



## Analysis of Cases of GTT Abnormality

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Analysis of 172 cases of GTT abnormality (GTT Abn) from 1969-1982, 68% of whom have been followed up for more than four years, is presented. With the aim to know the profile of glucose intolerance, effect of hypoglycaemic agents, diet and weight reduction in over-weight cases. 71% cases were diagnosed as Diabetes Mellitus (DM) and 29% as Impaired Glucose Tolerance (IGT). Of the 172 cases, 70 cases were aircrew. Amongst aircrew, cases of IGT are more (37%) as compared to ground duty officers (23.5%).

Of the total cases of GTT Abn, 37% were diagnosed before the age of 35 years whereas amongst aircrew 57% were diagnosed before the age of 35 years. Family history of DM was volunteered by only 16 cases (9.4%).

No symptoms were present in 143 of 172 cases (83%) and these were detected to have the disability during routine medical check-up. Amongst the asymptomatic, 43 cases were found to have glycosuria and of these 40 were diagnosed as DM and 3 as having IGT. Among 143 asymptomatic cases of GTT abn, 128 had glycosuria following glucose load showing a sensitivity index of 0.89.

In 40% (69/172) cases, body weight was detected to be beyond the maximum limit for the height. Amongst these 69 over-weight patients with GTT abnormality, 37 were managed only with diet and weight reduction which greatly improved their glucose tolerance.

Disposal of GTT abnormality cases is discussed. Among 102 ground duty officers, 32 were upgraded to medical category A4G1 and 48 were given permanent lower medical category. Among the 70 aircrew 36 were placed back in flying category out of which 35 within two years.

### Introduction

Diabetes mellitus is a chronic health problem which may be associated with obesity, especially in certain socio-economic class such as officers. At

At the same time obesity itself may produce hyperglycaemic state, however by a different mechanism. Our means of investigating hyperglycaemic state is standard oral GTT which in spite of its drawbacks and limitations is widely accepted.

Diagnosis of Diabetes Mellitus is important amongst officers especially where highly trained pilots are concerned, because on one hand over diagnosis will result in wastage of trained manpower but on the other hand not recognising their disease, when it actually exists, may compromise flight safety.

#### Materials & Methods

Case documents and medical board proceedings from 1969 to 1982 of 172 officers with GTT abnormality of which 70 were aircrew was studied with the aim to analyse the profile of glucose intolerance, effect of diet, hypoglycaemic agents and weight reduction, specially in over-weight individuals, and their improvement or deterioration in a course of time. Sixty percent of these cases have been followed up for more than 4 years.

During oral GTT, blood sugar estimation was done on venous blood by Folin and Wu method using photoelectric calorimeter. In all these cases loading dose of glucose was 100 gms.

Table I

Age distribution of cases of GTT abnormality  
Total No—172

Age in years	Age of detection of disability			
	Total cases		Aircrew	
	No	%	No	%
21-25	2	1	2	3
26-30	13	8	9	13
31-35	49	28	29	41
36-40	58	34	18	26
41-45	31	18	7	10
46-50	16	9	5	7
51-55	3	2	—	—
Total	172	100	70	100

Mean age—37 yrs (Range 21-53 yrs)

#### Observations

Mean age of cases of GTT abnormality is 37 years. Of the total cases 37% and amongst the aircrews 57% were diagnosed before the age of 35 years. The reason for early detection in aircrew could be due to more frequent and stringent medical examination in them.

There is increase in age incidence upto 40 years but not beyond. This is due to type of population under study having more number in middle age group. It has also been shown in large number of studies that with advancing age tissues become insensitive to insulin which is more marked between 20-45 years of age and levels off thereafter.

Two cases detected before the age of 25 yrs are amongst the aircrew, incidently both are navigators. Both recieved oral hypoglycaemic agents initially and after a follow up period of one year with restricted flying category were given full flying category during subsequent medical.

Table II

Total cases—172 (Mean age—38 years).  
Symptomatic—29 (17%) Mean age—38 years.  
Asymptomatic — 143 (83%) Mean age—37 years.

Reasons leading to the diagnosis of GTT abnormality in asymptomatic cases (143 cases)

Reason	Disability	Number	Mean age (yrs)	%
During	Glycosuria	43	39	30
Routine	Obesity	37	37	26
Medical	ECG Abnormality	21	39	15
Check-up	High BP	8	40	6
During review	Other diseases	34	37	23
Total		143	37	100

Thirst, polyuria, polydipsia are very familiar symptoms of DM, but then, why is it so often missed? In this study, 83% were symptom free and their disability was detected mainly during routine medical check-up or during review for other diseases. Mean

age of symptomatic and asymptomatic cases was calculated with a view to see any difference since Insulin Dependent DM produces more symptoms and is likely to occur at younger age, but in this study no such difference was found.

