

# Diabetes Mellitus and Food Balance in the Kingdom of Saudi Arabia

Aljabryn Dalal Hamad

**Abstract**—The present explanatory study concerns with the relation between Diabetes Mellitus and Food Balance in the Kingdom of Saudi Arabia during 2005-2010, using published data.

Results illustrated that Saudi citizen daily protein consumption (DPC) during 2005-2007 (g/capita/day) is higher than the average global consumption level of protein with 15.27%, daily fat consumption (DFC) with 24.56% and daily energy consumption (DEC) with 16.93% and increases than recommended level by International Nutrition Organizations (INO) with 56% for protein, 60.49% for fat and 27.37% for energy. On the other hand, DPC per capita in Saudi Arabia decreased during the period 2008-2010 from 88.3 to 82.36 gram/ day. Moreover, DFC per capita in Saudi Arabia decreased during the period 2008-2010 from 3247.90 to 3176.43 Cal/capita/ day, and daily energy consumption (DEC) of Saudi citizen increases than world consumption with 16.93%, whereas increases with 27.37% than INO. Despite this, DPC, DFC and DEC per capita in Saudi Arabia still higher than world mean. On the other side, results illustrated that the number of diabetic patients in Saudi Arabia during the same period (2005-2010). The curve of diabetic patient's number in Saudi Arabia during 2005-2010 is regular ascending with increasing level ranged between 7.10% in 2005 and 12.44% in 2010.

It is essential to devise Saudi National programs to educate the public about the relation of food balances and diabetes so it could be avoided, and provide citizens with healthy dietary balances tables.

**Keywords**—Diabetes Mellitus, Food Balance, Energy, Fat, Protein, Saudi Arabia.

## I. INTRODUCTION

**D**IABETES mellitus is one of the most common chronic diseases in nearly all countries, and continues to increase in numbers and significance, as changing lifestyles lead to reduced physical activity, and increased obesity. According to the International Diabetes Federation (IDF) [1], diabetes is reaching epidemic proportions worldwide, affecting more than 230 million people around the globe; and by the year 2025 diabetes is expected to affect 350 million people.

Diabetes mellitus is defined as "a clinical syndrome characterized by hyperglycemia in the fasting state, due to absolute or relative deficiency of insulin or defect in its receptors or other abnormalities" [2]-[4].

During the 1980's, few reports pointed to the occurrence of diabetes mellitus in Saudi populations, and showed a higher prevalence in urban compared to rural populations [5]. In addition, both genetic and environmental factors play an essential role in Diabetes Mellitus development. There are

different types of diabetes mellitus, most frequently occurs as a result of metabolic disorders and malnutrition related conditions.

Saudi Arabia has one of the highest percentages of Diabetes in the world, with an estimated number of 2,065,300 people diagnosed with the disease by 2010, which represents 16.8% of the population [6]. The high and increasing rates of diabetes in Saudi Arabia could be attributed to many factors, but most studies show that malnutrition, obesity and lack of exercise are the prominent factors.

Diabetes has long been linked to obesity and being overweight [7], [8]. Dietary budgets of nutrients have been recommended by national and international bodies, based on the available scientific data on human requirements [9]-[12]. Dietary standards may serve as guidelines for planning and procuring food supplies for population and interpreting *per capita* food consumption..

Obesity is a natural consequence of over nutrition and sedentary lifestyle. Persistent obesity dysregulates metabolic processes including action of insulin on glucose-lipid-free fatty acid metabolism and severely affects processes controlling blood glucose, blood pressure, and lipids. Thus begins a cluster of conditions; dysglycemia, dyslipidemia, hypertension, and procoagulant state, known as the metabolic syndrome. Data suggest that the obesity and the metabolic syndrome are immediate precursors of type 2 diabetes mellitus (T2DM) and cardiovascular disease [13]-[16].

The present study was carried out to investigate the relation between Diabetes mellitus and Food consumption in the Kingdom of Saudi Arabia.

