawn at time of interview after a 12-hour fasting period. Lipid profile results revealed that Total cholesterol (TC), low density lipoprotein -Cholesterol (LDL-C) and Triglycerides (TG) were increased in both groups. However, only TG was significantly higher in group I relative to group II as shown in (Table 4).

In addition, presence of comorbid conditions was more significantly pronounced among group I compared to group II with highest incidence of dyslipidemia and lowest among others as infertility and cardiovascular disorders as shown in (Table 5).
Table 1. Demographic Data of the Studied Groups

|               | Group I: Obese (n=1339) | Group II: Overweight (n=901) | P     |
|---------------|-------------------------|-----------------------------|-------|
|                | No  | %   | No   | %   |       |
| Sex           |     |     |      |     |       |
| Male          | 452 | 33.8| 382  | 42.4| 0.008*|
| Female        | 887 | 66.2| 519  | 57.6|       |
| Age (years)   |     |     |      |     |       |
| 18-20         | 147 | 11.0| 347  | 38.5|       |
| 20-29         | 256 | 19.1| 279  | 31.0|       |
| 30-39         | 549 | 41.0| 128  | 14.2|       |
| 40-50         | 313 | 23.4| 101  | 11.2|       |
| 50+           | 74  | 5.5 | 46   | 5.1 |       |
| Mean±S.D     | 38.2±9.95 |                              |       |
| Nature of patient’s life style (physical activity) |       |
| Sedentary    | 568 | 42.4| 428  | 47.5|       |
| Moderate     | 322 | 24.1| 99   | 11.0|       |
| Heavy        | 448 | 33.5| 374  | 41.5|       |

*Significant at p≤0.05

p was calculated by using Chi square test

Table 2. Distribution of the Studied Groups Regarding Weight Management Strategy Followed

|               | Group I: Obese (n=1339) | Group II: Overweight (n=901) | X²   | P     |
|---------------|-------------------------|-----------------------------|------|-------|
|                | No  | %   | No   | %   |       |
| Dietary control solely | 747 | 55.8| 536  | 59.5| 3.016 | 0.082|
| Dietary control plus exercise | 395 | 29.5| 51  | 35.1| 21.686 | <0.001*|
| Dietary control plus adjuvant anti-obesity prescriptions | 143 | 10.7| 14  | 1.5 | 68.818* | <0.001*|
| Dietary control plus both exercise and adjuvant anti-obesity prescriptions | 54  | 4.0 | 0   | 0   | 37.234* | <0.001*|

*Significant at p≤0.05

p was calculated by using Chi square test

Dietary control followed was mainly mediterranean diet

Table 3. Percentage Decrease in Body Weight in Relation to Weight Management Strategy

|               | Dietary control solely | Dietary control plus exercise, anti-obesity prescriptions (n=1339) | Dietary control plus exercise | Dietary control solely | Dietary control solely |
|---------------|------------------------|---------------------------------------------------------------|------------------------------|------------------------|------------------------|
| Range        | 12.0-19.0              | 5.0-18.0                                                      | 12.0-19.0                    | 5.0-18.0               | 6.0-12.0               |
| Mean         | 16.8                   | 12.72                                                        | 16.8                         | 12.72                  | 8.69                   |
| S.D          | 3.90                   | 3.65                                                         | 3.90                         | 3.65                   | 1.03                   |
| F            | 115.85                 | <0.001*                                                      | 115.85                       | <0.001*                | 115.85                 |
| *Significant at p≤0.05

p was calculated by using ANOVA-test

Sig. bet. grps was done using Post Hoc Test (LSD)

p1 : p value for comparing between Dietary control, exercise, anti-obesity prescriptions and Dietary control solely

p2 : p value for comparing between Dietary control plus exercise and Dietary control solely

