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SEASONAL PATTERNS: THEIR EFFECT ON INSULIN AND GLUCOSE LEVELS IN TYPE II DIAETICS

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ABSTRACT

Background: Type II diabetes mellitus is highly influenced by physical activity and the levels of physical activity mainly depend on the external environment and seasons.

Objectives: To find out the effect of seasonal variations on insulin and glucose level of type II diabetics.

Methods: 60 type II diabetes patients from Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, Jammu and Kashmir, India with age between 35 to 60 years were selected at random and were tested at different seasons of the year for selected criterion variables. All the subjects were tested in the middle of every season (Spring, Summer, Autumn and winter).

Results: The mean for fasting glucose in spring, summer, autumn and winter were 138.04, 123.23, 145.44 and 151.46 respectively. For postprandial glucose it was 160.03, 144.23, 170.38 and 183.77 respectively and for insulin 7.68, 7.25, 8.04 and 8.45 respectively.

Conclusion: The seasons (Spring, Summer, Autumn and Winter) significantly changed the level of Fasting Glucose (fg), post prandial glucose level (ppg), and insulin sensitivity in the type II diabetics.

Keywords: Type II diabetes, seasons, Fasting Glucose, post prandial glucose level, insulin

Introduction

Diabetes is a serious concern in modern society, as its prevalence is increasing at an alarming rate **(1)**. Bad food habits, sedentary life style and lack of physical activity have been found to be the primary causes of type II diabetes mellitus. Physical activity is strongly suggested for individuals with diabetes as regular exercise is connected with greater life expectancy and a lesser occurrence of diabetic complications in this population. Higher levels of physical activity are related to better physical fitness, favorable lipid profiles, decreased cardiovascular disease risk and superior self-reported quality of life in people with diabetes mellitus **(2)**. Though various studies have witnessed the association between ambient temperature and mortality but few studies have investigated the effects of extreme temperatures on diabetes mortality. Some studies have noticed that hot temperatures are allied with increased diabetes morbidity and mortality, but no noteworthy relations with

extremely cold temperatures were detected. Some other studies have concluded that cold winter is coupled with higher mortality **(3)**. The mechanism of effects of cold on diabetes mortality is undecided and a mystery. Cold weather is regarded as the major villain for playing a leading role in excess winter mortality. The lack of physical exercise **(4)**, lesser intake of fresh fruits and vegetables and higher intake of saturated fat during this season are also potential factors involved in winter mortality peaks **(5,6)**. Environmental factors are assumed to account for more than 50% of the risk for diabetes and have been hypothesized to uncover the disease in individuals with a genetic predisposition **(7)**. The diagnosis of non-insulin- dependent diabetes mellitus (NIDDM) has been suggested to be allied with seasonality showing the lowest occurrence during the summer months and a more than 2-fold increase in occurrence during winter and early spring, with intermediate occurrence in late spring and autumn. Moreover, it is usually accepted that decreased insulin sensitivity is a well-known feature in the pathogenesis of NIDDM. Thus it is appealing to theorize that the time of diagnosis of overt NIDDM may be attributable, at least in part, to a seasonal influence in insulin action, and this may be obvious in individuals with normal glucose tolerance **(8)**. Dietary fat and sugar-rich beverages are major risks of developing visceral obesity, type II diabetes, and cardiovascular disease in humans. Well-known epidemiologic analyses advocate that the human metabolic syndrome could be associated in part to seasonality. The Seasonal Affective Disorder (SAD, also known as so called winter depression) in general occurs under short photoperiods and is often related with carbohydrate craving. There are indications that SAD is connected with altered glucose metabolism. Besides carbohydrate craving, one more important symptom of SAD is increase in body mass and fat **(9)**. In Japan, glycemic control on average deteriorates during the New Year winter holiday season **(10)**. Weather had modest effects on physical activity of participants **(11).**

Methods

The purpose of the study was to find out the effects of seasonal changes on insulin and glucose response of type II diabetic patients. To achieve the purpose of the study 60 type II diabetes were selected at random and were tested on selected criterion variables at different seasons of the year (Spring, Summer, Autumn and Winter). The age of the subjects ranged between 35 to 60 years. All the subjects were tested in the middle of every season, that is April, July, October and January. Permission was granted from all the subjects and they were told to withdraw from the program if they felt any sort of discomfort. There were two patients (women) who withdrew after the first phase of data collection. Three men withdrew after the second phase and three more persons (2 women and 1 man) withdrew after the third phase.

