Original Article

A hospital-based assessment of glycemic control and medication adherence in type 2 diabetes mellitus in Eastern Nepal

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Abstract

Background: Poor glycemic control in type 2 diabetes mellitus (T2DM) causes damage to various organs and leads to the development of disabling and life-threatening complications. **Objectives:** To find out the prevalence of glycemic control and medication adherence (MA) and the factors affecting them. **Methods:** A cross-sectional study was conducted among patients with T2DM. The patients were categorized as good glycemic control (HbA_{1c} <7.0%) and poor glycemic control (HbA_{1c} ≥7.0%). MA was categorized as low (score <6), medium (score 6 or 7), and high (score 8). The Statistical Package for Social Science (version 11.5) was used for statistical analysis at a *P* value less than 0.05. **Results:** Of 129 patients, 65 (50.39%) were females. The mean age was 48.33 ± 12.86 years. The combination of metformin and glimepiride was prescribed to 37 (28.68%) patients. Diabetic knowledge was poor in 84 (65.12%) patients. Glycemic control was good in 108 (83.72%) patients. MA was medium in 72 (55.81%) patients. Patients taking regular fruit, having shorter duration of drug therapy, and having good diabetic knowledge had good glycemic control and were statistically significant (*P* value < 0.05). Patients having family support, nonalcoholic, taking regular fruit, being involved in daily jogging, having shorter duration of drug therapy, and having good diabetic knowledge had high MA and were statistically significant (*P* value < 0.05). **Conclusion:** The majority of the diabetic patients had good glycemic control and medium MA. Patients taking regular fruit, being involved in daily jogging, having a shorter duration of drug therapy, and having good diabetic knowledge were identified as factors that affect both glycemic control and MA.

Keywords: Glycemic control, medication adherence, metformin, type 2 diabetes

Introduction

Type 2 diabetes mellitus (T2DM) is the third major noncommunicable disease in Nepal, and its prevalence is 8.5%.[1-3] Glycemic control is one of the ultimate tools to evaluate the disease progression and treatment success in T2DM.[4] Diabetics who manage to keep their glycated hemoglobin (HbA_{1c}) below 7.0% are considered to have good glycemic control, while those above 7.0% are considered to have poor glycemic control.[5] The magnitude of poor glycemic control in diabetic patients in different parts of the world is high and ranges from 45 to 94%.[6-8] Poor glycemic control in T2DM causes damage to various organs and leads to various complications.[9,10] One point increase in the longitudinal value of HbA_{1c} is associated with a 14% higher risk of the combined end point of all-cause mortality, myocardial infarction, and ischemic stroke in T2DM.[6,11] Dropping HbA_{1c} from 9.1 to 7.3% reduces the risk of macrovascular disease by 41%, retinopathy by 63%, nephropathy by 54%, and neuropathy

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by 60%.[6] Ideal glycemic control (HbA_{1c} <7%) effectively reduces such cardiovascular and other microvascular and macrovascular complications in T2DM.[10] The use of diabetic medications combined with strict medication adherence (MA) is an important factor that contributes to achieving optimal glycemic control.[12]

The MA rate ranges from 50 to 60% among patients with chronic noncommunicable diseases.[13] Poor MA in T2DM leads to poor glycemic control and enhances the development of various complications and unnecessary hospitalization.[14] Improved adherence to diabetic medications is associated with 13% lower odds of subsequent hospitalizations or emergency department visits.[15] Poor knowledge of diabetes also has a negative impact on self-care behavior, which has a significant impact on glycemic control.[16] The assessment of knowledge about diabetes and its management among diabetic patients is a prerequisite. Increasing awareness of the importance of good glycemic control on disease progression and complications along with the effect of adherence to the prescribed drugs and lifestyle modifications on glycemic control in patients with T2DM should be emphasized from time to time. Objective information regarding the magnitude of glycemic control and diabetic knowledge is needed for the provision of standard care in patients with T2DM. Patient education and MA in T2DM are important for achieving and maintaining treatment targets within an optimal range. The data on glycemic control and MA among Nepalese patients with T2DM are scarce in our context. The objective of this study was to find out the prevalence of glycemic control and factors affecting it using HbA_{1c} and to find out the prevalence of MA and factors affecting it in patients with T2DM. The study findings would help the practitioner and other healthcare professionals in the proper management of diabetes.