In Table III record of family history of DM as available from the documents is presented.

Table III  
Family history of diabetes mellitus  
Total No—172

One Parent	—	11
Both Parent	—	3
One Parent + one CL	—	2
Both Parent + one CL	—	—
Total	—	16

CL = Close Relative.

Only 16 cases volunteered family history of DM. However this study also includes obese individuals having GTT abnormality in whom there may be no family history of DM.

Fasting and post glucose BSL of 161 cases prior to any drug therapy have been analysed in Table IV. In 11 cases initial GTT results could not be obtained from the documents.

These cases were considered to have abnormal GTT if any of the fasting, peak or 2 hours post glucose BSL were above the then considered normal levels.

In 57% cases fasting BSL was up to 100 mg but they had either the peak or 2 hrs. post glucose BSL above the normal.

Agewise mean BSL was analysed (Table V). In the age group of 21-30 yrs. fasting BSL was found to be more than higher age groups. This table also depicts gradual glucose intolerance with increasing age after the age of 30 yrs. which is due to tissue insensitivity to insulin and there may actually be hyperinsulinaemia.

Relationship of the body weight and the type of GTT abn is analysed, in Table VI. 71% cases were

diagnosed as DM and 29% as IGT. Among those having body weight upto the ideal for their height 83% were diagnosed as DM and 17% as IGT. With the increase in body weight, cases of IGT have increased.

Resistance to the action of insulin can often result from a variety of causes including formation of abnormal insulin or pro-insulin molecules, the presence of circulating antagonists to insulin or insulin receptors or defects in the insulin action at the target tissue level. The defects of latter types i.e. defects in the insulin receptors and post receptor level are characteristic of obesity.

In all cases except one, serum cholesterol level was used as the means to detect derangement of lipid metabolism Table VII. In one case fractionation of serum lipoproteins was carried out. Majority of cases show serum cholesterol well within normal levels. It has been shown that increased levels of FFA act as non-hormonal antagonists of insulin and impair peripheral utilisation of glucose.

Effect of weight reduction in obese hyperglycaemic individuals is shown in Table-VIII. No hypoglycaemic agent was given to these cases to lower their BSL. Fasting BSL has come down in all the cases. Peripheral glucose utilisation has improved as evidenced by reduction in the peak values and 2 hrs. post glucose BSL. Number of studies have shown improvement in glucose utilisation by the cells with body weight reduction in obese individuals and is mainly due to increase in the affinity of cell receptors for insulin rather than increase in their number.

An interesting fact was observed in those who were detected to have glycosuria during routine medical examination. They had rather severe form of GTT abnormality. Ninety percent (38/43) of these cases required drug treatment as against 60% in all 172 cases and in particular the insulin therapy, which was required in 12% (5/43) as against overall 6% (10/172).

Out of 143 asymptomatic cases having GTT abn. 43 had glycosuria on routine check-up where as following glucose load during oral GTT 128 had glycosuria. Sensitivity index of post glucose glycosuria was calculated to be 0.89. It

Table IV

Relationship of fasting BSL with peak and 2 hours post Glucose BSL of 161\* Cases of GTT Abnormality

Post Glucose BSL mg/100 ml		Fasting BSL (mg/100 ml)			
		Upto 100	101-120	121-140	141 & above
		91/161 57%	39/161 24%	13/161 8%	18/161 11%
Peak	Upto 180	41/91 45%	3/39 8%	—	—
BSL	181-200	24/91 27%	7/39 18%	—	—
** 180	201-220	13/91 14%	16/39 33%	6/13 46%	—
	221 & above	13/91 14%	16/39 41%	7/13 54%	18/18 100%
Two Hrs. BSL	Upto 100	10/91 11%	—	—	—
** 100	101-120	28/91 31%	6/39 15%	—	—
*** 120	121-140	16/91 17%	5/39 13%	—	—
**** 120	141-160	20/91 22%	15/39 39%	5/13 38%	—
	161-180	7/91 8%	5/39 13%	2/13 16%	1/18 6%
	181 & above	10/91 11%	8/39 20%	6/13 46%	17/18 94%

\* Initial BSL prior to therapy were not available in 11 cases.

\*\* Previous normal GTT levels in Armed Forces.

\*\*\* Present normal GTT levels in Armed Forces.