## II. MATERIAL AND METHODS

This study was conducted to investigate the relationship between food balance and diabetes mellitus, using published data on food balances of the Kingdom of Saudi Arabia during 2005-2007, published by the Ministry of Agriculture in 2012 and Medical Technical papers and Scientific Reports published on Diabetes Mellitus in Saudi Arabia in an explanatory study.

## III. RESULTS

Table I and Fig. 1 clearly show that daily protein consumption (DPC) for Saudi citizen (g/capita/day) is more than the average global consumption level of protein with 15.27%, whereas it increases than recommended level by International Nutrition Organizations (INO) with 56%. On the other hand, DPC per capita in Saudi Arabia decreased during the period 2005-2007 up to 2008-2010 from 88.3 to 82.36

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gram/ day (6.73% reduction average) and despite this, DPC per capita in Saudi Arabia still higher than world mean (76.6 g/capita/day). In addition, and as shown in Table I and Fig. 1, Saudi citizen daily fat consumption (DFC) increased with 24.56% than world consumption level and with 60.49% than INO. On the other hand, DFC per capita in Saudi Arabia decreased during the period 2008-2010 from 97.90 to 91.89 gram/ day (6.01% reduction average) and despite this, DFC per capita in Saudi Arabia still higher than world mean (78.6 g/capita/day). Furthermore, and as shown in Table I and Fig. 1, daily energy consumption (DEC) of Saudi citizen increases than world consumption with 16.93%, whereas increases with 27.37% than INO. On the other hand, DFC per capita in Saudi Arabia decreased during the period 2008-2010 from 3247.90 to 3176.43 Cal/capita/ day (71.47 Calorie reduction average) and despite this, DFC per capita in Saudi Arabia still higher than world mean (2777.7 Calorie/capita/day). On the other side, Table II and Fig. 2 illustrated the number of diabetic patients in Saudi Arabia during the same period (2005-2010). It is revealed that the curve of diabetic patient's number in Saudi Arabia during 2005-2010 is regular ascending with increasing level ranged between 7.10% in 2005 and 12.44% in 2010.

The daily consumption percentages of Saudi citizen of protein, fat and energy increasing rates from the world and INO are +15.27%, +24.56%, +16.93% and +56.00%, +60.49%, +27.37%, respectively.

TABLE I  
COMPARISON OF NUTRITIONAL LEVEL FOR SAUDI CITIZEN AND INTERNATIONAL NUTRITIONAL LEVEL BETWEEN 2005-2010 [37]

Item	Protein (g/day)	Fat (g/day)	Energy (Cal/day)
Saudi citizen (2005-2007)	88.3	97.9	3247.90
Saudi citizen (2008-2010)	82.36	91.89	3176.43
World	76.6	78.6	2777.7
International Nutrition organizations (INO)	56.6	61.0	2550.0
Percentage change from the world	+15.27%	+24.56%	+16.93%
Percentage change from INO	+56.00%	+60.49%	+27.37%

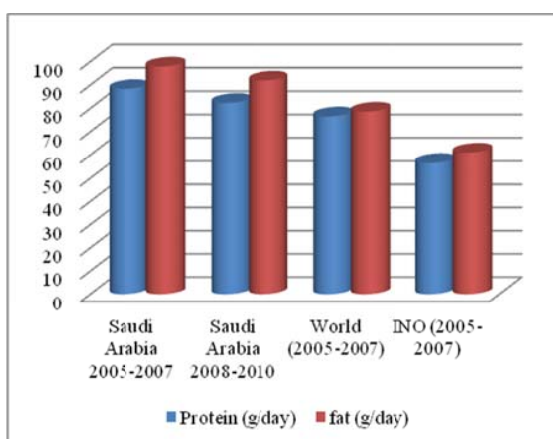


Fig. 1 Protein and Fat Consumption (g/capita/day)

TABLE II  
NUMBER OF DIABETIC PATIENTS IN SAUDI ARABIA DURING 2005-2010 [38]

Year	Number of patients	Total population (Mean)	Patient percentage*
2005	1713618	24130720	7.10%
2006	1953524		8.10%
2007	2227017		9.20%
Mean	1964720	26528286	8.14%
2008	2538799		9.60%
2009	2894231		10.91%
2010	3299423		12.44%
Mean	2910818		10.98%