Methods

A hospital-based cross-sectional descriptive study was conducted among patients with T2DM at **the** outpatient department (OPD) of General Practice and Emergency Medicine, B.P. Koirala Institute of Health Sciences (BPKIHS), from June 2021 to July 2022. The sample size of 129 was calculated using single proportion formula at 95% confidence interval, 80% power, 10% allowable error, and 10% nonresponse rate based on the prevalence of 76.6% poor glycemic control in an Indian study.[17] Patients with T2DM taking oral antidiabetic drugs for at least six months and attending the OPD for follow-up and aged between 18 and 60 years were enrolled. Patients having blood transfused within the previous six-month period, pregnant patients, diagnosed with sickle cell trait, spherocytosis, iron deficiency anemia, HIV/AIDS, tuberculosis, cancer, and psychiatric disorder, taking antipsychotic drugs and aspirin, and not willing to participate in the study were excluded. The convenience sampling method was used to recruit the patients. The ethical approval was obtained from the Institutional Review Committee, BPKIHS (IRC/2031/020).

A semi-structured proforma was prepared through an extensive literature review and expert advice to collect the relevant data.[6,18,19] It was divided into four sections: (A) sociodemographic data, (B) diabetes self-care practices, (C) knowledge of diabetes mellitus, and (D) MA. Score 1 was given to the correct response and zero for other responses. The eight-item Morisky Medication Adherence Scale (MMAS-8) was used to measure adherence to antidiabetic medications. It consisted of eight items with binary scoring for the first seven items (yes = 0, no = 1) and a five-point Likert score for the last item, which contributes a score of 1 or zero (1 for "never" and zero for other responses, such as "once in a while," "sometimes," "usually," and "always").[20] The questionnaire was translated from English to Nepali language, and back-translation to English was subsequently carried out to ensure response consistency**.** It was a valid and reliable tool; however, it was again tested and validated in 10% of the study sample and those study samples were not used in the final data analysis. The purpose of the study was explained to the patients, and then, informed consent was obtained. The patients were interviewed face-to-face, and their health cards were also reviewed to collect the relevant data. The study has been conducted in accordance with the ethical principles mentioned in the Declaration of Helsinki, 2013.[21]

The data were entered into Microsoft Excel 2010, and descriptive statistics (mean, standard deviation, frequency, and percentage) were calculated. Based on the mean score, knowledge of diabetes was categorized as "good" (score above the mean) and "poor" (score below the mean).[18] Glycemic control was categorized as good (HbA_{1c} <7.0%) and poor (HbA_{1c} >7.0%).[17] Based on the MMAS scores, MA was categorized as low (score <6), medium (score 6 or 7), and high (score 8).[20] Non-categorical variables were analyzed using the Chi-square test. The Statistical Package of Social Sciences (version 11.5) was used for statistical analysis. A *P* value less than 0.05 was considered statistically significant.

Results

Of 129 patients, 65 (50.39%) were females and 66 (51.16%) belonged to the age group of 46–75 years. The mean age of the patients was 48.33 ± 12.86 years, and the median age was 46 years [Table 1].

Diabetes self-care practices among the patients are shown in Table 2.

The combination of metformin and glimepiride was prescribed to 37 (28.68%) patients, and 27 (20.93%) patients were prescribed metformin, sitagliptin, and empagliflozin [Figure 1].

About 19 (14.73%), 76 (58.91%), and 34 (26.36%) patients were prescribed one, two, and three antidiabetic drugs, respectively. Table 3 shows knowledge of diabetes mellitus among the patients. The mean knowledge score was 5.11 ± 0.841. The knowledge score was poor in 84 (65.12%) patients and good in 45 (34.88%) patients [Figure 2].