The investigator explained the purpose of the study and the importance of the study and verbally motivated the subjects to take part in the study and explained their role in carrying out the study successfully. All the subjects assured that they will offer their full support. All the subjects (N=60) were advised to take their medicine as per routine or as prescribed by their doctor. The subjects were not advised any additional physical activity except from the routine physical activity which they involved in

because of their personal, family, social, recreational and other affairs, however the researcher regularly (once in two weeks) enquired about their physical activity status by phone calls or personal contact.

In the present study data were collected in four phases, once in every season (spring, summer, autumn, winter) in the middle of the season. In all the four phases data were collected from the documented cases of type II diabetes subjects from OPD of Endocrinology, Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, Jammu and Kashmir, India. The data collected from different seasons (spring, summer, autumn and winter) groups were statistically analysed by repeated ANOVA. If obtained 'F' ratio was found to be significant Scheffe'S post hoc test was employed to find out the mean difference between the groups. In all the cases level of confidence was fixed at 0.05 for significance.

RESULTS

Table –I shows the mean, standard deviation and 'F' ratio value of fasting glucose, post prandial glucose and insulin of various seasons such as spring, summer, autumn and winter for type-II diabetes of Kashmir valley.

TABLE-I

One way ANOVA repeated for different seasons on selected criterion variables

	Spring	**Summer**	**Autumn**	**Winter**	**SOV**	**SS**	**df**	**MS**	**F**
Fasting glucose	138.04 9.12	123.23 7.68	145.44 12.13	151.46 12.89	B W	23150.70 2573.04	3 153	7716.90 16.81	458.86*
Post prandial glucose	160.03 9.62	144.23 6.16	170.38 14.39	183.77 15.31	B W	43252.20 10983.54	3 153	14417.40 71.78	200.83*
Insulin	7.68 0.96	7.25 0.92	8.04 1.03	8.45 1.16	B W	40.90 9.10	3 153	13.63 0.06	229.09*

*Significant at 0.05 level of confidence with df.

(Table value required for significance at 0.05 level with df 3 and 153 is 2.60).

Fasting Glucose

The obtained mean value for fasting glucose level during spring, summer, autumn and winter are 138.04, 123.23, 145.44 and 151.46 respectively. The obtained 'F' ratio value for fasting glucose is 458.86, which is greater than the table value of 2.60 required for significance at 0.05 level with df 3 and 153. The result of the study showed that there was a significant difference among the seasons on fasting glucose level of type II diabetics. To find out the mean difference the Scheffe's test was applied and presented in table I.A.

Post Prandial Glucose

The obtained mean value for post prandial glucose level during spring, summer, autumn and winter are 160.03, 144.23, 170.38 and 183.77 respectively. The obtained 'F' ratio value for post prandial glucose is 200.83, which is greater than the table value of 2.60 required for significance at 0.05 level with df 3 and 153. The result of the study showed that there was a significant difference among the seasons on post prandial glucose level of type II diabetics. To find out the mean difference the Scheffe's test was applied and presented in table I.A.

Insulin

The obtained mean value for insulin level during spring, summer, autumn and winter are 7.68, 7.25, 8.04 and 8.45 respectively. The obtained 'F' ratio value for insulin is 229.09, which is greater than the table value of 2.60 required for significance at 0.05 level with df 3 and 153. The result of the study showed that there was a significant difference among the seasons on insulin level of type II diabetics. To find out the mean difference the Scheffe's test was applied and presented in table I.A.

TABLE-I.A

Scheffe'S test for mean difference of different seasons on selected criterion variables

Variables	Spring vs Summer	Spring vs Autumn	Spring vs Winter	Summer vs Autumn	Summer vs Autumn	Autumn vs Winter	CI
Fasting glucose	14.81*	7.40*	13.42*	22.21*	28.23*	6.02*	2.22
Post prandial glucose	15.80*	10.35*	23.74*	26.15*	39.54*	13.39*	4.60
Insulin	0.43*	0.36*	0.77*	0.79*	1.20*	0.41*	0.133

*Significant at 0.05 level of confidence

Table –I.A showed the mean difference between spring and summer, spring and autumn, spring and winter, summer and autumn, summer and winter and autumn and winter for type II diabetics on fasting glucose, post prandial glucose and insulin level.

The mean difference of fasting glucose for all the six comparisons were significant at 0.05 level of confidence. The result of the study indicates that fasting glucose level was significantly lower in summer when compared with spring, autumn and winter. Further the results shows that in spring fasting glucose was significantly lower than autumn and winter. The result also reveals that in autumn the fasting blood glucose level was significantly lower than winter. Hence it was concluded that fasting blood glucose was lower during summer and higher during winter for type II diabetics.

