IJIRR

International Journal of Information Research and Review
Vol. 2, Issue, 01, pp. 318-323 January, 2015

Full Length Research Article

INCIDENCE OF VITAMIN D DEFICIENCY IN TYPE II DIABETIC PATIENTS

[1,*]Dr. Rekha Battalwar and [2]Ms. Dhrishti Bijlani

[1]Department of Food and Nutrition, SVT College of Home Science (Autonomous), SNDT Women's University, Juhu Tara Road, Mumbai- 400 049, India
[2]Clinical Nutrition and Dietitics, DR. B.M.N College of Home Science, 338, R.A. Kidwai Road, Matunga, Mumbai- 400 019, India

ARTICLE INFO

Article History:
Received 24th October, 2014
Received in revised form
04th November, 2014
Accepted 30th December, 2014
Published online 31st January, 2015

Keywords:

Type II diabetes mellitus,
Vitamin D deficiency,
Calcium deficiency,
Dietary recall,
Overweight.

ABSTRACT

Type II Diabetes Mellitus is associated with increasing complications and decreasing overall life expectancy globally. Vitamin D deficiency is rising equally worldwide. To observe the incidence of Vitamin D deficiency in type II diabetic and healthy subjects and the associated risk factors, an observational study of 150 subjects (100 diabetic and 50 non-diabetic) was conducted. The Ethical Committee approval was taken, and participation was voluntary. A pre-tested oral questionnaire was used to collect data of the subjects from two urban clinics. The data collected included personal information, medical history, anthropometric measurements (height, weight, body mass index, waist circumference, hip circumference and waist to hip ratio), biochemical parameters (fasting and postprandial blood sugar level, glycosylated haemoglobin, vitamin D and calcium levels), blood pressure, food frequency questionnaire and 24 hour three day dietary recall. Age group of the subjects was 51-60 years in the experimental and <40 years in the control group. Percentage of females was higher than males in both groups. 87% of the diabetics were overweight. 66% had a higher waist circumference. 93.8% diabetics had glycated haemoglobin levels above 6.5%.Vitamin D and calcium levels were higher in diabetics due to supplementation. 59% of the diabetics showed high blood pressure. Protein intake was less in both the groups. Fat intake was higher in the diabetics (p=.001). The study highlighted that the Vitamin D deficiency is common in type II diabetic patients and has a role to play in glucose metabolism. Low levels of vitamin D status, sun exposure and low intake of proteins (quality and quantity) and increased intake of fats increases the prevalence of type II diabetes mellitus.

INTRODUCTION

Type II Diabetes Mellitus, an endocrinological disorder of insulin resistance and insulin deficiency is a progressive disorder. It may account for 90 to 95% of all the diagnosed cases of diabetes. It is characterised by an abnormal pattern of insulin secretion and action, decreased cellular uptake of glucose and increased postprandial glucose, and increased release of glucose by liver known as gluconeogenesis (Mahan *et al*., 2011). The World Health Organization (WHO) estimated that with the global prevalence increasing at an alarming rate, the total number of diabetic cases would increase from 171 million in 2000 to 388 million by the year 2030. Individuals above 65 years of age were considered to be at higher risk of type II diabetes mellitus (Wild *et al*., 2004).

Corresponding author: Dr. Rekha Battalwar
Department of Food and Nutrition, SVT College of Home Science (Autonomous), SNDT Women's University, Juhu Tara Road, Mumbai- 400 049 India.

A Finnish Diabetes Prevention study stated that with induced lifestyle changes in high diabetics, there was long-term prevention of progression to type II diabetes mellitus (Lindstorm *et al*., 2013).

Vitamin D deficiency, a worldwide problem and is considered a world pandemic. One billion people are known to suffer from vitamin D deficiency. In the sunniest of the areas in the world, with adequate sun exposure, individuals are at a greater risk due to less frequency and duration of sun exposure. 90% Indians are found to have hypovitaminosis D. The major causes being dark skin complexion, lack of appreciation of sun exposure, vegetarian food habits, use of sunscreen, etc. (Holick *et al*., 2014). A study in the Chinese population showed that lower serum vitamin D levels were associated with visceral body fat in subjects with normal glucose tolerance (Hao *et al*., 2014).