Table 1: Sociodemographic characteristics of the patients (*n*=129)

Variables	*n*	%
Age group (years)		
27-45	63	48.84
46-75	66	51.16
Gender		
Male	64	49.61
Female	65	50.39
Educational status		
Illiterate	31	24.03
Literate	98	75.97
Occupation		
Employed	77	59.69
Unemployed	52	40.31
Residence		
Rural	67	51.94
Urban	62	48.06
Alcoholic status		
Yes	40	31.01
No	89	68.99
Smoker		
Yes	31	24.03
No	98	75.97
Support from family		
Yes	120	93.02
No	9	6.98
Used complementary and alternative medicine for DM		
Yes	18	13.95
No	111	86.05
Duration of drug therapy		
Up to 5 years	74	57.36
>5 years	55	42.64

Of 129 patients, glycemic control was good in 108 (83.72%) and poor in 21 (16.28%) patients [Figure 3]. MA was low in 9 (6.98%), medium in 72 (55.81%), and high in 48 (37.21%) patients [Figure 4]. Patients taking regular fruit, having shorter drug therapy, and having good diabetic knowledge had good glycemic control and were statistically significant (*P* value < 0.05) [Table 4].

In this study, patients with good glycemic control had medium MA; however, it was statistically insignificant (*P* value > 0.05). Patients having family support, nonalcoholic, taking regular fruit, being involved in daily jogging, having shorter drug therapy, and having good diabetic knowledge had high MA and were statistically significant (*P* value < 0.05) [Table 5].

Discussion

In the present study, diabetes self-care activities among the patients were not optimal. Most of the patients (86.82%) did not practice self-monitoring of blood glucose at home. Similar to this finding, Nazmi *et al.* reported that two-thirds of the patients did not use a glucometer to monitor their blood sugar at home.[22] Only 59% of participants were practicing self-monitoring of blood glucose

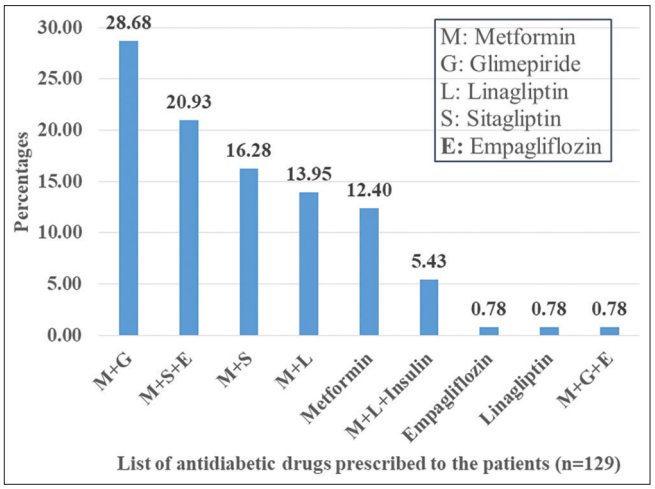

Figure 1: List of individual drugs prescribed to the patients (n = 129)

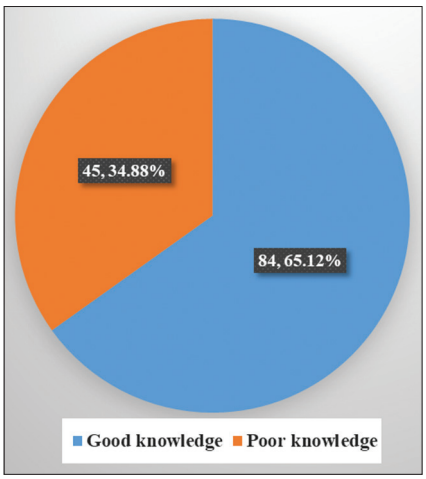

Figure 2: Level of knowledge of diabetes in the patients (n = 129)

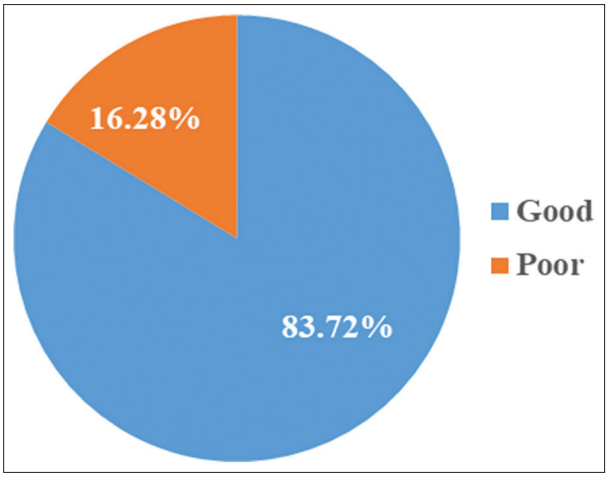

Figure 3: Level of glycemic control in the patients (n = 129)

at home in a study conducted in Jordan.[23] The cost might be a limiting factor for the adoption of the practice of glucometer use at home. As self-monitoring of blood glucose at home is associated with favorable glycemic control in diabetic patients, the healthcare professions should counsel the patients regarding