Table 4. Lipid Profile in Studied Groups

|               | Group I: Obese (n=1339) | Group II: Overweight (n=901) | P     |
|---------------|-------------------------|-----------------------------|-------|
| T.C (mg/dl)  | 223.77±24.32            | 210.89±17.89                | 0.065 |
| HDL-C (mg/dl)| 44.67±4.57              | 48.34±4.57                  | 0.107 |
| LDL-C (mg/dl)| 138.58±21.67            | 128.76±19.16                | 0.098 |
| TG (mg/dl)   | 167.29±34.68            | 149.45±29.89                | 0.032 |

*Significant at p≤0.05

p was calculated by using T-test

Table 5. Distribution of the Studied Participants Regarding Associated Comorbidities

|               | Group I: Obese (n=1339) | Group II: Overweight (n=901) | P     |
|---------------|-------------------------|-----------------------------|-------|
| Associated comorbidities | No  | %   | No   | %   |       |
| Yes           | 985                      | 73.6                        | 178   | 19.8 | 0.001*|
| DM            | 346                      | 25.1                        | 112   | 12.4 | 0.0021*|
| Hypertension  | 145                      | 14.7                        | 124   | 13.8 | 0.089 |
| Dyslipidemia  | 469                      | 37.6                        | 12    | 1.3  | 0.0001*|
| Others        | 25                       | 2.5                         | 1     | 0.1  | 0.085 |

*Significant at p≤0.05

p was calculated by using Chi square test
DISCUSSION

Previous studies reported increasing prevalence of obesity and overweight in developing countries.11,12 MENA region study stated that about one fifth of the adult population are considered obese.13 Moreover, systematic reviews suggested that about 31% of ischemic heart disease and 8% of stroke mortality were correlated with obesity, due to associated hypertension and dyslipidemia.14 A chief concern in the former studies was data collected from different sources using diverse methods and therefore it was difficult for comparison throughout developing countries. Therefore, the present interview-based study used a considerably large sample of the data collected from nutrition clinics to explore the perception and value of dietary control, exercise and use of anti-obesity agents on both weight reduction and conservation.

In this study 59.8% of participants were obese (group I) and 40.2% were overweight (group II). Highest incidence of obesity was among participants in age group 30-39 years (41.0%), this finding was in agreement with previous study by Aitsi-Selmi et al.15 In that study they found highest incidence of obesity among age group 25-35 years 42.8%.15 On the other hand, highest incidence of overweight was among adolescence 18-20 years (38.3%). In concordance with Manyanga et al, where it was reported that about 31.4% of school children were overweight in a survey performed in Egypt.15 Aitsi-Selmi et al also concluded that high prevalence of obesity among Egyptian youth may be indicative of nutrition transition due to rapid urbanization.17 Participants in the present study were familiar with obesity comorbidities; the majority of obese subjects suffered from dyslipidemia (47.6%), diabetes mellitus (35.1%) and hypertension (14.7%). On the contrary, Alsheikh-Ali et al reported a high prevalence of dyslipidemia (70%), followed by hypertension (43%) and diabetes mellitus (25%).12 Flegal et al performed a systematic review of hazard ratios (HRs) of all-cause mortality (cardiovascular, renal, neoplastic factors) for overweight and obesity relative to normal weight in the general population. They found grades 2 and 3 obesity (BMI of ≥35) were accompa-

Consequently, deficiency of exercise could be considered an important factor when examining the correlation to obesity; it is believed that energy intake as opposed to energy expenditure is considered an important factor in obesity.14 Similarly, Yasin et al documented that physical exercise was least favorite among participants in a survey performed in Egypt 1998. They stated in their study that about 2% of participants reported practicing some sports on a daily basis.17

In regards to presence of genetic element, participants in both groups; 29.2% of participants stated a positive family history of obesity as, they believed that genetic factor might be considered as a possible cause of disturbed body metabolism and obesity. There are more than 56 different genes described to be related obesity phenotypes. Those genes mostly are genes that interact with environmental factors related to energy intake and expenditure.18

On the other hand, 26.5% complained of life stresses. They suggested that life-stresses influences food preferences, favoring foods rich in fat and sugar. Aside from overeating, stress can also lead to decreased motivation to exercise.16