Vitamin D status and sunlight exposure is of a major concern today. A broad spectrum study conducted in South Asia and South East Asian countries, showed that 70% of the subjects were vitamin D deficient due to skin pigmentation, sun protection such as long sleeve clothes, sunscreen use, lifestyle and nutritional factors, etc. (Nimitphong *et al*., 2013). Vitamin D and calcium supplementation was found to improve the pancreatic B-cell function and plasma glucose levels in 48 non-diabetic subjects (Harinarayan *et al*., 2013). A study on patients with hypovitaminosis D showed that vitamin D supplementation was important for these patients (Kannan *et al*., 2013). Vitamin D has shown to have a link with pancreatic B-cell functioning, insulin resistance and also glycemic control (Sheshadri *et al*., 2011). A lot of supporting studies suggest an association between 25(OH) D levels and type II diabetes mellitus.

A 5-year follow up study in Koreans, showed vitamin D to play a role in the pathogenesis if type II diabetes mellitus independently of known risk factors (Lim *et al*., 2013). A study on type II diabetic Punjabi patients of North India showed that low levels of serum vitamin D was related to cardio-metabolic risks (Braun *et al*., 2013). 90 type II diabetic subjects showed an improvement in their glycemic status with daily intake of vitamin D fortified yogurt drink with or without the addition of calcium. A study carried out on prediabetic hypovitaminosis D subjects below 40 years of age showed that vitamin D supplementation had no effect on insulin secretion and sensitivity, but improved serum 25 (OH)D concentrations (Davidson *et al*., 2013). Vitamin D deficiency is not just a risk factor for bone disease, but also for type II diabetes mellitus, dyslipidemias, hypertension and cardiovascular diseases.