Table 2: Diabetes self-care activities among the patients (*n*=129)

Variables	*n*	%
Do you eat fruit at least five servings per week?		
Yes	103	79.84
No	26	20.16
Do you walk daily (or do physical exercise) for at least 30 min?		
Yes	85	65.89
No	44	34.11
Do you practice any yoga exercises?		
Yes	15	11.63
No	114	88.37
Do you check your feet for any symptoms of diabetic complications?		
Yes	29	22.48
No	100	77.52
Do you practice self-monitoring of blood glucose?		
Yes	17	13.18
No	112	86.82
How frequently do you visit your doctor for checkup for eyes, kidneys, and nerves?		
Every 3 months	4	3.10
Every 6 months	51	39.53
Once a year	22	17.05
Never	8	6.20

Table 3: Knowledge of diabetes mellitus among the patients (*n*=129)

Variables	Response	*n*	%
Is diabetes a hereditary disease?	Yes	110	85.27
	No	12	9.30
	Don't know	7	5.43
Is diabetes an infectious disease?	Yes	0	0.00
	No	127	98.45
	Don't know	2	1.55
Is exercise beneficial for the control of blood sugar in diabetes?	Yes	129	100.00
	No	0	0.00
	Don't know	0	0.00
Is stopping smoking and alcohol intake beneficial for the control of blood sugar?	Yes	126	97.67
	No	0	0.00
	Don't know	3	2.33
What is the optimal value of HbA1c?	<7%	22	17.05
	<10%	18	13.95
	Don't know	89	68.99
What is the normal fasting blood glucose level?	<130	101	78.29
	<150	25	19.38
	Don't know	3	2.33
What is the normal postprandial blood glucose level?	<180	65	50.39
	<160	61	47.29
	Don't know	3	2.33

the practice of self-monitoring of blood glucose at home and its importance should be emphasized at each follow-up.[24] One in five patients (20.16%) did not include fruits as per the recommendation. Higher fresh fruit consumption is associated with a significantly lower risk of death and development of major vascular complications in diabetics.[25] Inadequate fruit/vegetable consumption is independently associated with significantly higher odds of diabetes.[26] One-third (34.11%) of the patients did not practice daily jogging, and this finding was similar to other studies (30.5%).[27] This low level of physical activity among diabetic patients might be due to poor patient counseling about the benefit of regular exercise. Physical activity improves blood sugar control in diabetic patients, reduces cardiovascular risk factors, contributes to weight loss, and improves well-being.[25] The diabetic patients should be engaged in 150 minutes or more of moderate-to-vigorous intensity aerobic activity per week and spread out over at least 3 days/week, with no more than two consecutive days without activity.[28] The patients should be counseled about the benefits of daily exercise. Healthcare professionals should emphasize diabetic education and motivate patients to engage in regular physical activity and intake of fresh fruits at frequent intervals.

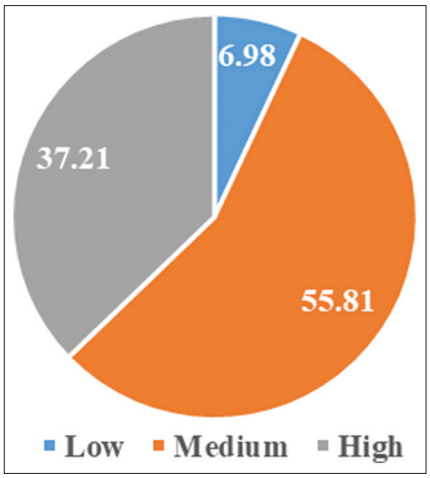

Figure 4: Level of medication adherence in the patients (n = 129)