Consistent with previous studies obesity management strategies focus on change of individual behavior specifically dietary pattern and exercise.19,20 Results from our interview suggested that a considerable number of participants were dissatisfied with weight management results in both groups (19.4% group I and 23.6% group II). Particularly participants who followed weight reduction strategy either dietary control “Mediterranean diet” solely or combined with exercise. Those participants stated that the cause maybe due to poor compliance, lack of motivation, also sometimes weight loss results were less than expected. On the contrary, Anderson et al performed a long-term observational study utilizing two groups of balanced diet for 5-years; very low carbohydrate diets (VLCDs) versus hypoenenergetic balanced diets. They found that the VLCD group attained a significantly more net weight loss than the hypoenenergetic balanced diet group (29% compared with 18%).21 The proposed mechanism for dietary control was that reduced intake of fat and carbohydrate rich food may be beneficial in weight loss by increasing satiety and by promoting fat oxidation at the expense of carbohydrate oxidation.22 Moreover, high-protein food as grilled meat, and food rich in fibers such as fresh vegetables and fruits have been shown to increase satiety, preserve fat-free mass.23 Hemmingsson et al also found that a considerable initial weight loss predicts long-term weight reduction.24

Participants from both groups (I and II) who followed daily exercise accompanied with dietary control achieved more satisfactory results. Since exercise plays an equivalent role to dietary restriction in terms of energy balance. Also, exercise improves insulin sensitivity, increasing aerobic capacity and mitochondrial function, with superimposed prevention of weight regain.21 However in another study, Redman et al found that when caloric restriction is precisely controlled, modifications in abdominal fat distribution are attained with no further addition of exercise.22 They reported fat deposits, regardless of their location, were reduced by

Original Research | Volume 5 | Number 1| 15
Demerdash HM, et al.

Obes Res Open J. 2018;5(1): 11-17. doi: 10.17140/OROj-5-135
about 30% in men and 25% in women.23 Furthermore, Malis et al suggested that inability of caloric restriction to adjust body fat distribution would indicate that affected individuals are genetically or epigenetically predisposed for fat storage which cannot be easily overcome by dietary restriction.24 Besides, one of the beneficial effects of dietary restriction could be reduction of oxidative stress. Additionally, caloric restriction results in alterations in energy balance, due to reduced energy expenditure, as a consequence of decreased oxygen consumption or mitochondrial adaptation.25,26

Bray and DeLany conveyed that anti-obesity drugs are less important tool in weight loss than exercise. Though pharmaceutical adjuvant anti-obesity prescriptions are recently gaining popularity; only 211 participants received anti-obesity prescriptions in this interview. Particularly among obese participants along side dietary restriction with or without exercise; mostly consumed Orlistat. Orlistat decreases intestinal fat absorption by about 30%.7 Similarly, Chanoine et al found that Orlistat was administered as adjuvant therapy together with a balanced diet and exercise, it resulted in a decrease in BMI by about 5% within 12-weeks.26 The second in use anti-obesity prescription received was laxatives as Royal regime tea; as it enhances intestinal motility and reduces nutrients absorption, and therefore should be accompanied with vitamin supplements.

The third pharmaceutical agent was anti-diabetic agents which was only consumed by group I; obese participants who received anti-diabetic agents stated that it increased satiety and improved insulin resistance. Anti-diabetic agents do not increase body weight, nevertheless they help to limit weight gain, improve associated hyperglycemia and clinical cardiovascular outcomes.30 Results from, lipid profile samples in this study results revealed significantly high total cholesterol in both groups (I and II), and elevated triglyceride in group I. This may be explained by prevalence of comorbidities as hypertension and diabetes. Another study reported significantly elevated LDL-cholesterol as a potentially important factor hindering obesity management.31 This observation may suggest that dietary pattern have a complex relationship with lipid profile.

CONCLUSION

Finally, this interview-based study revealed that main improvement in weight-reduction was seen in obese subjects following dietary control together with both exercise and adjuvant anti-obesity prescriptions. Although only 9.4 % of participants received anti-obesity prescriptions; The most commonly used anti-obesity prescription was Orlistat.