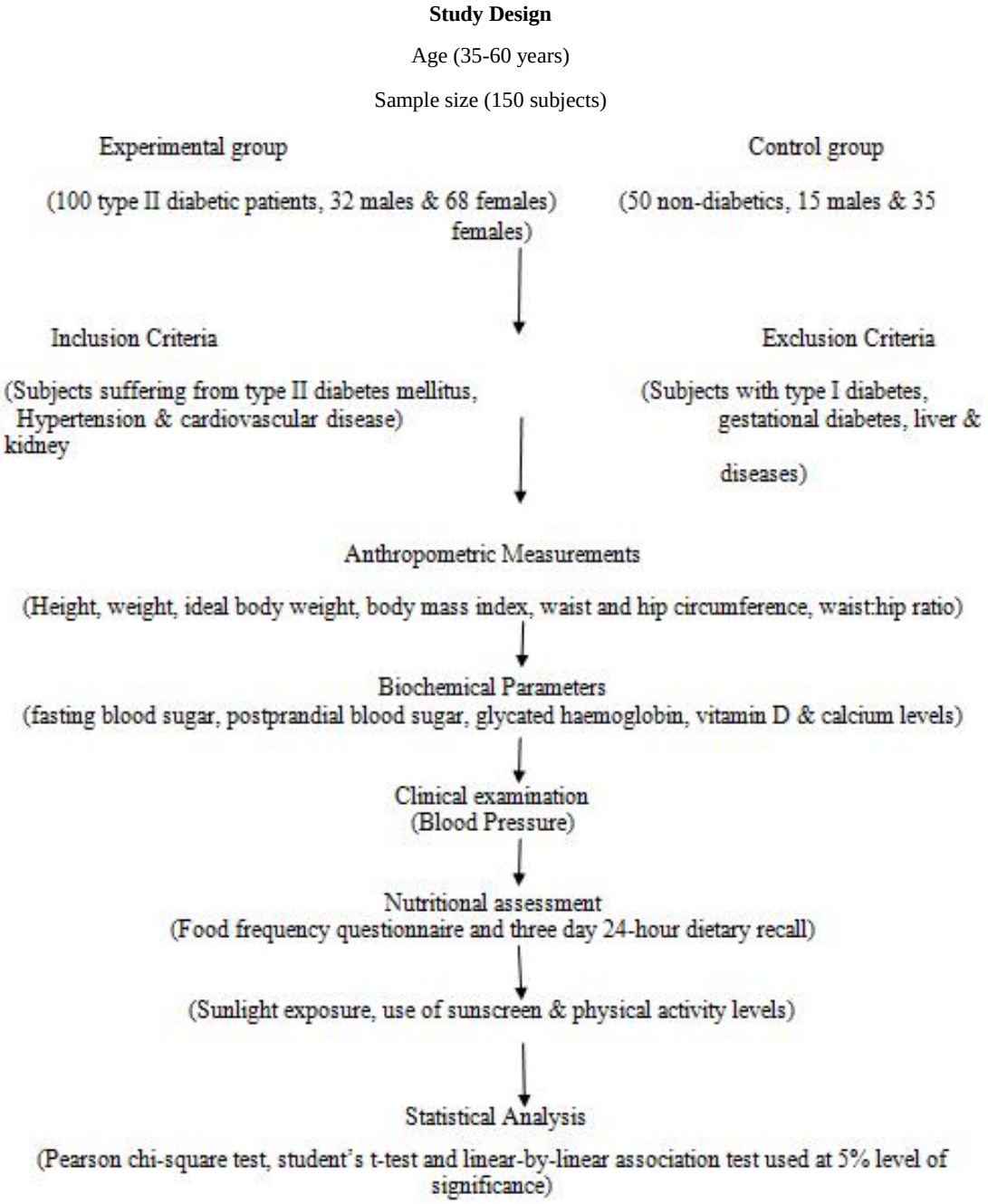

Figure 1. Schematic representation of methodology

A study with 88 diabetic patients, 61 years of age, with a BMI of 29 Kgs/M^2 concluded that weight, BMI and waist circumference were best predictors of vitamin D status (Kavaric *et al*., 2013). Low vitamin D levels were found to be independent risk factors for prediabetes and diabetes (Trur *et al*., 2013**).** The prevalence and severity of vitamin D deficiency was linked to diabetic foor infection and 25(OH)D levels were lower in subjects with diabetic foor infection (Tiwari *et al*., 2012).

MATERIALS AND METHODS

The aim of the study was to observe the incidence of Vitamin D deficiency in type II diabetic patients, and the associated risk factors.

Ethical committee approval and consent of patients was taken.

RESULTS AND DISCUSSION

Table 1 the study included 150 subjects, 100 from the experimental and 50 from the control group. Of the study subjects, maximum were Hindus. The mean age was 50 years in the experimental group and <40 years in the control group, which indicated that the risk of diabetes increases with increasing age. Diagnosis and management of diabetes in the elderly requires special attention and with other metabolic factors such as hyperlipidemia, hypertension, etc, the risk of other complications increases at a faster rate as compared to the younger population where management of diabetes can be conducted well (Tessier *et al*., 2001). The percentage of females was higher in both the study groups as compared to that of males. A study showed that there was a stronger effect of type II diabetes mellitus on the risk of coronary artery diseases in women along with greater effect of blood pressure and artherogenic dyslipidemia as compared to diabetic men (Juutilainin *et al*., 2014).

Table 1. Baseline Characteristics and Anthropometric Measurements of the Study Groups