It was interesting to find that only one-fifth (20.93%) of the patients received monotherapy and more than half of the patients (58.91%) were prescribed two antidiabetic drugs. In contrast to these findings, a higher number of patients (53.4%) were prescribed monotherapy and only 41.4% of the patients received dual therapy in another study.[29] There is considerable evidence of decreased adherence related to polytherapy and multiple daily-dosing schedules in various medical disorders.[30] The most frequently prescribed antidiabetic drug combination was metformin and glimepiride (28.68%). This was inconsistent with other studies in which the most frequently prescribed combination was metformin and sitagliptin (60.44%).[31] The combination therapy produces synergistic actions with different mechanisms of actions of drugs, and it also helps to reduce the doses of drugs leading to minimal adverse effects; however, the combination of drugs increases the cost of diabetic therapy.

About one-third (34.88%) of the patients had good knowledge of diabetes, and this was higher than that of Chavan *et al.* (23.8%).[32] In contrast to this, a higher number of patients (45.2%) had excellent diabetic knowledge in another study.[33] This finding might be an indication of ineffective communication between

Table 4: Factors affecting glycemic control in the patients (*n*=129)

Variables	Glycemic control (*n*, %)		*P*
	Good	Poor	
Gender			
Male	8 (6.2)	56 (43.41)	0.24
Female	13 (10.08)	52 (4031)	
Age category (years)			
Up to 45	14 (10.85)	49 (37.98)	0.07
>45	7 (5.43)	59 (45.74)	
Education level			
Illiterate	6 (4.65)	25 (19.38)	0.59
Literate	15 (11.63)	83 (64.34)	
Occupation			
Employed	14 (1085)	63 (48.44)	0.47
Unemployed	7 (5.43)	45 (34.88)	
Residence			
Rural	11 (8.53)	56 (43.41)	0.96
Urban	10 (7.75)	52 (40.31)	
Regular fruit intake			
Yes	10 (7.75)	93 (72.09)	0.000*
No	11 (8.53)	15 (11.63)	
Family support			
Yes	20 (15.5)	100 (77.52)	0.66
No	1 (0.78)	8 (6.2)	
Smoker			
Yes	10 (7.75)	21 (16.28)	0.06
No	11 (8.53)	87 (67.44)	
Alcoholic status			
Yes	9 (6.98)	31 (24.03)	0.19
No	12 (9.3)	77 (59.69)	
Duration of therapy (years)			
Up to 5	7 (5.43)	67 (51.94)	0.01*
>5	14 (10.85)	41 (31.78)	
Number of drugs prescribed			
Single	5 (3.88)	17 (13.18)	0.36
> one drug	16 (12.4)	91 (7054)	
Daily yoga			
Yes	3 (2.33)	12 (9.3)	0.67
No	18 (13.95)	96 (74.42)	
Daily jogging			
Yes	10 (7.75)	75 (58.14)	0.05
No	11 (8.53)	33 (25.58)	
Self-monitoring of blood glucose at home			
Yes	8 (6.2)	23 (17.83)	0.09
No	13 (10.08)	85 (68.89)	
Knowledge of diabetes			
Good	21 (16.28)	84 (65.12)	0.01*
Poor	0 (0.0)	24 (18.6)	
Medication adherence			
Low	1 (0.78)	8 (6.2)	0.28
Medium	9 (6.98)	63 (48.84)	
High	11 (8.53)	37 (28.68)	

*Statistically significant at $P<0.05$ (Chi-square test)

patients and healthcare professionals. Better patient counseling by healthcare professionals is needed to educate the patient about the disease, drug therapy, self-care practices, role of proper diet, and regular follow-up that can help them adhere to the medications.[34]

The majority of the patients (83.72%) had good glycemic control in the present study. A similar finding was also found in another study in which the majority of the patients (75.5%) had good glycemic control.[29] In contrast to this, a lower percentage of the patients had good glycemic control in studies by Shita *et al.* (58.4%).[35] It might be due to the difference in sample size, study design, operational definitions used for glycemic control, diabetic knowledge among the patients, and socioeconomic, cultural, and lifestyle of the study populations. Intake of regular fruit, having shorter drug therapy duration, and having good diabetic knowledge were identified as significant factors associated with good glycemic control.