\*\*\*\* Present WHO normal GTT levels.

Table V  
Agewise mean BSL of 172 cases of GTT abnormality

Age in Years	BSL mg/100 ml of Venous Blood		
	Fasting	Peak	2 Hours
21-30	127 (7)	222 (12)	165 (9)
31-40	102 (6)	205 (11)	155 (9)
41-50	110 (6)	222 (12)	170 (7)

(Figures in paranthesis are Millimol/Ltr)

Table VII  
Serum Cholesterol Levels in GTT Abnormality Cases Total No 172

Serum Cholesterol mg/100 ml of Blood	Total Cases % 172		Aircrew % 70	
	%	%	%	%
151-200	109	63	45	64
201-250	51	30	18	26
251-300	9	5	6	8
301 & above	3	2	1	1
Total	172	100	70	100

Table VI  
Relationship of body weight and Abnormality in 172 Cases

Body Weight	Number	Abnormality	
		I G T	D M
Ideal	64/172	11/64	53/64
Weight	37%	17%	83%
Ideal/Max.	39/172	12/39	27/39
	23%	31%	69%
Over weight	43/172	14/43	29/43
Up to 10%	25%	33%	67%
Over weight	22/172	10/22	12/22
11%—20%	13%	45%	55%
Over weight	4/172	3/4	1/4
Above 21%	2%	75%	25%
Total	172	50/172	122/72
		29%	71%

Ideal-Max — Between ideal weight and Maximum Limit for the height.

Table VIII  
GTT in obese individuals Having GTT ABN before and after weight reduction without Drugs Total No 37

Blood Sugar	BSL Levels (mg/100 of blood)	Before Weight Reduction	After Weight Reduction
Fasting	Upto 100	22 (60%)	35 (95%)
	101—120	11 (30%)	2 (5%)
	121—140	2 (5%)	—
	141 & above	2 (5%)	—
Peak	Upto 140	—	11 (30%)
	141—180	11 (30%)	22 (60%)
	181—220	19 (51%)	4 (10%)
	221 & above	7 (19%)	—
2 Hours	Upto 100	2 (5%)	22 (60%)
	101—120	14 (38%)	12 (32%)
	121—140	6 (16%)	3 (8%)
	141—160	10 (28%)	—
	161—180	3 (8%)	—
	181 & above	2 (5%)	—

Average weight loss-7.24 Kg (Range 2-20 Kg)

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Table VI  
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		I G T	D M
Ideal Weight	64/172 37%	11/64 17%	53/64 83%
Ideal/Max.	39/172 23%	12/39 31%	27/39 69%
Over weight Up to 10%	43/172 25%	14/43 33%	29/43 67%
Over weight 11%—20%	22/172 13%	10/22 45%	12/22 55%
Over weight Above 21%	4/172 2%	3/4 75%	1/4 25%
Total	172	50/172 29%	122/72 71%

Ideal-Max — Between ideal weight and Maximum Limit for the height.

Table VII  
Serum Cholesterol Levels in GTT Abnormality Cases Total No 172

Serum Cholesterol mg/100 ml of Blood	Total Cases % 172		Aircrew % 70
	%	%	
151-200	109	63	45
201-250	51	30	18
251-300	9	5	6
301 & above	3	2	1
Total	172	100	70

Table VIII  
GTT in obese individuals Having GTT ABN before and after weight reduction without Drugs Total No 37

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Fasting	Upto 100	22 (60%)	35 (95%)
	101—120	11 (30%)	2 (5%)
	121—140	2 (5%)	—
	141 & above	2 (5%)	—
Peak	Upto 140	—	11 (30%)
	141—180	11 (30%)	22 (60%)
	181—220	19 (51%)	4 (10%)
	221 & above	7 (19%)	—
2 Hours	Upto 100	2 (5%)	22 (60%)
	101—120	14 (38%)	12 (32%)
	121—140	6 (16%)	3 (8%)
	141—160	10 (28%)	—
	161—180	3 (8%)	—
	181 & above	2 (5%)	—

Average weight loss-7.24 Kg (Range 2-20 Kg)

Table IX

**Relationship of Asymptomatic Glycosuric Patients and Hypoglycaemic Agents**

Total No		: 172		
Total Symptomatic Cases		: 29		
Total Asymptomatic Cases		: 143		
Asymptomatic Glycosuric Cases		: 43		
Abnormality	Number	Hypoglycaemic Drugs		
		Oral	Oral + Insulin	No Drugs
D Mellitus	40	33	5	2
Impaired Glucose Tolerance	3	—	—	3
<b>Total</b>	<b>43</b>	<b>33</b>	<b>5</b>	<b>5</b>

may be worthwhile to institute urinalysis 2 hrs. following glucose load in all cases during annual medical examination since it is cheap and easy and yet a very sensitive method of screening cases of GTT abn.