	Diabeticgroup (N=100)	Non-diabetic group (N=50)	Total	P value
AGE (years)				
<40	25(25)	46(23)	32(48)	
41-50	30(30)	30(15)	30(45)	.015*
51-60	45(45)	24(12)	38(57)	
SEX				
Male	32(32)	30 (15)	31.3(43)	.803
Female	68 (68)	70(35)	68.7(103)	
RELIGION				
Hindu	73 (73)	80(40)	75.3(113)	
Muslim	12 (12)	2 (1)	8.7(13)	.127
Christian	10 (10)	6 (3)	8.7(13)	
Zoroastrian	4 (4)	8(4)	5.3(8)	
Sikh	1(1)	4(2)	2(3)	
EATING-PATTERN				
Vegetarian	48(48)	52(26)	49.3(74)	.644
Non-Vegetarian	52(52)	48(24)	50.7(76)	
OCCUPATION				
Business	16(16)	14(7)	15.3(23)	
Service	25(25)	36(18)	28.7(43)	.115
Housewife	57(57)	42(21)	52(78)	
Student	2(2)	8(4)	4(6)	
INCOME				
High	1(1)	0	0.7(1)	.012*
Medium	73(73)	50(25)	65.3(98)	
Low	26(26)	50(25)	34(51)	
HEIGHT				
Below normal	62 (57)	38 (35)	100 (92)	.123
Normal	74.1(43)	25.9(15)	100 (58)	
WEIGHT				
Below normal	8 (8)	20(10)	12 (18)	
Normal	5(5)	6(3)	5.3 (8)	.031*
Above Normal	87 (87)	74(37)	82.7 (124)	
BMI				
<18	0	100(4)	100(4)	
18-22.9	63.9(23)	36.1(13)	100(36)	.023*
23-24.9	63.9(23)	36.1(13)	100(36)	
Above 25	73(54)	27(20)	100(74)	
WAIST CIRCUMFERENCE				
Below Normal				
Normal	31 (31)	50 (25)	37.3 (56)	
Above normal	3(3)	2 (1)	2.7 (4)	.027*
	66 (66)	48 (24)	60 (90)	
WAIST:HIP RATIO				
Below Normal	16 (16)	20 (10)	17.3 (26)	.542
Above normal	84 (84)	80 (40)	82.7 (124)	

Note: The figures in the parentheses is the number of the sample. * Indicates the significant P value < 0.05

52% of the diabetics were non-vegetarians and 48% of the non-diabetics were vegetarians. The prevalence of diabetes was the highest in housewives than in service going persons highlighting that sedentary lifestyle is the contributing risk factor to type II diabetes mellitus.

Diabetics belonged to higher middle and high income groups, so their lifestyle would be luxurious such as inclusion of more junk foods and rich calorie dense diet, lack of physical activity, etc.

Table 2. Biochemical and Clinical Parameters of the Study Groups

Parameters	Normal Range	Diabetic group (N=100)	Non-Diabetic group (N=50)	Total	P value
Fasting blood sugar	60-110mg/dl				
Normal					
Above normal		2(2)	100 (50)	100(50)	.000*
		98(98)	0	0	
Post prandial blood sugar	70-140 mg/dl				
Normal					
Above normal		7(7)	100(50)	38(57)	.000*
		93(93)	0	62(93)	
Vitamin D					
-Deficient	<10ng/dl	27 (27)	32 (16)	28.7 (43)	1.87
-Insufficient	10-30ng/dl	41 (41)	44 (22)	42 (63)	
-Sufficient	30-100ng/dl	32 (32)	24 (12)	29.3 (44)	
Glycated haemoglobin					
Normal	<6.5%				
Above Normal		6.2 (1)	100 (16)	53.1 (17)	
		93.8 (15)	0	46.9 (15)	.000*
Calcium	8.8-10.5 mg/dl				
Below Normal		29.6 (8)	38.1(8)	33.3 (16)	
Normal		70.4(19)	61.9 (13)	66.7(32)	.537
Blood pressure	120/80mmHg				
Normal		41 (41)	48 (24)	43.3(65)	.415
Above Normal		59 (59)	52 (26)	56.7 (85)	

Note: The figures in the parentheses is the number of the sample. * Indicates the significant P value < 0.05

Table 3. Awareness on Sun Exposure, Clothing and Use of Sunscreen in the Study Groups

