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EFFECTS OF EXERCISE IN FASTING AND POSTPRANDIAL CONDITIONS WITH METABOLIC PROFILING OF FATS AND CARBOHYDRATES

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ABSTRACT

Exercise influence metabolic activities, especially carbohydrates and fats. Metabolism also gets synchronized in fasting and postprandial states stratifying glycogen supply, fat oxidation and related liver functions. Present study described correlation between fasting, postprandial status of fats and carbohydrates and effects of exercise and interrelationships in both states. Twenty five, healthy individuals were selected for this experimental study, subjected to fasting (12 hrs) and postprandial studies, 72 hours (or 3 days apart), with and without exercise. For postprandial study with and without exercise", individuals were fed a mixed meal of fats carbohydrates and proteins. Glucose, Lactate, Amylase, Triglyceride, Lactate dehydrogenase, Insulin was analyzed on automated Roche Cobas c501 chemistry and Roche Cobas e411 immunoassay analyzers. Comparative inference was noted with significance of <0.03 to <0.00001 amongst biochemical parameters, enzymes and hormone. Data suggested strong correlation between fasting, postprandial status of fats and carbohydrates metabolism. Moreover, consequent affects of exercise in both states was evident that resulted in post-exercise carbohydrates and triglycerides mobilization.

Key words: Postprandial, Fasting, metabolism, fat oxidation

INTRODUCTION

It is well known fact that exercise, either done in fasting state or postprandial, does effect weight, either through enhancing aerobic metabolism or stratifying glycogen supply, fat oxidation and liver functions (de Lima *et al*., 2015, Maughan *et al*., 2010, Paoli *et al*., 2010; Shimada *et al*., 2013). Notably, suppression of fat oxidation takes place after a carbohydrate meal before exercise regiments (Bennarad and Docuet, 2006; Coyle *et al*., 1985; De Bock *et al*., 2008; Shimada *et al*., 2013). Literature documented that exercise response to metabolic activity is dependent on meal taken just prior to it, thus pre-breakfast exercising is valuable to reduce body fat (Horowitz *et al*., 1997). It was documented in literature that fasting exercise induces low maintenance of respiratory exchange ratio, which impedes supply of glycogen, thus causing mobilization of fat and its oxidation for energy contribution (Deighton *et al*., 2012; Paoli *et al*., 2010; Shimada *et al*., 2013). Liver is the actual organ which controls metabolism and mobilization of carbohydrates, protein and fats, in addition to maintaining homeostasis of all three (Nelson and Cox 2014; Roca and Malheiros, 2017; Schutz 2014). Carbohydrate, amino acids and some of triglycerides (fats) goes through blood directly to liver, while most of the triglycerides is taken up by liver through Lymphatic system to be utilized or stored in adipose tissues (Nelson and Cox 2014; Roca and Malheiros, 2017; Schutz 2014; Voet *et al*., 2015). In fasting state per se, liver glycogenolysis, muscle proteolysis and lipolysis are responsible for maintaining energy needs and hemostasis (Roca and Malheiros, 2017). Postprandial distribution of carbohydrates, proteins and fats, its metabolism and storage shows variability and interrelationship do exists between fasting and state and postprandial circumstance (Nelson and Cox, 2014; Voet *et al*., 2015). Therefore correlation between fasting, postprandial status of fats and carbohydrates, effects of exercise in both states and interrelation is being assessed in presented study here.

MATERIALS AND METHODS

Twenty five, healthy individuals, all male, aged 24 yrs to 31 yrs were selected for this experimental study. Same group of these twenty five individuals were subjected to fasting and postprandial studies, 72 hours (or 3 days apart), with and without exercise. For study "Fasting without exercise", 5 ml blood samples were collected in specialized Vaccutes after 12 hours fasting. For "Postprandial study without exercise", individuals were fed a mixed meal of 200 gm yogurt, one whole cookie, one banana, a cereal bar (containing 50.0 g of carbohydrate 10 g of protein, 8.00

g of lipids) as per protocol described earlier (de Lima *et al*., 2015) and blood was collected after 2 hours. For studies with exercise, all individual performed exercise on standard treadmill (at local Gym) for 30 minutes (Paoli *et al*., 2010). To exercise after 12 hr fasting, all individuals rested for 15 minutes before performing running on treadmill, while for exercise after meal, all individuals were given standard meal as mentioned above, rested for 20 minutes and then performed 30 minutes standard treadmill exercise. In both instances, 5 ml blood was collected immediately after exercise in specialized Vaccutes. Gap of 72 hours was maintained between both types of experimental studies, without and with exercise. Glucose, Lactate, Amylase, Triglyceride, Lactate dehydrogenase, Insulin were analyzed on automated Cobas c501 chemistry and Cobas e411 immunoassay analyzers (Roche Diagnostics, Basil) referring to protocols described earlier (Alam *et al*., 2014; 2017). Results were analyzed statistically using one tailed *t*-test with $P < 0.05$ as significant.

