

Original Research Article

**GLYCAEMIC CONTROL IN PATIENTS WITH TYPE 2 DIABETES MELLITUS
IN A SECONDARY AND TERTIARY HEALTH CENTER IN BENIN CITY,
SOUTH-SOUTH NIGERIA.**

ABSTRACT: Diabetes is the commonest endocrine metabolic disorder in Nigeria

Aim: The aim was to assess the level of glycaemic control in diabetics in Benin metropolis, with a view of planning improved diabetes care.

Study and Design: This is a cross sectional prospective study.

Place and Duration of the study:

The study was carried out in the department of medicine Central Hospital Benin (Secondary Health center), department of Medicine University of Benin teaching Hospital(Tertiary Health center) and department of chemical pathology, University of Benin teaching hospital Benin City Nigeria between October 2012 and June 2013.

Methodology :Fasting Blood sample of 126 type II diabetics (38.1% males and 61.9% females from the secondary health centre and 781 type II diabetics (47.1% male and 58.3% females) from the tertiary health centre was assayed for plasma glucose and Glycated haemoglobin .Body mass index was calculated from measured height and weight and blood pressure measurements taken with mercury sphygmomanometer.

Results :- Mean fasting plasma glucose and mean glycated haemoglobin was 7.9 ± 0.4 mmol/l, 8.3 ± 2.1 % and 8.1 ± 0.3 mmol/l , 8.3 ± 2.6 % for patients in the secondary and tertiary health centres respectively. 20.6% of the patients in the secondary health centre and 40.5% of those in the tertiary health centre had glycated haemoglobin values < 7% as recommended by the American Diabetes Association

(ADA). 25.3% and 20.6% of the patients in the secondary and tertiary health centres respectively , met the blood pressure target recommended by ADA.

Conclusion:

Most diabetics in south-south Nigeria still have suboptimal glycaemic control, are hypertensive and have chronic complications of the disease. Improved Health care delivery, and subsidization of health care is recommended.

Key words;- Diabetes mellitus, glycemic control,American Diabetes Association (ADA) guidelines.

Introduction

Diabetes mellitus is a chronic disease with an increasing prevalence worldwide. It has significant health and socioeconomic burden on both patients and the health care systems. The WHO estimated a projection of 221 million people with diabetes in 2010 and 300 million in 2025¹. The prevalence in Nigeria varies from the 0.65% in rural mangu village, to 11.0% in urban Lagos.² The WHO suggested that Nigeria has the greatest number of people living with diabetes in Africa, with an estimated burden of about 1.7 million which will increase to 4.8 million by 2030³.

Good glycaemic control and control of other cardiovascular risks in diabetic patients lead to reduced morbidity and mortality³. With the incidence of diabetes in the African population on the rise, the incidence of late diabetic complications is also expected to increase correspondingly,^{4,5} and this will pose a major healthcare and economic problem³.

Several studies such as the diabetes complications and control (DCCT); the United Kingdom Prospective Diabetes Study (UKPDS) and their follow up studies, found that the adequate management of diabetes, improves the outcome in terms of morbidity, mortality, and quality of life.^{6,7,8} Therefore following recommended international and national guidelines in managing diabetic patients is of utmost importance. These guidelines include glycaemic targets, systolic and diastolic blood pressure targets, body mass index (BMI) and other antropometric indices, lipid levels, self management and behavioural targets³. Various countries have studied the status of diabetes control in their population.^{9,10,11} The reports have varied in different population groups. The diabcare study group in Nigeria carried out a study in 2008 to assess the status of diabetes care in Nigeria.

This study aims to assess the level of glycaemic control in a secondary and tertiary health centre in Benin City, South-south Nigeria.

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66 **Materials and methods**

67 This was a cross sectional study carried out in two health care centers, a secondary
68 hospital and a tertiary hospital. The secondary hospital which is Central Hospital Benin,
69 provides comprehensive health care services and specialized services. The tertiary
70 hospital which is University of Benin Teaching Hospital, is a regional medical institution
71 that provides comprehensive and specialized services and serves as the highest level
72 of referrals from both primary and secondary health centers and other states in the
73 south-south geopolitical zone in Nigeria. The study was carried out between October
74 2012 and June 2013. Consent for the study was obtained from the ethical committee of
75 the hospitals and informed consent from the patients. 126 type 2 diabetic patients were
76 recruited from the secondary health care center, they were recruited consecutively as
77 they came to attend the out-patient diabetic clinic. 781 type 2 diabetic patients were
78 recruited from the tertiary health care center. They were selected consecutively as they
79 came to the phlebotomy room for fasting plasma glucose and glycated haemoglobin
80 assays, before attending the diabetic out-patient clinic. They have been diabetic for a
81 mean duration of.....