\* of total population

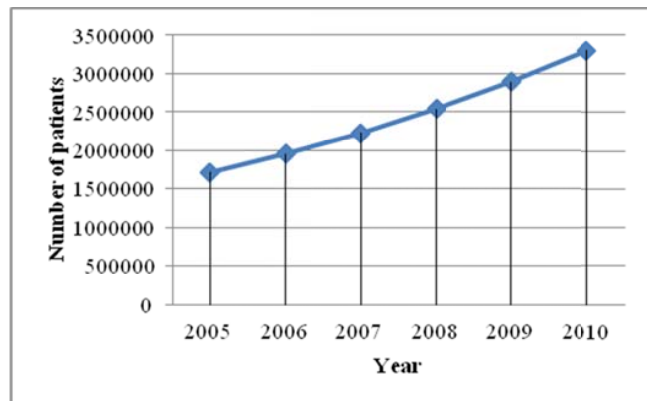


Fig. 2 Ascendant Curve of Diabetic Patients in Saudi Arabia during 2005-2010

#### IV. DISCUSSION

It is well known that there are some factors affect the readiness to Diabetes Mellitus such as lifestyle, diet, physical activity and obesity.

In recent times in Saudi Arabia, food size of portions and choice have increased dramatically, which, plus the sedentary lifestyle, comes the increased risk in obesity. Unfortunately, many Saudis are becoming more obese because of the convenience of fast foods, and this adds to the scary diabetes statistics [17]. On the other hand, Saudis drink too many high-sugar drinks where the climate is arid and very hot in most of the country and there is no doubt that hydration is critical. In addition, National Center for Health Statistics [18] reported that it seems that socioeconomic status plays a role in development of non-insulin-dependent diabetes mellitus (NIDDM); where it was known as a "Disease of the rich". On the contrary, the same reference reported that NIDDM was more prevalent in lower income level and those with less education and these differences may be due to the type of food consumed and by the differences in physical activity in this group.

Nutrition Scientists advised that nutrition is very important in managing diabetes, not only type, but also quantity of food which influences blood sugar. Meals should be at regular times, low fat, and high fiber with a limited amount of simple carbohydrates.

In the present study (Table I), it was observed that daily consumption per capita for Saudi citizen of protein; fat and energy during 2005-2007 were higher than these recommended by INO or consumed by the world's population, and the despite this, DPC, DFC and DEC per capita in Saudi Arabia still higher than world mean.

In the present study, it was observed that daily consumed energy in Saudi Arabia ranged between 3247.90 and 3176.43 calories. On the other hand, [19] recommends that 45 to 65% of calories come from carbohydrates and the daily diet calories about 2000 calorie. Moreover, [20] stated that a typical, healthy adult needs between 1,800 and 2,200 calories each day. Furthermore, [21] explained that certain wheat and milk proteins are shown to have the strongest diabetogenic effect and are believed to be capable of triggering mechanisms that lead to destruction of the pancreatic islet insulin secreting cells.

In agreement with the present study, as in [22] who concluded that a low carbohydrate, high fat diet might increase the risk of diabetes. Furthermore, [23] suggests that excessive intake of processed carbohydrates particularly sucrose has a strong positive correlation to the development of NIDDM. However, [24] stated that no association has been demonstrated on different populations. Moreover, [25] showed a close link between diabetes and decreased crude fiber intake. However, [26] concluded that such association could not be demonstrated in Mubal island population who consume large amount of fibers had quite high prevalence of diabetes, whereas Eskimos who consume low fiber diet had very low frequency of diabetes [27]. In addition, the author reported that during the World War I and II it was observed that due to the food shortage in some countries, diabetes mortality rates decreased significantly, whereas in those countries where there was no food shortage, there was no decrease in the diabetes mortality rates.