Furthermore, most common obesity comorbidity observed in obese participants was dyslipidemia; which may impede effective obesity management. Consequently, dietary control supplemented by anti-obesity prescriptions might be beneficial in obesity management in resistant cases.

Moreover, it is necessary to introduce educational programs that aim at promoting healthy dietand physical exercise, particularly commencing early in childhood.

ACKNOWLEDGEMENTS

We kindly appreciate the support of all members of pharmacology and Toxicology department at Faculty of Pharmacy, Pharos University, Alexandria, Egypt.

DISCLOSURE OF CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTIONS

Equally contributed.

FUNDING

Pharos University in Alexandria.

REFERENCES

1. Kite J, Grunseit A, Bohn-Goldbaum E, et al. A systematic search and review of adult-targeted overweight and obesity prevention mass media campaigns and their evaluation: 2000-2017. J Health Commun. 2018; 23(2): 207-232. doi: 10.1080/10810730.2018.1423651
2. Yanovski SZ, Yanovski JA. Toward precision approaches for the prevention and treatment of obesity. JAMA. 2018; 319(3): 223-224. doi: 10.1001/jama.2017.20051
3. Afshin A, Forouzanfar M, Reitsma M, et al. Health effects of overweight and obesity in 195 countries over 25-years. N Engl J Med. 2017; 377: 13-27. doi: 10.1056/NEJMoai1614362
4. El Rhazi K, Nejari C, Zidouh A, et al. Prevalence of obesity and associated sociodemographic and lifestyle factors in Morocco. Public Health Nutr. 2011; 14(1): 160-167. doi: 10.1017/S1368980010001825
5. Vetter ML, Faulconbridge LF, Webb VL, Wadden TA. Behavioral and pharmacologic therapies for obesity. Nat Rev Endocrinol. 2010; 6: 578-588. doi: 10.1038/nrendo.2010.121
6. James W, Caterson I, Coutinho W, et al. Effect of sibutramine on cardiovascular outcomes in overweight and obese subjects. N Engl J Med. 2010; 363: 905-917. doi: 10.1056/NEJMoia1003114
7. Zimmet PZ, Alberti KG. Introduction: Globalization and the non-communicable disease epidemic. Obesity (Silver Spring). 2006; 14: 1-3. doi: 10.1038/oby.2006.1
8. Astrup A, Madsbad S, Breum L, et al. Effect of testosterone on bodyweight loss, body composition, and quality of life in obese patients: a randomised, double-blind, placebo-controlled trial. Lancet.
9. Shai I, Schwarzfuch D, Henkin Y, et al. Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet. NEJM. 2008; 359 (3): 229-241.

10. Ekelund U, Sepp H, Brage S, et al. Criterion-related validity of the last 7-day, short form of the international physical activity questionnaire in Swedish adults. Public Health Nutr. 2006; 9(2): 258-265.

11. Aitsi-Selmi A, Chandola T, Friel S, et al. Interaction between education and household wealth on the risk of obesity in women in Egypt. PLoS One. 2012; 7(6): e39507. doi: 10.1371/journal.pone.0039507

12. Alsheikh-Al-A, Omar MI, Raal FJ, et al. Cardiovascular risk factor burden in Africa and the Middle East: The Africa Middle East Cardiovascular Epidemiological (ACE) study. PLoS ONE. 2014; 9(8): e102830. doi: 10.1371/journal.pone.0039507

13. Musaiger AO. Diet and prevention of coronary heart disease in the Arab Middle East countries. Med Princ Pract. 2002; 11: 9-16. doi: 10.1159/00006415

14. Flegal KM, Kit BK, Orpana H, Graubard BI. Association of all-cause mortality with overweight and obesity using standard body mass index categories: A systematic review and meta-analysis. JAMA. 2013; 309: 71-82. doi: 10.1001/jama.2012.113905

15. Manyanga T, El-Sayed H, Doku D, Randall J. The prevalence of underweight, overweight, obesity and associated risk factors among school-going adolescents in seven African countries. BMC Public Health. 2014; 14: 887. doi: 10.1186/1471-2458-14-887

16. Popkin BM, Lu B, Zhai F. Understanding the nutrition transition: Measuring rapid dietary changes in transitional countries. Public Health Nutr. 2002; 5: 947-953. doi: 10.1079/PHN2002370

17. Yasin A. Time expenditure in Egyptian community Cairo: National center for social and crime studies 1998 (in Arabic). Annals of Alquds Medicine. 2013; 9 (1435): 13-21.