82 Structured questionnaire was used to obtain vital information including duration of
83 disease, type of medications they are on, history suggestive of complications. General
84 physical examination was carried out on the patients including height, which was
85 measured with a stadiometer to the nearest 0.1cm. Weight was measured with a
86 weighing scale with light clothes on, to the nearest 0.1kg. Blood pressure was
87 measured using a sphygmomanometer.

88 **Sample collection**

89 5ml of fasting venous blood was collected, and 2.5ml each dispensed into fluoride
90 oxalate bottle, and ethylene diamine tetracetate (EDTA) bottle. The sample in both
91 bottles were inverted 8 to 10 times to ensure proper mixture of blood and anticoagulant.
92 Sample in the EDTA bottle was immediately refrigerated at 4⁰C, while that in the fluoride
93 oxalate bottle was centrifuged at 3,000rpm for 5 minutes, and plasma separated into
94 clean plain tubes and stored in an ultrafridzer at -80⁰C within 30minutes of collection,
95 until time of analysis. Urine was collected in universal bottle with preservative.

96 **Methodology**

97 Plasma glucose was assayed by the glucose oxidase method. Glycated haemoglobin
98 was assayed by the Boronate Affinity method using the HbA₁C kit
99 (In 2it Tm system from Bio-rad). Urinalysis was done using combi-9 dipsticks.

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102 **Statistical Analysis**

103 This was done using SPSS version 13. Means of values are reported as mean±
104 standard deviation.

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RESULT

Out of the 126 patients involved in the study in the secondary health centre, 38.1% were males and 61.9% females, while 41.7% out of the 781 patients in the tertiary health centre were males and 58.3% females (Table1).

Mean age of patients in the secondary health centre was 58.3 ± 1.2 years and 56.1 ± 1.4 years in the tertiary health centre (Table 1).

Mean fasting plasma glucose and glycated haemoglobin values for patients in the secondary health centre was 7.9 ± 0.4 mmol/L and $8.3 \pm 2.1\%$ respectively, while that for the patients in the tertiary hospital was 8.1 ± 0.3 mmol/L and 8.3 ± 2.6 respectively Table 1).

Figure1 shows the percentage of patients with glycated haemoglobin values $<7\%$ and $>7\%$ in both secondary and tertiary health care centers

Mean BMI was 27.6 ± 6.5 kg/m² in patients in the secondary health care center and 27.5 ± 4.3 kg/m² in those in the tertiary health care centre. Mean systolic and diastolic blood pressure was 144 ± 24 mmHg and 84 ± 10 mmHg respectively, in patients in the secondary health center, and 143 ± 26 mmHg and 89 ± 14 mmHg respectively for the patients in tertiary health centre. (Table 1)

While 20.6% of the patients in the secondary health centre had glycated haemoglobin values $<7\%$, 79.4% of them had values $>7\%$. 40.5% of those in the tertiary health centre had glycated haemoglobin values $<7\%$ and 59.5% had values $>7\%$. Blood pressure of 25.3% of the patients in the secondary health centre was $<130/80$ mmHg, while for 74.7% of the patients it was $\geq 130/80$ mmHg. In the tertiary health centre, 20.6% of the patients had blood pressure $<130/80$ mmHg and 79.4% $\geq 130/80$ mmHg (Table 2).

While 68.7% of the patients in the secondary health center were hypertensive, 35.8% of those in tertiary health center were hypertensive.(Table 3) Also 74.4% of the patients in the secondary health centre had proteinuria, 23.3% glucosuria, while in tertiary center 40% of the patients in the had proteinuria and 20% glucosuria.(Table 3)

Discussion

Achieving good glycaemic control, which in turn limits the development of complications, is the goal in management of diabetic patients all over the world. The American Diabetes Association (ADA), American Association of Clinical Endocrinologists (AACE), International Diabetes Federation have all given guidelines of target values for good glycaemic control.¹²

In the present study some of the guidelines given by American Diabetes Association (ADA) were used to assess glycaemic control of diabetic patients in this environment.