Obesity has been known to play an important role in the development of diabetes from the early 1920's. Several studies have confirmed that there is a strong positive association between the duration of obesity and an impaired glucose tolerance test [28] and diabetes [29]-[33], [27]. However, as in [34], the frequency of non-insulin dependent diabetes mellitus (NIDDM) was significantly more in obese individuals compared to non-obese individuals. In addition, [35], in the studies on Saudis, shows that most of the patients with NIDDM are obese.

Taylor et al. [36] stated that physical activity plays an important role in NIDDM development, where physical inactivity is associated with abnormal glucose tolerance, higher insulin levels and hence NIDDM.

#### V. CONCLUSION

This explanatory study on the relation between Diabetes mellitus and Food balances in the Kingdom of Saudi Arabia revealed that there is malnutrition due to dietary habits of Saudi citizen could be one of the various factors involved in Diabetes mellitus development.

Healthy diet and active lifestyle may significantly decrease the risk of T2DM in spite of having a family history of diabetes. Effective health education programs promoting healthy diet and regular exercise are needed to reduce the burden of diabetes in Saudi Arabia.

#### VI. RECOMMENDATIONS

It is essential to devise nationwide programs to educate the public about diabetes, its causes and complications and about the ways and means by which the development of diabetes may be avoided. In addition, the need and the importance of the control of hyperglycemic state must be stressed. Thus, preventive aspects of diabetes mellitus require implementation in all regions of Saudi Arabia, and may play an important role in decreasing the prevalence of diabetes in this population.

#### REFERENCES

- [1] IDF—International Diabetes Federation. Facts and Figures: <http://www.idf.org/home/index.cfm?node=37>.
- [2] Marble, A.; White, P.; Bradley, R.F. and Krall, L.P.(eds). (1973). *Joslin's Diabetes mellitus*, Philadelphia: Lea and Fabiger, 1-5.
- [3] Irvine, W. J. (1977). Classification of idiopathic diabetes. *Lancet*, i: 638-642.
- [4] National Diabetes Data Group (1979). Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. *Diabetes*, 28: 1039-1057.
- [5] El-Hazmi, M.; Warsy, A.; Al-Swailem, A.; Al-Swailem, A. and Sulaimani, R. (1998). Diabetes mellitus as a health problem in Saudi Arabia. *East Mediterr. Health J.*, 4: 58-67.
- [6] Diabetes Atlas (2012). Global and Regional Diabetes Statistics.
- [7] Bonadonna, R.C., Groop, L. and Kraemer, N. (1990). Obesity and insulin resistance in humans: a dose-response study. *Metabolism*, 39:452-459.
- [8] Rexrode, K. M., Manson, J. E. and Hennekens, C. H. (1996). Obesity and cardiovascular disease. *Curr. Opin. Cardiol.* 11:490-495.
- [9] FAO/WHO/UN (1985). Energy and protein requirements. Report FAO/WHO/UN Expert Consultation. Geneva, World Health Organization, Technical report Series, No. 724.
- [10] Beaton, G. H. (1991). Human nutrient requirement estimates. *Food nutrition and Agriculture*, Vol.1: 3-15.
- [11] Khan, M. A. (1991). Recommended dietary allowances for Pakistan, Islamabad. Pakistan National Agricultural Research Center.
- [12] Scrimshaw, N.S. (1996). Human protein requirements: a brief update, *Food and nutrition bulletin*, 17 (3): 185-190.
- [13] NCEP (2002). Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III): final report. *Circulation* 106:3143-3421.
- [14] Mensah, G. A.; Mokdad, A. H.; Ford, E.; Narayan, K. M.; Giles, W. H.; Vinicor, F. and Deedwania, P. C. (2004). Obesity, metabolic syndrome, and type 2 diabetes: emerging epidemics and their cardiovascular implications. *Cardiol Clin* 22:485-504.
- [15] Chan, J. M.; Rimm, E. B.; Colditz, G. A.; Stampfer, M. J. and Willett, W. C. (1994). Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. *Diabetes Care* 17:961-969.
- [16] Rexrode, K. M.; Carey, V. J.; Hennekens, C. H.; Walters, E. E.; Colditz, G. A.; Stampfer, M. J.; Willett, W. C. and Manson, J. E. (1998). Abdominal adiposity and coronary heart disease in women. *JAMA* 280:1843-1848.
- [17] Badran, M. and Laher, I. (2011). "Obesity in 31arrh-speaking countries," *Journal of Obesity*, vol. 2011, Article ID 686430, 9 pages.
- [18] National Center for Health Statistics (1987). Druny, T.F. and Powell, A.L.: Prevalence of known diabetics among Black Americans. Advance data from vital and health statistics. Hyattsville MD, Public Health Service. DHHS Publication No. 130 (PHS) 87-1250.
- [19] McKinley Health Center (2008). Macronutrients: The Importance of Carbohydrate, Protein, and Fat.
- [20] Ulmer, G. (2010). Diet and Nutrition. Recommended daily Nutritional intake for health. Livestrong.

