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# Effect of Nibbling and Gorging Dietary Regimens on Weight and Lipid Profile in Rat

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**Abstract:** To investigate the effects of nibbling and gorging dietary regimens on weight and lipid profiles in rat, thirty female Wistar rats, after 10 day acclimatization period, were weighed and randomly assigned into two equal groups. They were fed the same food for 60 days as eight meals at 2 h intervals starting from 6 pm (nibbling group) or as two meals at 9 pm and 6 am (gorging group). The serum lipid levels and weight of animals were determined before and after the intervention. The body weight in two groups increased significantly ($p<0.001$) during the period of study but there was no significant ($p>0.05$) difference between two groups before and after the intervention. Nibbling regimen caused a reduction in the serum Total Cholesterol (TC), triglyceride and LDL-C levels, whereas these parameters increased during gorging diet. However, none of these changes were significant. There was a significant decrease ($p<0.05$) in TC and LDL-C levels in nibbling diet compared to gorging one. According to obtained results, nibbling regimen has better effect on lipid profile than gorging one in rat.

**Key words:** Nibbling, gorging, lipid profile, weight, rat

## INTRODUCTION

Human mental and physical status are strongly influenced by nutrition and the quality and quantity of nutrients are important factors in maintenance of good health and physical activity (Brayan *et al*., 2004; Beydoun and Wang, 2007). Now, it is well accepted that apart from the amount of nutrients, food pattern and human nutritional behavior play an important role in the quality of life and indirectly, in longevity (Waijers *et al*., 2006; Pala *et al*., 2006; Solomons, 2004; Singh *et al*., 2003; Shimizu *et al*., 2003). Human nutritional behavior depends on not only biological but also cultural and social aspects. The nature and range of food variety, food preparing ways, norms of consumption, social conventions and quantity of meals are extremely affected by cultural and social factors (Chiva, 1997). One of these behaviors is meal frequency which it's number, time, quantity and quality of foods eaten in each meal may differ markedly from one society to another (Chiva, 1997). Although consumption of three or less than three meals a day (gorging diet) is usual in some communities, in western population there is an inclination toward many small meals a day (nibbling diet) (Drummond *et al*., 1996). Several studies have been conducted to investigate the biological and clinical effects of meal frequency and the pattern of food intake. These studies have mostly examined the effects of nibbling and gorging dietary patterns on lipid profile (Jenkins *et al*., 1995; Edelstein *et al*., 1992; Murphy *et al*., 1996), weight (Ozelci *et al*., 1978), glucose (Arnold *et al*., 1993) and insulin metabolism (Bertelsen *et al*., 1993), particularly in hyperlipidaemic (Arnold *et al*., 1994) and diabetic patients (Segura *et al*., 1995). However, the results published are insufficient and sometimes controversial.

Several human studies have already provided evidence that nibbling diet is associated with lower concentration of serum total cholesterol (Jenkins *et al*., 1989; Arnold *et al*., 1993), LDL-C (Mcgrath and Gibney, 1994; Jenkins *et al*., 1989; Arnold *et al*., 1993), HDL-C (Jenkins *et al*., 1995; Arnold *et al*., 1993), apolipoprotein B and insulin (Jenkins *et al*., 1989, 1992). On the other hand, according to some other authors, alteration of meal frequency does not result in significant difference in the concentrations of fasting lipids (Peters *et al*., 1979; Jordan and Novascone, 1989; Arnold *et al*., 1994) and

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insulin (Maislos *et al*., 1998; Bertelsen *et al*., 1993; Segura *et al*., 1995). There is also some evidence indicative of the beneficial effects of gorging diet on some blood lipid parameters (Wadhawa *et al*., 1973; Young *et al*., 1971; Maislos *et al*., 1998). The reasons for these controversial results have been attributed to many factors including the lack of information regarding the foods consumed, limited period of experimental dietary regimens and difficulty in conducting well-controlled eating-frequency researches in human studies for a long period (Gatenby, 1997). One way to overcome these problems is the use of laboratory animals. Therefore, the objective of present study is to investigate the effects of nibbling and gorging dietary regimens on weight and lipid profiles in rats.