In both healthcare institutions where the study was carried out, the female patients were of a higher percentage than the males. A similar observation was made in the multicenter diabcare study in Nigeria³. The reason for this could be multifactorial, ranging from life style, dietary habits, to health care financing, which in Nigeria is still largely “pay as you go”. Women are more likely to be supported by relations and loved ones to visit the hospital compared with their male counterparts. Men may also be more preoccupied with “making ends meet” to provide for the family, and not create time to come to the hospital.

Mean age of patients in this study was similar to that reported by Chinenye et al³ in the multicenter diabcare study in Nigeria, but lower than reported in other developed countries like United Kingdom¹³, Spain¹¹ United State America¹⁴.

Mean fasting plasma glucose of patients in both institutions studied was higher than that recommended by the American diabetes Association,¹² and similar to that reported by Chinenye et al³ in their study amongst diabetics in Nigeria. While 69.9% of the patients met the fasting plasma glucose target by ADA in the secondary health center, only 46.2% met the fasting plasma glucose target in the tertiary hospital. Chinenye et al³ in their own study also reported 52.6% achieving fasting plasma glucose ADA guidelines. The values are comparable, and also similar reported by Adebisi et al¹⁵ in Nigeria.

Mean BMI was in the overweight category in the patients studied, with 53.5% and 76% of the patients in the secondary and tertiary health centers respectively having BMI >25kg/m². A similar observation was made by Eid M and associates⁹ in their study amongst diabetics in Malaysia, where 66% of the patients had BMI>25kg/m². This still corroborates the association between obesity and diabetes mellitus type II.

Mean glycated haemoglobin in the patients in both healthcare centers were higher than the recommended values by ADA. The patients in the tertiary health center had slightly higher values than those attending the secondary healthcare center, though the difference was non-significant. This was the same observation reported by Chinenye et al³ in Nigeria. Mean glycated haemoglobin values reported in their own study was also higher than that set as target by ADA. Adebisi et al¹⁵ in Ilorin, Nigeria and Idogun ES¹⁶ in Benin Nigeria, also made the same observation in their studies. This is an indication that achieving good glycaemic control still appears to be a challenge in Nigeria. While 79.4% of the patients in the secondary health center had glycated haemoglobin values >7%, 59.5% in the tertiary health center had values >7%. The percentage of those with poor glycaemic control is high in both centers. The multicenter diabcare study by Chinenye et al³ in Nigeria also reported a high percentage of the patients with glycated haemoglobin values >7%. This has been the bane of diabetes care in the country, poor glycaemic control is still prevalent in the nation. So many factors may be responsible for this; ranging from education, to life style and other factors such as economic, drug compliance, availability of genuine drugs. Education still has a role to play in the control and management of diabetes mellitus. It has been reported from various studies^{17,18} that patients with adequate knowledge about the disease, had good control of the disease and lower frequency of complications. Although education alone is not a cure for the disease, the type 2 diabetes patients is not able to achieve metabolic regulation, if he/she does not know the basic principles of nutrition, physical action, care of the lower extremities, as well as specific skills related to the administration of subcutaneous injection of insulin, control of blood sugar levels and other necessary parameters¹⁸. This may also be one of the reasons for the higher percentage of patients with glycated haemoglobin values, >7% in the secondary health center in this study, compared with those in the tertiary health center. The secondary health center serves as a referral center for the primary health centers in the rural communities and local government areas of the state, and therefore is largely patronized by more of illiterate and semi-literate people than literate people. This is unlike the tertiary health center, which caters for both the state and other states in the south-south geopolitical zones of Nigeria. It is largely patronized more by literate people than semi-literate and illiterate people.

Lifestyle and economic factors also seem to play diverse-roles in the management and control of diabetes in this environment. While lifestyle and dietary habits may lead to poor glycaemic control especially in the affluent patients, lack of funds to purchase drugs, or pay hospital bills, or pay for investigations will also affect the low income group of patients.

Therefore while the affluent patients may have poor glycaemic control because of social lifestyle and dietary habits, the low income group of patients may have poor

glycaemic control because of lack of funds to procure drugs and use them consistently, irregular hospital visits for check up and monitoring, lack of adequate knowledge in self care and self-monitoring. This may be some of the reasons for the higher percentage of patients with glycated haemoglobin values >7% in the secondary health center compared with the tertiary health center.