In service medical categorisation for any Chronic disability is essential for employability. In ground duty personnel it is mainly required to provide sheltered and non strenuous or non operational jobs and at the same time to keep them under continuous medical supervision. At the time of onset of disease 77 officers were given A4G5 and 25, A4G3. Over a period of time 32 have been restored to full ground medical category and 48 have been given permanent lower medical category.

Lower medical category in ground duty officers does not significantly affect the task whereas in the

Table X

**Disposal of Cases (Ground duty)**  
Total Cases 102

Type of Disposal	Category				Total
	A4G5	A4G3	A4G2	A4G1	
Initial (Temp)	77	25	—	—	102
Intermediate (Still under review)	9	10	2	—	21
Final (Permanent)	9	11	28	32	80
					101*

\* One case did not report for review of initial temporary category.

Table XI

**Disposal of Cases (Aircrew)**

Type of Disposal	Category							Total	
	A4G5	A4G3	A4G1	A3G3	A3G2	A2G2	A2G1		A1G1
Initial (Temp)	56	8	—	—	5	1	—	—	70
Intermediate (Still under review)	2	5	1	3	—	—	—	—	70
Final (Permanent)	9	12	5	2	—	2	2	27	

case of aircrew placing them from aerial to ground category definitely affects the flying task and there is a constant effort on the part of the medical authorities to bring them back to flying medical category. Out of the total 70 aircrew, 36 i.e. 51% have been placed back in the flying category.

In table XII detailed analysis of time based

follow up and medical disposal has been attempted which brings out that within two years 45% cases and within three years 65% were given flying medical category. Thirty six cases out of 70 i.e. 51% have been placed in flying category, six cases within 6 months, 19 cases within one year and 35 in two years were restored to flying category which amounts to 50% of the total cases.

Table XII

Time based relationship of Follow—UP and Disposal of Aircrew having GTT abnormality  
Total No 70

Period upto (Yrs)	Medical				Total	Disposal				Total
	Temporary					Permanant				
	Ground Category	Aerial Category				Ground Category	Aerial Category			
A4	A3	A2	A1	A4	A3	A2	A1			
0.5	64	5	1	—	70	—	—	—	—	—
	XX									
1.0	50	11	2	1	64	1	—	1	4	6
	X									
1.5	35	10	1	5	51	2	—	2	13	17
		XXX								
2.0	24	7	3	1	35	10	1	2	19	32
2.5	17	7	—	1	25	12	1	3	23	38
	XX									
3.0	13	1	1	2	17	14	1	4	26	45
	XX									
4.0	7	1	1	1	10	20	2	4	26	52
6.0	2	—	1	—	3	24	2	4	27	57
8.0	1	—	—	—	1	26	2	4	27	58

X = Holding Temporary Medical Category since the period marked against them.

This table (Table-XIII) is presented to reveal relationship of hypoglycaemic drugs and medical categorisation in aircrew. Flying is not permitted while the pilot is taking hypoglycaemic drugs but in case they are managed with drugs in the initial stages, an attempt is made to withdraw the drugs so that flying category can be given. Out of the 36

aircrew who were put back in flying, 13 required drug treatment in the beginning which was later withdrawn and normoglycaemic state was maintained with diet and weight reduction. In those who were permanently grounded, hypoglycaemic drugs remained essential to control their disease and could not be withdrawn.



Table XIII  
 Relationship of disposal and drugs aircrew  
 having GTT abnormality  
 Total No—70

Disposal	No	Oral HGA	Insulin	No drug
Permanant Ground Category	26	21	5	—
Temporary Ground Category	8	5	—	3
Flying Category	36	13	—	23

**Conclusion**

172 cases of GTT abnormality have been evaluated. 71% cases were diagnosed as Diabetes mellitus and 29% as impaired Glucose tolerance. Amongst aircrew the incidence of IGT is more than the ground duty officers.

83% of the cases were asymptomatic and were diagnosed on routine medical check up. 40% of the individuals were over weight and of these 54% could be effectively managed by diet restrictions and weight reduction only. Among 102 ground duty officers, 32 were upgraded to medical category A4G1 and 48 were given permanant lower medical category. Amongst the 70 aircrew 36 were placed back in flying category out of which 35 within two years.