## MATERIALS AND METHODS

Thirty female Wistar rats (11 weeks old) with the mean initial body weight of 210±15 g were obtained from the animal house of Tabriz University of Medical Sciences. They were fed with standardized laboratory rat chow and water *ad libtum* for an acclimatization period of 10 days. The nutrient composition of the diet was include: carbohydrate (46%), protein (20%), fat (16%), fiber (16%), lysine (0.6%), methionine + cystin (0.8%), calcium (0.6%), phosphorus (0.4%), NaCl (0.5%). The room temperature was maintained at 22±2°C, at 50±10% humidity, under a 12 h light/dark cycle (07:00-19:00 as light hours and 19:00-07:00 as dark hours) with adequate ventilation. The daily food intake of each rat was recorded (20.2±0.7 g $day^{-1}$) at the last three days of acclimatization period. Then, the animals were weighted and randomly assigned into two equal groups. At the end of the acclimatization period, the food was withdrawn at 18 pm leaving the animals with free access to water. Twelve hours later, the animals were lightly anesthetized with ether and blood samples were taken from the retro-orbital sinus. The blood was collected and centrifuged at 1200 g for 15 min at 2-8°C. Serum was separated and its total cholesterol, triglycerides, LDL-C and HDL-C levels were measured by using commercial kits (Iran, Ziest chem.) and used as baseline values. The first group received its diet as eight meals at 2 h intervals starting from 18 pm (nibbling group) and was allowed to eat for half hour at each meal. The other group received the same diet as two meals at 9 pm and 6 am (gorging group) with one and half hour allowance at each meal to eat their meals. To obtain the acclimatization period for these two dietary regimens, the amounts of daily food eaten by each animal in each group was recorded. The corresponding value was 15 g, which was achieved at 8th day after beginning

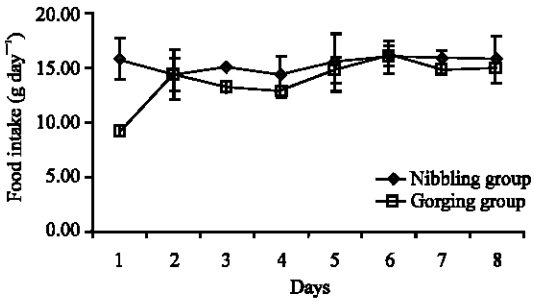


Fig. 1: The amounts of food intake by nibbling and gorging groups of rats during the first 8 days of the intervention (mean±SD, n = 15, in each group)

of the intervention (Fig. 1) and was continued for two months. At 60th day, the blood samples were taken and the lipid contents of the serum were determined. The animals were weighed at the first and every 12 days through the study.

All values were expressed as mean±SD and the comparison was made using paired t-test and ANOVA. The research project was reviewed and approved by the Medical Ethics Committee of Tabriz University of Medical Sciences in year of 2005.

## RESULTS AND DISCUSSION

The results concerning the effects of meal frequency on body weight are not consistent. The results obtained from human studies vary from a significant decrease (Metzner *et al*., 1977) to a significant increase in body weight (Edelstein *et al*., 1992) during nibbling regimen compared to gorging one. Meanwhile, some authors (Miller and Mumford, 1973) have found a significant increase in body weight following gorging regimen compared to nibbling diet. The increase in body weight during gorging dietary regimen has been attributed to elevation of lipogenesis or storage of energy after consuming a large meal (Wilhelmine *et al*., 1991; Kral *et al*., 2001). On the other hand, some researchers have emphasized that moving from gorging diet to nibbling regimen is one of the major factors in the etiology of obesity (Drummond *et al*., 1996). Regarding the human studies, this controversy may partly result from the lack of a good control on the food intake and the shortage of the period of study. It is one major reason for using animal models for food frequency studies by some researchers (Ozelci *et al*., 1977; Juhel *et al*., 2000; Sitren and Stevenson, 1978).

In the present animal study, the body weight in two groups significantly ($p<0.05$, t-test) increased but there was not a significant difference ($p>0.05$, ANOVA)

between two groups of animals before and after intervention (Fig. 2 and Table 1) which is in agreement with the results reported by others (Ozelci *et al*., 1977). Taking into account the equal initial body weight of animals and the equal food intake during the intervention period (Table 1), it could be suggested that the body weight status is not influenced by meal frequency and the increase in the weights during the study could be due to the physiological growth of the animals rather than the influence of the dietary regimens.

Regarding the influence of meal frequency on lipid profile, there is also controversial argument. Some studies (Peters *et al*., 1979; Rashidi *et al*., 2003; Murphy *et al*., 1996) have indicated that alteration of meal frequency dose not result in significant differences in the concentrations of fasting lipids of normolipidaemic individuals. In contrast, some other human studies have demonstrated that total cholesterol (Jenkins *et al*., 1989; Arnold *et al*., 1993) and LDL-C concentrations reduce following the nibbling diet compared with the gorging one (Mcgrath and Gibney, 1994; Jenkins *et al*., 1989; Arnold *et al*., 1993), which is consistent with our present animal study (Table 2). The reduction in serum lipids during nibbling diet has been attributed to reduction in HMG-CoA reductase activity (the enzyme responsible for hepatic cholesterol receptors synthesis) due to reduction of nutrients intake per meal and insulin secretion (Jenkins *et al*., 1989).