Achieving good glycaemic control is however not a challenge peculiar to this environment alone, as reports from other countries also show that it is still a challenge being tackled. Eid M and associates⁹ in Malaysia reported 73% of the patients studied with glycated haemoglobin values >7%, while Fox KM¹³ in the United Kingdom reported 76% of the patients studied with glycated haemoglobin values is >7%. Macifaac RJ et al¹⁰ in Australia reported 53.3% of patients with values >7%, while in China¹⁹ 43.9% were reported to have glycated haemoglobin values of >7%. However it is interesting to note that Saadine JB and associates¹⁴ in the United State reported that only 20% of diabetic patients in their own study had poor glycaemic control. The following deductions can therefore be made;

These are:

- a) It is possible to achieve good glycaemic control than what obtains right now in various parts of the world including Nigeria, since it could be achieved in the United State. Various factors already mentioned before including environmental factors could all be contributory to the varying observations in different parts of the world.
- b) A closer look at the patient management and care in the United State vis avis. Health care programmes and policies is necessary as these may have helped them to achieve good glycaemic control in a large percentage of their patients. This is with the aim to see how we can improve on our own patients management and care.

Comorbidities were also prevalent in the patients studied in both health centers. While 74.4% of the patients in the secondary health center had proteinuria, 23.3% glucosuria, 40% of the patients in the tertiary health center had proteinuria, 20% glucosuria. While 68.7% were hypertensive in the secondary health center, 35.8% were hypertensive in the tertiary health center.

The prevalence of complications seems to be higher in patients in the secondary health center compared with those in the tertiary health center. This could have been due to the fact that those attending the tertiary health center are better educated, can afford regular monitoring, blood glucose and glycated haemoglobin assays, hospital visitations, and can afford to buy their drugs amongst other factors.

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269 In summary the achievements so far in the management and control of diabetes
270 mellitus in this environment still lives a lot to be desired. Poor glycaemic control is still
271 prevalent. The percentage of patients with complications is still high, as a result of poor
272 glycaemic control. The following recommendations may be helpful.

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- 274 1) Emphasis on preventive medicine: Educating the public on appropriate diet,
275 social habits, lifestyle, should be done regularly. In achieving this, the various
276 means of media enlightenment viz television, radio, internet, seminars, public
277 lectures can all be used. Special days like world diabetes days can be used for
278 nationwide screening for diabetes mellitus.
 - 279 b) Also screening of population at risk, age group at risk, family members of
280 affected individuals to detect early any, case of impaired glucose tolerance or
281 diabetes so that early intervention can be instituted.
 - 282 3) The scope of National Health insurance scheme which is already in operation
283 should be expanded to incorporate provision of healthcare services to individuals
284 with diseases like this at subsidized rates.
 - 285 4) Provision of drugs for chronic diseases like diabetes, hypertension at subsidized
286 rates may enhance compliance especially in the low income group category

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288 **Conclusion**

289 Achieving good glycaemic control is still a challenge in South-south Nigeria, as this
290 study has revealed. Efforts have to be intensified to reduce the incidence of this
291 disease and prevalence of poor glycaemic control which in turn will cause a reduction in
292 morbidity and mortality. The” health of a nation is the wealth” of the nation

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300 **Consent:** Informed consent was given by the patients.

301 **Ethical Approval:** was given by the Ethical Committees of Central Hospital ,Benin and
302 University of Benin Teaching Hospital, Benin .

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REFERENCES

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331 1. International Diabetics federation. 3rd ed. 2006. The improved Diabetes Atlas.

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333 2. Akinkugbe O.O., final report of National survey on communicable diseases in
334 Nigeria series 1. Federal ministry of Health and social services, Lagos: 1997