RESULTS

Data available as per outcome of two separate experimental designs were compared with each other, fasting vs postprandial without exercise, fasting vs postprandial with exercise, and correlated fasting data with and without exercise and postprandial data with and without exercise. Interesting comparative outcome was noted and found considerably varied with significance of <0.03 to <0.00001. In experimental set of without exercise fasting and postprandial status, biochemical parameters glucose, lactate, amylase, triglyceride, lactate dehydrogenase and Insulin showed variable significance with glucose showing the highest ($P < 0.00001$) followed by amylase, Insulin and triglyceride (mild significance) (Table 1), whereas lactate dehydrogenase and lactate exhibited non-significance. However, when same comparison was done in experimental set of exercise fasting and postprandial, amylase, Lactate, triglyceride and lactate dehydrogenase showed high significance ($P < 0.00001$ to $P < 0.00007$), in addition to moderately significance, comparatively, glucose and insulin (Table 2). Comparison of fasting status with and without exercise (Table 3), exhibited noticeable data with most biochemical parameters exhibiting markedly significant ($P < 0.0002$ to $P < 0.00001$) variations except triglyceride (weakly significance $P < 0.015$) and insulin which is non-significant ($P< 0.425$). Similarly comparison of postprandial status with and without exercise (Table 4), exhibited even more noticeable data with all metabolic/biochemical parameters manifesting markedly significant ($P < 0.0001$ to $P < 0.00001$) except, in contrast, insulin (weakly significant $P < 0.022$) and amylase (moderately significant $P < 0.0016$).

Table 1. Biochemical parameters in subjects without exercise.

Parameters	**Fasting**	**Postprandial**	**t value**	**P < 0.05**
Glucose mg/dL	97.10 ± 15.10	107 ± 14.35	-9.82379	<0.00001
Lactate mg/dL	11.25 ± 4.40	10.50 ± 3.40	0.63591	<0.53 NS
Triglyceride mg/dL	102.10 ± 16.25	128.25 ± 17.55	-1.92787	<0.038
Amylase U/L	75.43 ± 10.90	98.55 ± 11.20	-3.44545	<0.002
Lactate dehydrogenase U/L	210.55 ± 17.45	222.60 ± 20.50	-0.99148	<0.170 NS
Insulin micro U/mL	10.05 ± 2.65	18.45 ± 3.40	-3.26119	<0.003

Table 2. Biochemical parameters in subjects with exercise.

Parameters	**Fasting**	**Postprandial**	**t values**	**P < 0.05**
Glucose mg/dL	91.29 ± 10.15	101.14 ± 11.20	-3.74941	<0.0013
Lactate mg/dL	20.29 ±3.55	30.10 ± 4.45	-5.45018	<0.00007
Triglyceride mg/dL	98.05± 11.65	112.14 ±15.30	-7.01205	<0.00001
Amylase U/L	87.29 ± 8.25	94.86 ± 9.65	-4.474	<0.00038
Lactate dehydrogenase U/L	229.71 ± 21.35	255.86 ± 25.40	-10.9756	<0.00001
Insulin microU/mL	10.62 ± 2.75	15.14 ± 3.40	-3.4192	<0.00228

Table 3. Comparison of Biochemical parameters in subjects with and without exercise in fasting.

Parameters	**Without exercise**	**With exercise**	**t values**	**P < 0.05**
Glucose mg/dL	97.10 ± 15.10	91.29 ± 10.15	4.7640	<0.0002
Lactate mg/dL	11.25 ± 4.40	20.29 ±3.55	-7.66716	<0.00001
Triglyceride mg/dL	102.10 ± 16.25	98.05± 11.65	2.4386	<0.01561
Amylase U/L	75.43 ± 10.90	87.29 ± 8.25	-10.5410	<0.00001
Lactate dehydrogenase U/L	210.55 ± 17.45	229.71 ± 21.35	-10.54101	<0.00001
Insulin micro U/mL	10.05 ± 2.65	10.62 ± 2.75	-0.1926	<0.42524

Table 4. Comparison of Biochemical parameters in subjects with and without exercise Postprandial.