	Diabetic group (N=100)	Non-Diabetic group (N=50)	Total	P Value
Importance of Sun Exposure				
- Yes				
- No	80 (80)	90 (45)	83.3 (125)	.121
	20 (20)	10.0 (5)	16.7 (25)	
Frequency of Sun Exposure				
- Everyday				
- 2-3 times/week	34 (34)	28 (14)	32 (48)	
- Never				.082
	62 (62)	58 (29)	60.7 (91)	
	4 (4)	14(7)	7.3 (11)	
Correct Time of Sun Exposure				
- 8-11 am				
- 10-3 pm	21 (21)	42 (21)	28 (42)	
- 2-4 pm	67 (67)	26 (13)	53.5(80)	.000*
- Any other	9(9)	20 (10)	12.7(19)	
	3(3)	12(6)	6(9)	
Duration of Sun Exposure				
- 5-10 mins				
- 10-15 mins	19 (19)	6(3)	14.7(22)	.000*
- >20 mins	72 (72)	70(35)	71.3(107)	
	9(9)	24(12)	14(21)	
Importance of clothing				
- Yes				
- No	30 (30)	26 (13)	28.7 (43)	
	70 (70)	74 (37)	71.3(107)	.610
Use of Sunscreen				
- Yes	27 (73)	34 (17)	29.3 (44)	.375
- No	73 (27)	66(33)	70.7 (106)	
SPF value of sunscreen				
- SPF 10				
- SPF 20	5(5)	10(5)	6.7(10)	
- SPF 40	4(4)	8(4)	5.3(8)	.511
- SPF 60	10(10)	6(3)	8.7(13)	
- NA	8(8)	10(5)	8.7(13)	
	73(73)	66(33)	70.7(106)	
Sunscreen in vitamin D synthesis				
- Yes				
- No				
	83 (83)	30 (15)	65.3(98)	.000*
	17 (17)	70(35)	34.7(52)	

Note: The figures in the parentheses is the number of the sample. * Indicates the significant P value < 0.05