- [21] Spenser, K. and Cudworth, A. (1983). The aetiology of insulin dependent diabetes mellitus. In: Mann JI, Pyorala K, Teuscher A (Eds). Diabetes in Epidemiological Perspective. Churchill Livingstone, London.
- [22] Hinsworth, H. P. (1935). Dietetic factor determining glucose tolerance and sensitivity to insulin of healthymen. ClinSci, 2: 67-94.
- [23] Yudkin, J. (1964). Dietary fat and dietary sugar in relation to ischaemic heart disease and diabetes. Lancet, 2: 4-5.
- [24] Tsai, S. H. (1971). Sugar consumption in Taiwan. In: Tsuji S, Wadar M. Diabetes Mellitus in Asia. Amsterdam, Excerpta Med: pp 104.
- [25] Trowell, H. P. (1974). Diabetes mellitus death – rates in England and Wales 1920-70 and food supplies. Lancet, 2: 998-1004.
- [26] Winterbotham, H. J. (1961). Diabetes mellitus at Mabuag Island, Torres Straits, 1960. Med J Aust., 1: 780-781.
- [27] West, K. M. (1978). Epidemiology of diabetes and its vascular lesion. New York, Elsevier, pp: 19.
- [28] Short, J. J. and Johnson, H. J. (1939). Glucose tolerance in relation to weight and age: Study of 541 cases. Proc Assoc Life Ins Med Dire, 25: 237-257.
- [29] Vinke, B.; Nagelsmit, W. F. and Buchan-Van F. S. (1959). Some statistical investigations in diabetes mellitus. Diabetes, 8: 100-104.
- [30] Slome, C.; Gampel, B.; Abramson, J. H. and Scotch, N. (1960). Weight, height and skinfold thickness of Zulu adults in Durban. S. Afr Med J, 34: 505-509.
- [31] Jackson, W. P. (1978). Epidemiology of diabetes in South Africa. Advance Metabol. Discord, 9: 111-146.
- [32] Mann, J. I.; Pyorala, K. and Teuscher, A. (1983). Diabetes in epidemiological perspective. Churchill Livingstone, London.
- [33] Ohlson, L. O.; Larsson, B. and S'Vardsudd, K. (1985). The influence of body fat distribution on the incidence of diabetes mellitus. 13:5 years of follow-up of the participants in the study of members in 1913. Diabetes, 34: 1055-1058.
- [34] Joslin, E. P. (1972). The prevention of diabetes mellitus. J Amer Med Assoc, 76: 79-84.
- [35] Kingston, M. and Skoog, W. C. (1986). Diabetes in Saudi Arabia. Saudi Med J, 7(2): 130-142.
- [36] Taylor, R.; Ram, P. and Zimmet, P. (1984). Physical activity and prevalence of diabetes in Melanesian and Indians males in Fiji. Diabetologia, 27: 578-582.
- [37] Ministry of Agriculture (2012). Food Balance Sheets for the period (2005-2007) to (2008-2010). Agricultural Research and Development Affairs, Dept. of Studies Planning and Statistics, 7<sup>th</sup> Issue: pp 78.
- [38] Al Hameed, M. S. (2007). Diabetes Mellitus, Causes, complications and treatment. King Saud University, Faculty of Medicine. Kingdom of Saudi Arabia, Riyadh.