335

336 3. Chineye S., Uloko A.E.,Ogbera A.O, Ofoegbu E,N, Fasanmade O.A, Fasanmade

- A.A et al: Profile of Nigerians with diabetes mellitus- Diabcare Nigeria study group (2008): Results of a multicentre study. Indian J Endocrinol Metab.2012;16(6):981
4. Nathan P.M., Cleary PA, Backlund JY, Genuth SM, Lachim J.M., Orchard T.J. et al. Diabetes control and complications Trial/Epidemiology of Diabetes interventions and complications (DCC T/EDIC) study research group: Intensive Diabetes treatment and cardiovascular disease in patients with type 1 diabetes. N Engl J. Med 2005; 353: 2643 – 53.
5. Wild S, Roglic C, Green A, Sicrete R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes care 2004; 27: 1047 – 53.
6. Zimmet P. The burden of type 2 diabetes: Are we doing enough? Diabetes metab 2003; 29: 659 – 18.
7. Diabetes control and complications trial research Group. The effect of intensive treatment of diabetes on the development of good progression of long – term complications in insulin dependent diabetes mellitus. N Engl J Med 1993; 329: 977 – 85.
8. United Kingdom prospective diabetes study (UKPDS) group. Effect of intensive blood-glucose control with met formions complications in over weight patients with type 2 diabetes (UKPDS 34). Lancet 1998; 352: 854 – 65.
9. Eid M, Mafauzy M, Faridah AR. Glycaemic control of type 2 Diabetes patients on follow up at Hospital Universiti Sains Malaysia. Malays J Med Sci. 2003 July. 10 (2): 40 – 49.
10. Macisaac RJ, Jerums G, Weekes AJ, Thomas MC. Patterns of glycaemic control in Australian primary care (NEFRON 8). Intern Med J. 2009 Aug; 39 (8): 512 – 8. doi: 10, 1111/J. 1445 – 5994.
11. De Pablos Velasco P, Franch J, Banegas JR, Fernandez S, Sicras A, Diaz S. Cross-sectional epidemiological study of clinical profiles and glycaemic control in diabetic patients in primary care in Spain. (The EPIDIAP study). Endocrinol Nutr. 2009 May; 56(5): 233 – 240. doi: 10. 1016/51575 – 0922 (09) 71406 – 8.
- 12 American Diabetes Association. Standards of Medical care in diseases(Position Statement). Diabetes Care 2005;28(Suppli):S4-S36.

- 377 13. Fox KM, Gerber Pharmd RA Bolinder B, Chen J, Kumar S. Prevalence of
378 inadequate glycaemic control among patients with type 2 diabetes in the UK
379 general practice research database. A series of retrospective analyses of data
380 from 1998 through 2002. Clin Ther. 2006 Mar; 28 (3): 388 – 395.
- 381 14. Saadine JB, Cadwell B, Cregg FW, Engelgau MM, Vinicor F,
382 Imperatore G et al. Improvement in Diabetes process of care and intermediate:
383 United States, 1988 – 2002. Ann intern Med. 2006; 144: 465 – 74.
- 384 15. Adebisi SA Oghagbon EK Akande TM, Olarinoye JK. Glycated haemoglobin and
385 glycaemic control of diabetics in Ilorin. Niger J. Clin Pract. 2009 Mar; 12 (1): 87 –
386 91.
- 387 16. Idogun ES Olumese FE, Prevalence of poor glycaemic control in diabetics seen
388 in a tertiary medical centre. Niger Postgrad Med J. 2007 Mar; 14 (1): 34 – 6.
- 389 17. Afridi MA, Khan MN. Role of health education in the management of diabetes
390 mellitus. J Coll physicians Surg Pak. 2003 Oct; 13 (10): 558 – 61.
- 391 18. Polikandrioti M. The role of education in diabetes mellitus type 2 management.
392 Health science Journal. 2010 4(4) 201 – 202. E – ISSN: 1791 – 809 X.
- 393 19. Bi Y, Zhu D, Cheng J, Zhu Y, Xy N, Cui S, et al. The status of glycaemic control:
394 A cross-sectional study of outpatients with type 2 diabetes mellitus across
395 primary, secondary and tertiary hospitals in the Jiangsu province of China: Clin
396 Ther. 2010 May; 32(5): 973 – 83. doi: 10.1016/j. Chin Thera. 2010.05.002.

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404 **Table 1: Demographic characteristics of the patients in the secondary**
405 **and tertiary health centres**

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Parameter	Secondary health center mean $\pm$ SD	Tertiary health center mean $\pm$ SD
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Male population (%)	38.1	41.7
Female population (%)	61.9	58.3
Age (years)	58.3 ± 1.2	56.1±1.4
BMI (Kg/m ²)	27.6 ± 6.5	27.5±4.3
Systolic blood pressure (mmHg)	144 ± 44	143 ± 26
Diastolic blood pressure(mm Hg)	84 ±10	89 ± 14
Fasting plasma glucose(mmol/L)	7.9 ± 0.4	8.1 ± 0.3
Glycated haemoglobin (%)	8.3 ± 2.1	8.3 ± 2.6

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Table 2: American Diabetes Association (ADA) guidelines and percentage of the study population that met the guidelines in the secondary and tertiary health centers.