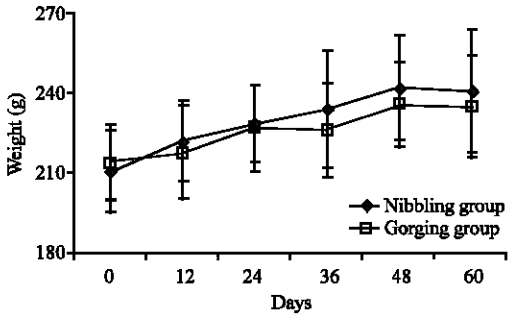


Fig. 2: The variation of weights in nibbling and gorging groups of rats during study (mean±SD, n = 15 in each group)

Table 1: The body weights before and after study, food and water intakes in nibbling and gorging groups of animals[a]

| | Body weight | | | |
|---|---|---|---|---|
| Groups | Before | After | Food intake (g day$^{-1}$ rat$^{-1}$) | Water intake (mL day$^{-1}$ rat$^{-1}$) |
| Nibbling | 210.27±15.2 (195.2-225.3) | 240.4±23.3[b] (217.3-263.5) | 14.69±0.52 (14.2-15.2) | 30.15±3.28 (26.9-33.4) |
| Gorging | 213.8±14.28 (199.6-228.0) | 234.87±19[b] (216.1-253.7) | 13.95±1.07 (12.9-15.0) | 29.52±3.42 (26.1-32.9) |

[a]: The values are expressed as mean±SD, n = 15 in each group, [b]: Significant difference between after and before at p<0.05

Results concerning the effects of the number of meals on serum HDL-C concentration also are different. Although some reports have indicated a significant increase in HDL-C level during gorging diet (Murphy *et al*., 1996; Maislos *et al*., 1998), other studies have shown a marked reduction in serum levels of this lipoprotein following nibbling regimen (Arnold *et al*., 1993). Our previous human study was indicative of no significant difference in HDL-C level following two regimens (Rashidi *et al*., 2003) which is in agreement with our present animal study.

High fasting triglyceride level is associated with subsequent myocardial infarction in human (Sharrett *et al*., 1999; Sarkar *et al*., 2007). There is also controversial argument in the influence of meal frequency on serum triglyceride level. According to some human studies, serum concentration of triglyceride reduces following the nibbling diet compared with gorging regimen (Jenkins *et al*., 1992). However, we did not find a significant difference (p>0.05, ANOVA) between two dietary regimens in terms of triglyceride level either in our pervious human (Rashidi *et al*., 2003) or in the present animal study (Table 2). No significant difference in serum triglyceride concentration has also been reported by other human studies (Arnold *et al*., 1994; Maislos *et al*., 1998).

In conclusion, according to the results obtained in the present study, nibbling regimen has better effect on lipid profile than gorging one in rat. Further research may be needed to confirm and explain this and to elucidate the mechanism of any alteration in animal subjects.

Table 2: Lipid profile in nibbling and gorging groups of animals before and after intervention[a]

| | Total cholesterol (mg dL$^{-1}$) | | Triglyceride (mg dL$^{-1}$) | | HDL-cholesterol (mg dL$^{-1}$) | | LDL-Cholesterol (mg dL$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|
| Groups | Before | After | Before | After | Before | After | Before | After |
| Nibbling | 71.8±5 (66.8-76.8) | 68.7±7 (61.8-75.6) | 80.9±8 (73.0-88.8) | 79.6±8.9 (70.8-88.4) | 43±5 (38-48) | 42.2±3 (39.2-45.2) | 22.7±2 (20.7-24.7) | 20.1±1.6 (18.5-21.7) |
| Gorging | 70.0±10 (60.1-79.9) | 72.2±11[b] (61.3-83.1) | 78.8±9 (69.9-87.7) | 79.6±11 (68.7-90.5) | 43±4 (39-47) | 42.5±3 (39.5-45.5) | 21.2±2 (19.2-23.2) | 22.7±2.4[b] (20.3-25.1) |

[a]: The value are expressed as mean±SD, n = 15 in each group, [b]: Significant difference between two groups at p<0.05

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