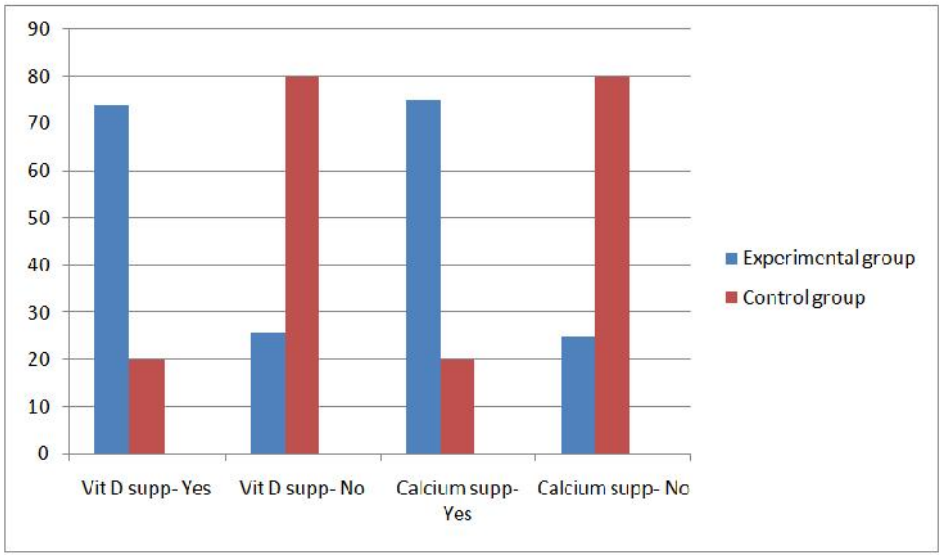

Figure 2. Vitamin D and Calcium Supplementation status in the Study Groups

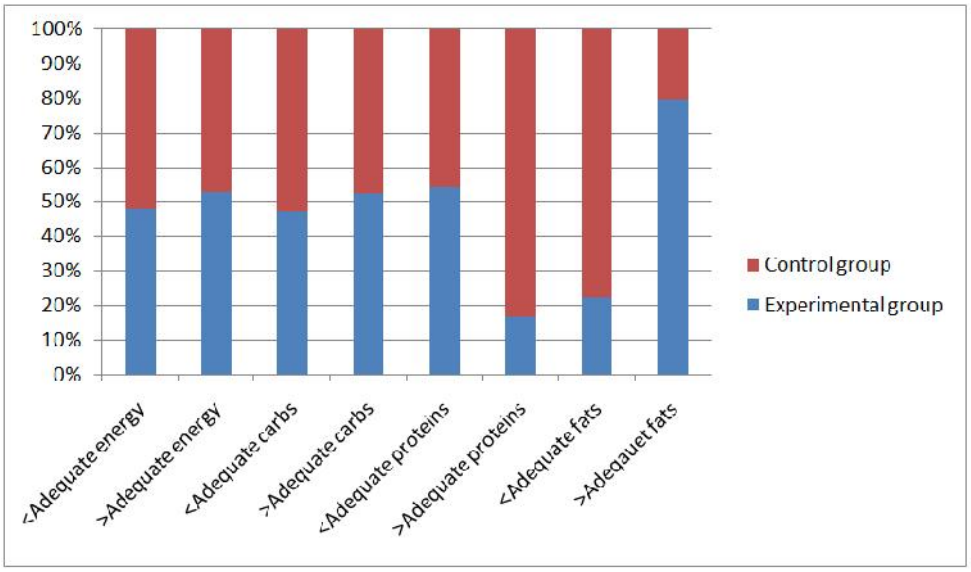

Figure 3. Nutrient Intake of the Study Groups

Data from the study showed that 87% of the diabetics were above normal weight, males were more than 60 kgs and females more than 55 kgs. 74% of the non-diabetics were overweight as well. Increased BMI in the experimental group indicated the presence of high body fat and obesity. A higher than normal waist circumference, that is 66% in the diabetic group than 48% in the non-diabetic group, supports the prevalence of obesity such as apple shaped obesity in males and pear shaped obesity in females, being important key factors in the incidence of type II diabetes mellitus. BMI and mortality were found to be well associated in diabetic patients (Tobias *et al*., 2014).

Table 2 93.8% diabetics showed glycated haemoglobin levels above 6.5%. Other biochemical parameters such as vitamin D and calcium were found to be higher in the diabetics than the non-diabetics. Table 3 the diabetics were more aware about the need of sun exposure, covering the body completely with clothes, use of sunscreen and its application in vitamin D synthesis and absorption as compared to the non-diabetics. The use of sunscreen was very less in diabetics than the non-diabetics, as they were counselled by the doctor.

The prevalence of hypertension was higher in the diabetic group. 59% of the diabetic subjects showed levels above 120/80mmHg. 52% of the no-diabetic subjects were hypertensive and 48% of them were normotensive. 27% of the diabetics were vitamin D sufficient, 41% insufficient and 32% normal. 32% non-diabetics were vitamin D deficient, 44% insufficient and 24% normal. There was a negative correlation in the vitamin D status and type II diabetes mellitus (p=0.187). Though not statistically significant, vitamin D deficiency and insufficiency was higher in non-diabetics than the diabetics. But, the diabetics were more vitamin D sufficient than the non-diabetics. Figure 2 this is because 74% diabetics were taking vitamin D supplementation and 73% of them were consuming regular calcium supplementation.

Figure 3 energy intake was more in the diabetic group. The diabetics consumed more than adequate carbohydrates as compared to the non-diabetics. Protein intake was less than adequate in both the study groups. 96% diabetics and 80% non-diabetics consumed proteins less than adequate, thus showing the lower consumption of high biological value proteins. Fat

consumption was more adequate in the diabetics. 77% of the diabetic subjects consumed more fats as compared to 20% of the non-diabetic subjects. This implies that the diabetics got more calories from carbohydrates and fats and lesscalories from proteins. This highlights the reason of most of the diabetics being overweight, obese, having more body weight and a higher BMI as compared to the non-diabetics.

Conclusion

There is a relation between vitamin D, sunlight exposure, diet and type II diabetes mellitus. The study shows that vitamin D deficiency is common in type II diabetic patients and has a role to play in glucose metabolism. Low levels of vitamin D status, sun exposure and low intake of proteins (quality and quantity) and increased intake of fats increases the prevalence of type II diabetes mellitus. Hence, as Asians are more prone to type II diabetes, apart from diet modification, vitamin D status and lifestyle behavioural changes are to be emphasized to improve the quality of life of diabetic patients.

REFERENCES

Braun, T., Been, L., Blackett, P. and Sanghera, D. 2013. Vitamin D deficiency and cardio- metabolic risk in a North Indian community with highly prevalent type II diabetes, *Journal of Diabetes and Metabolism, J. Diabetes Metab*, 3: 10.4172/2155-6156.1000213.

Davidson, M. 2013. High dose vitamin D supplementation in people with prediabetes and hypovitaminosis D, Diabetes Care, Volume 36, 260-266.