Parameters	Recommended target value	N ₁	N ₂	Percentage of patients who achieved the target values	
		Population in secondary health	Population in tertiary health center	N ₁	N ₂

		center			
Glycated haemoglobin (HbA _{1c})	< 7%	126	781	(26)20.6%	(316)40.5%
Plasma glucose before meals (mg/dL)	90 – 130	126	781	(88)69.9%	(361)46.2%
Blood pressure (mmHg)	<130/80	126	781	(32)25.3%	(156)20.6%

Table 3: Percentage of patients with co-morbidities in the secondary and tertiary health centers

Parameter	Secondary health center %	Tertiary health center %
Glucosuria	23.3	20
Proteinuria	74.4	40
Hypertension(BP≥140/90mmHg)	68.7	35.8

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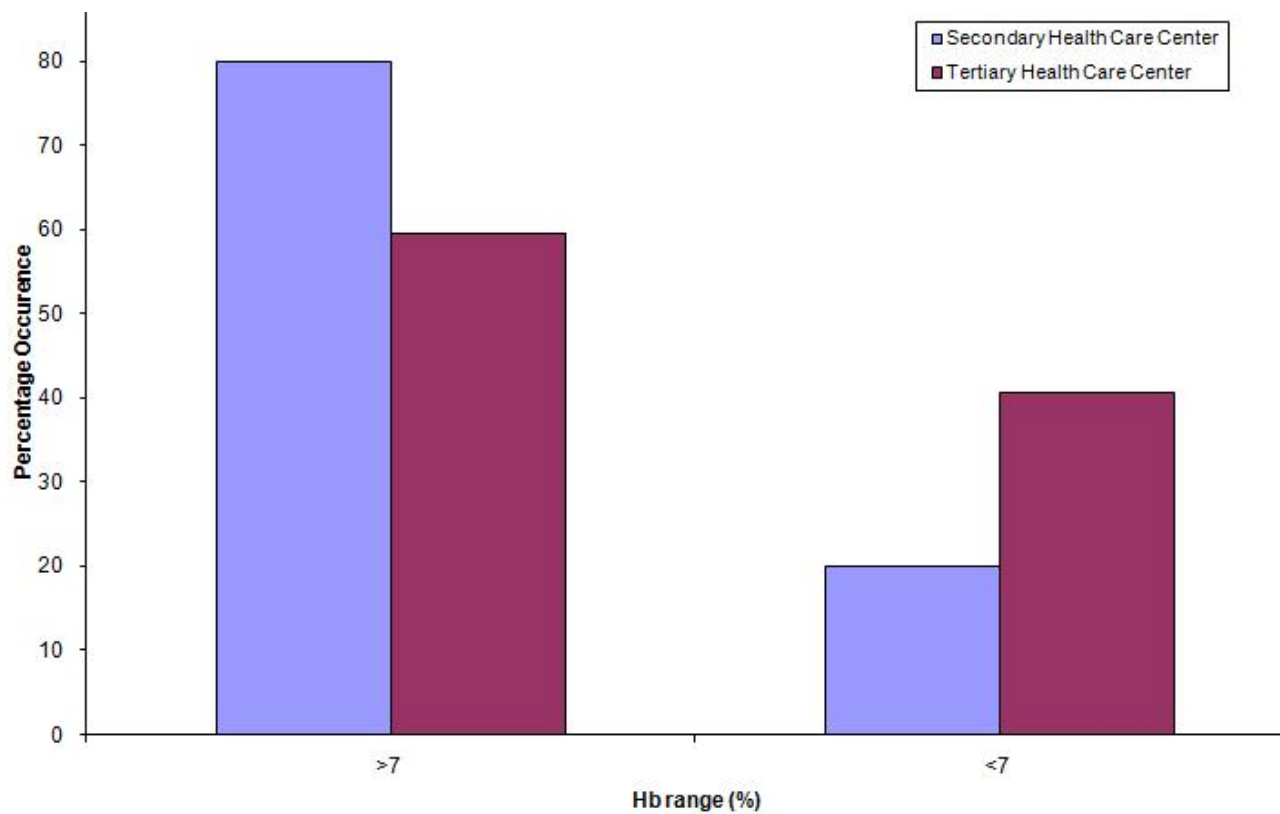


Fig.1 : Chart Showing Percentage of Patients With Glycated Haemoglobin Values Below 7 % and Above 7% in Both Secondary and Tertiary Health Care Centers

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