The mean difference of post prandial glucose for all the six comparisons were significant at 0.05 level of confidence. The result of the study indicates that post prandial glucose level was significantly lower in summer when compared with spring, autumn and winter. Further the results shows that in spring post prandial glucose level was significantly lower than autumn and winter. The result also reveals that in autumn

the post prandial glucose level was significantly lower than winter. Hence it was concluded that post prandial glucose was lower during summer followed by spring and autumn and post prandial glucose was higher during winter for type II diabetics.

The mean difference of insulin for all the six comparisons were significant at 0.05 level of confidence. The result of the study indicates that insulin level was significantly lower in summer when compared with spring, autumn and winter. Further the results shows that in spring insulin level was significantly lower than autumn and winter. The result also reveals that in autumn the insulin level was significantly lower than winter. Hence it was concluded that insulin was lower during summer followed by spring and autumn and the insulin level was higher during winter for type II diabetics.

Discussion

The results of the study on different seasons (spring, summer, autumn and winter) show significant difference on fasting blood glucose level, post prandial glucose level and insulin sensitivity of type II diabetics. Further the results of fasting blood glucose and post prandial glucose level were significantly reduced during summer followed by spring and autumn and during winter high glucose on fasting and post prandial conditions were recorded. The results also conclude the inverse effect on insulin secretion of type II diabetics. It was high during winter followed by autumn, spring and summer. The level of leisure-time physical activity and physical fitness are generally higher in the summer than in the winter for most people living away from the equator. There are seasonal variations in the physiological responses to the exercise and the occurrence of injuries during participation in sports, but it is not known whether these changes are explained by fluctuations in activity levels and environmental conditions, or bag any endogenous circannual rhythms in the human vo2 max. and other physiological indicators of exercise performance might not mirror seasonal variations in real performance, which suggests that top class athletes maintain a good level of physical conditioning throughout the year **(12)**. Seasonal variation of AIC levels among Canadian men and women type II diabetes and greater understanding of its determinants could lead to targeting physical activity levels to remain at exceed peak values achieved during more favorable weather conditions. Strategies may include shifting to indoor activities or adapting to less favorable conditions. Increasing does/number of glucose-lowering medications during the winter and reducing these during the summer, in anticipation of seasonal variations. The impact of bright light therapy on active and AIC among type II diabetes patients with a increase in depressive symptomology when sunlight hours decline. **(13)** Daily caloric intake was higher by 86kcal/day during the fall compared to the spring. Percentage of calories from carbohydrate, fat and saturated fat showed slight seasonal variation, with a peak in the spring for carbohydrate and in the fall for total fat and saturated fat intake. The lowest physical activity level was observed in the winter and the highest in the spring. **(14).** Youth were more active in the summer and activity levels were higher after school than in school. Summer season provided relevant contexts for youth physical activity accumulation. Winter season may have been a significant barrier to physical activity. **(15)** Regions with colder winter temperatures had larger winter-summer contrasts than

did those with warmer winter temperatures. The seasonal patterns followed trends similar to those of many physiologic markers, cardiovascular and other diabetes outcomes and mortality. **(16)**. Sitagliptin is a suitable oral agent for preventing deterioration of glycemic control during winter in Japanese type II diabetes mellitus. **(17)**. Weight gain is due to increase in food intake and decrease in exercise during winter and visceral fat accumulation also has been shown to have a negative impact on glycemic control in the persons with diabetes. **(18).** Weekly leisure-time energy expenditure averaged approximately 15-20 % higher during spring and summer **(19)**. Seasonal variations in the fasting glucose levels in diabetic patients were higher in colder than warmer months. **(20).** During the summer, objectively measured mean physical activity increased by 51 minutes/day in men and 16 minutes/day in women. The authors observed complex patterns of seasonal change that varied in amplitude and phase by type and intensity of activity and by subject characteristics. Physical activity was lower during winter and increased during warmer months **(21).** The result of the seasons significantly reduced fasting blood glucose, post-prandial glucose and increased insulin level during summer, spring, autumn and winter respectively. The inverse effect of an increase of insulin was observed among the subjects. This may be due to the length of the day, food habits of the seasons, physical activity and shift of circanam rhythm of the type II diabetics. Further the above mentioned studies are in conformity with the findings of this season result.

Conclusion

The seasons (spring, summer, autumn and winter) significantly changed the level of Fasting Glucose (fg), post-prandial glucose level (ppg), and insulin sensitivity in the type II diabetics. Among the seasons it was observed that the level of fasting glucose (fg) was high during winter followed by autumn, spring and summer respectively. Hence it was concluded that especially in winter the type II diabetic patients need more attention for their treatment, diet and exercise pattern.

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