Hao Y., Ma X., Shen Y., Luo Y., Xiao Y., Bao Y. and Jia W. 2014. Associations of serum 25- hydroxyvitamin D_3 levels with visceral adipose tissue in Chinese men with normal glucose tolerance, Plos One, Volume 9. DOI: 10.1371/journal.pone.0086773.

Harinarayan, C.V. 2014.Improvement in Pancreatic B-cell function with vitamin D and calcium supplementation in vitamin D deficient non-diabetic subjects, Journal of Endocrine Practise, Volume 20, Issue 2, 129-138.

Holick, M. 2008. Sunlight, UV Radiation, Vitamin D and skin cancer: How much sunlight do we need, *Advances in Experimental Medicine and Biology*, Volume 624, pp 1-15.

Juutilainin, A., Juutilainen, A. 1., Kortelainen, S., Lehto S., Rönnemaa, T., Pyörälä, K. and Laakso, M. 2014. Gender differences in the impact of type II diabetes on coronary heart disease risk, Diabetes Care, Volume 27, Issue 12, 2898- 3904.

Kannan, S. and Lim, H. 2013. Photoprotection and Vitamin D: a review, Photodermatology, Photoimmunology and Photomedicine.

Kannan, S., Henry, W. 2013. Photoprotection and Vitamin D: a review, Journal:Photodermatology, Photoimmunology and Photomedicine. December 2013.

Kavaric, S., Kavarić, S. 1., Vuksanović, M., Bozović, D., Jovanović, M., Jeremić, V., Radojicić, Z., Pekić S. and Popović V. 2013. Body weight and waist circumference as predictors of vitamin D deficiency in patients with type II diabetes and cardiovascular disease, Vojnosanit Pregl Volume 70, Issue 2, 163-169.

Lim, S., Kim, M., Choi, S., Shin, C., Park, K., Jang, H., Billings, L. and Meigs, J. 2013. Association of Vitamin D deficiency with Incidence of type II diabetes mellitus in high risk Asian subjects, *Diabetes Research Centre, Am. J. Clin Nutr*., Mar 2013; 97(3): 524–530.

Lindström, J., Peltonen M., Eriksson, J., Ilanne-Parikka, J., Aunola, S., Keinänen- Kiukaanniemi, S., Uusitupa M. and Tuomilehto, J. 2013. Improved lifestyle and decreased diabetes risk over 13 years: long-term follow-up of the randomised Finnish Diabetes Prevention Study (DPS) Diabetologia, Volume 56, Issue 2, 284-293.

Mahan, K. K. and Escott-Stump, S. 2011. Krause's Food, Nutrition and Diet Therapy, WB Saunders Company, Philadelphia.

Nimitphong, H., Holick, M.F. 2013. Vitamin D status and sun exposure in south east Asia. Dermatoendocrinol, 5(1):34-7.

Seshadria, K., Tamilselvana, B. and Rajendran, 2011. A Role of Vitamin D in Diabetes, *Journal of Endocrinological Metabolism*, Volume 1, Issue 2, 47-56.

Tessier, M., Kesavadev, J. D., Short, K. R. and Nair, S. K. 2001. Diabetes in old age: An emerging epidemic, *Journal of Gerontol and Biology Science Medical Science*, 5-13.

Tiwari, S., Tiwari, S. 1., Pratyush, D. D., Gupta, B., Dwivedi, A., Chaudhary, S., Rayicherla, R. K., Gupta, S. K. and Singh, S. K. 2012. Prevalence and severity of vitamin D deficiency in patients with diabetic foot infections, British *Journal of Nutrition*, Volume 109, 99-102.

Tobias, D. K., Jackson, C. L. and Reilly, E.J. 2014. Body mass index and mortality in type II diabetic patients, Nutrition English Journal of Medicine, Volume 138, Issue 370, 233-244.

Trur, A., Tsur, A1, Feldman, B. S., Feldhammer, I., Hoshen, M. B., Leibowitz, G. and Balicer, R. D. 2013. Decreased serum concentrations of 25-hydroxycholecalciferol is associated with increased risk of progression to impaired fasting glucose and diabetes, Diabetes Care, Volume 36, 1361-67.

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

****