Parameters	**Without exercise**	**With exercise**	**t value**	**P < 0.05**
Glucose mg/dL	107 ± 14.35	101.14 ± 11.20	4.8687	<0.0001
Lactate mg/dL	10.50 ± 3.40	30.10 ± 4.45	-17.2714	<0.00001
Triglyceride mg/dl	128.25 ± 17.55	112.14 ±15.30	11.5970	<0.00001
Amylase U/L	98.55 ± 11.20	94.86 ± 9.65	3.64423	<0.0016
Lactate dehydrogenase U/L	222.60 ± 20.50	255.86 ± 25.40	-19.9308	<0.00001
Insulin micro U/mL	18.45 ± 3.40	15.14 ± 3.40	2.24546	<0.02217

DISUSSION

In present study, fasting and postprandial status of fats and carbohydrates, and correlating affects of exercise in both fasting and postprandial conditions were assessed and compared. In experimental sets of individuals subjected to without exercise fasting and postprandial state, their biochemical parameters glucose, lactate, amylase, triglyceride, lactate dehydrogenase and Insulin were tested accordingly and noted variable significance from marked to poor. Glucose was the most affected followed by amylase, Insulin and triglyceride, whereas lactate dehydrogenase and lactate exhibited non-significance when fasting and postprandial status were compared with each other without exercise. However, when same comparison was done in experimental set of exercise with fasting and postprandial, amylase, Lactate, triglyceride and lactate dehydrogenase showed high significance ($P < 0.00001$ to $P < 0.00007$), in addition to moderately significance effects on glucose and insulin. Comparison was also made for fasting status with and without exercise, which demonstrated noticeable significance with most biochemical parameters exhibiting markedly significant ($P < 0.0002$ to $P < 0.00001$) variations except triglyceride (weakly significance $P < 0.015$) and insulin with is non-significance. Moreover, postprandial status with and without exercise exhibited even more perceptible figures with all most all metabolic/biochemical parameters manifesting striking significance ($P < 0.0001$ to $P < 0.00001$) except, in contrast, insulin with weak significance and amylase with moderate significance.

It was reported and known that concentration of glucose is dependent on exercise and its intensity (de Lima *et al*., 2015; Thompson *et al*., 2001). Earlier it was contended that glucose level remains constant, even during exercise due to mobilization of glucose from glycogenolysis and probably from gluconeogenesis as well (Simoes *et al*., 2003). Moreover, several other studies reported constant concentration of glucose during exercise and decline after postprandial exercise, possibly due to carbohydrate metabolism, stimulated by glucagon, catecholamines and cortisol in former case and usage of glucose fuel postprandial, influenced by insulin in later case (Adams *et al*., 2013; Colberg *et al*., 2013; Goodwin, 2010). In our case, decline in glucose concentration didn't manifest in fasting or in postprandial case, whether after exercise or without exercise, supporting the fact that intensity, type and duration of exercise, in addition to carbohydrate food/feed taken before onset of fasting or postprandial, does affect blood glucose levels, both negatively and positively (Awobajo *et al*., 2013, Colberg *et al*., 2013).

In our study plasma lactate level remains within normal range, both in fasting and postprandial state without exercise status whereas drastic increase was noted in both states when individuals were subjected to exercise. In earlier studies, similar affects were reported and explained by reduction of available bicarbonates for buffering lactic

acidosis, increase in carbon dioxide production and thus high threshold of anaerobic glycolysis and influence of catecholamine in lactate kinetics (Older, 2012; Westerblad *et al*., 2002). A recent past study concluded that lactate production increased in both exercise and postprandial states (and consequently lactate dehydrogenase), suggesting that resistance exercises might help in reducing blood lactate levels in diabetic patients (Heden *et al*., 2017). Regarding triglycerides, without exercise status showed milder significance in postprandial triglycerides; however, in experimental set of with exercise, significant difference was noted. It was reported that during moderate and even long-term exercise, main energy fuel being lipids, and especially in postprandial status, triglycerides deposits and its clearance is of great importance (Curi *et al*., 2003; Roca and Malheiros, 2017; Perez 2016). Postprandial increase in triglyceride in our study might be due to natural lipemia response that occurs after a feed, in addition to increase in triglyceride clearance as a result of exercise (Davitt *et al*., 2013). Moreover, it was also documented that post-exercise lipolysis enhancement results in high triglyceride concentrations, consequently ensuing increase in glycerol and free fatty acids as well, thus putting stress on pancreatic enzyme amylase and pancreatic hormone insulin (de Lima *et al*., 2015). Furthermore, mild to moderate increase in amylase and insulin might also took place due to postprandial increase in carbohydrate load, whether exercise set or not, resulting in mobilization of glucose as byproduct, in addition to pyruvate and subsequently lactate.

CONCLUSION

In present study, separate experimental designs were compared with each other, fasting vs postprandial without and without exercise, and correlated fasting data with and without exercise and postprandial data with and without exercise. Interesting comparative outcome was noted and found considerably varied with significance of <0.03 to <0.00001. Biochemical parameters, enzymes and hormone viz glucose, lactate, amylase, triglyceride, lactate dehydrogenase and Insulin showed variable significance. Data suggested strong correlation between fasting, postprandial status of fats and carbohydrates metabolism, effects of exercise in both states and interrelation postprandial and post-exercise carbohydrates and triglycerides mobilization.

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