18. Walley A, Blakemore A, Froguel P. Genetics of obesity and the prediction of risk for health. Hum Mol Genet. 2006; 15 Spec No 2: R124-R130. doi: 10.1093/hmg/ddl215

19. Merchant AT, Anand SS, Kelemen LF, et al. Carbohydrate intake and HDL in a multiethnic population. Am J Clin Nutr. 2007; 85(1): 225-230. doi: 10.1093/ajcn/85.1.225

20. Liu S, Manson J, Stampfer M, et al. Dietary glycemic load assessed by food-frequency questionnaire in relation to plasma high-density-lipoprotein cholesterol and fasting plasma triacylglycerols in postmenopausal women. Am J Clin Nutr. 2001; 73: 560-566. doi: 10.1093/ajcn/73.3.560

21. Anderson JW, Konz EC, Frederich RC, Wood CL. Long-term weight loss maintenance: A meta-analysis of US studies. Am J Clin Nutr. 2001; 74: 579-584. doi: 10.1093/ajcn/74.5.579

22. Maclean PS, Bergouignan A, Cornier MA, Jackman MR. Biology’s response to dieting: the impetus for weight regain. Am J Physiol Regul Integr Comp Physiol. 2011; 301(3): R581-R600. doi: 10.1152/ajpregu.00755.2010

23. Redman L, Heilbronn L, Martin C, et al. Effect of calorie restriction with or without exercise on body composition and fat distribution. J Clin Endocrinol Metab. 2007; 92(3): 865-872. doi: 10.1210/jc.2006-2184

24. Hemmingssson F, Johansson K, Eriksson J, et al. Weight loss and dropout during a commercial weight-loss program including a very-low-calorie diet, a low-calorie diet, or restricted normal food: Observational cohort study. Am J Clin Nutr. 2012; 96: 953-961. doi: 10.3945/ajcn.112.038265

25. Larson-Meyer D, Redman L, Heilbronn L, Martin C, Ravussin E. Caloric restriction with or without exercise: The fitness versus fatness debate. Med Sci Sports Exerc. 2010; 42: 152-159. doi: 10.1249/MSS.0b013e3181ad7f17

26. Malis C, Rasmussen EL, Poulsen R, et al. Total and regional fat distribution is strongly influenced by genetic factors in young and elderly twins. Obes Res. 2005; 13: 2139-2145. doi: 10.1038/oby.2005.265

27. Santos-Pinto FN, Luz J, Griggio MA. Energy expenditure of rats subjected to long-term food restriction. Int J Food Sci Nutr. 2001; 52(2): 193-200.

28. Panagiotakos D, Pitsavos C, Chrysohoou C, Skoumas J, Stefanadis C. Status and management of blood lipids in Greek adults and their socio-demographic, life-style and dietary factors: The ATTICA study. Blood lipid distribution in Greece. Atherosclerosis. 2004; 173(2): 351-361. doi: 10.1016/j.atherosclerosis.2003.12.031

29. Chanoine J, Hampl S, Jensen C, Boldrin M, Hauptman J. Effect of orlistat on weight and body composition in obese adolescents: A randomized controlled trial. JAMA. 2005; 293(23): 2873-2883. doi: 10.1001/jama.293.23.2873

30. Scheen AJ. Current management strategies for coexisting diabetes mellitus and obesity. Drugs. 2003; 63: 1165-1184.

31. Bray G, DeLany J. Opinions of obesity experts on the causes and treatment of obesity: A new survey. Obes Res. 1995; 3(4): 419S-423S.