The majority of the patients (55.81%) had medium MA, and this finding was in line with Alqarni *et al.* (42.9%).[36] In contrast to this, the majority of the patients had a low level of MA in Saudi Arabia (54.8%)[36] and Ethiopia (76.9%).[37] These differences in MA to antidiabetic medications might be due to variations in the socioeconomic status, educational level, healthcare services, and metrics used for the assessment of adherence across the study settings. Patients having family support, nonalcoholic, taking regular fruit, being involved in daily jogging, having shorter drug therapy duration, and having good diabetic knowledge were identified as factors associated with high MA. Patients having good glycemic control had medium MA; however, it was not statistically significant. Similarly, in other studies, there was no significant relationship between MA and glycemic control.[29,38] In contrast, other studies had found a relationship between MA and glycemic control in diabetic patients.[20,39] Patient counseling on the importance of strict adherence to their medication should be emphasized and given equal importance. The present study has some limitations. The study had a small sample size. The effect of the cost of medication on antidiabetic nonadherence could not be assessed. The patient recall and self-reports might have affected the patient's adherence levels.

Conclusion

The present study shows that the majority of the patients had good glycemic control and medium MA. Patients taking regular fruit, being involved in daily jogging, having a shorter duration of drug therapy, and having good diabetic knowledge were identified as factors that affect both glycemic control and MA. Adequate patient counseling and health education on diabetes and self-care practices should be practiced to improve MA and subsequent attainment of good glycemic control. A prospective and interventional study in a larger population would be helpful to know the effect of diabetic education on glycemic control and MA in diabetic patients.

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We thank Dr. Siddhartha Sah for helping with the data collection.

Table 5: Factors affecting medication adherence in the patients (*n*=129)

Variables	Medication adherence (%)			*P*
	Low	Medium	High	
Gender				
Male	4 (3.1)	39 (30.23)	21 (16.28)	0.50
Female	5 (3.88)	33 (25.58)	27 (20.93)	
Age category (years)				
Up to 45	2 (1.55)	32 (24.81)	29 (22.48)	0.05
>45	7 (5.43)	40 (31.01)	19 (14.73)	
Education level				
Illiterate	3 (2.33)	16 (12.4)	12 (9.3)	0.74
Literate	6 (4.65)	56 (43.41)	36 (27.91)	
Occupation				
Employed	5 (3.88)	42 (32.56)	30 (23.26)	0.87
Unemployed	4 (3.1)	30 (23.26)	18 (13.95)	
Residence				
Rural	3 (2.33)	35 (27.13)	29 (22.48)	0.22
Urban	6 (4.65)	37 (28.68)	19 (14.73)	
Family support				
Yes	6 (4.65)	71 (55.04)	43 (33.33)	0.001*
No	3 (2.33)	1 (0.78)	5 (3.88)	
Smoker				
Yes	1 (0.78)	13 (10.08)	17 (13.18)	0.06
No	8 (6.2)	59 (45.74)	31 (24.03)	
Alcoholic status				
Yes	3 (2.33)	16 (12.4)	21 (16.28)	0.04*
No	6 (4.65)	56 (43.41)	27 (20.93)	
Duration of therapy (years)				
Up to 5	4 (3.1)	49 (37.98)	21 (16.28)	0.02*
>5	5 (3.88)	23 (17.83)	27 (20.93)	
Number of drugs prescribed				
Single	0 (0.0)	11 (8.53)	11 (8.53)	0.20
> one drug	9 (6.98)	61 (47.29)	37 (28.68)	
Daily yoga				
Yes	2 (1.55)	11 (8.53)	2 (1.55)	0.10
No	7 (5.43)	61 (47.29)	46 (35.66)	
Daily jogging				
Yes	6 (4.65)	58 (44.96)	21 (16.28)	0.000*
No	3 (2.33)	14 (10.85)	27 (20.93)	
Self-monitoring of blood glucose at home				
Yes	3 (2.33)	18 (13.95)	10 (7.75)	0.69
No	6 (4.65)	24 (18.6)	38 (29.46)	
Knowledge of diabetes				
Good	5 (3.88)	53 (41.09)	47 (36.43)	0.000*
Poor	4 (3.1)	19 (14.73)	1 (0.78)	
Glycemic control				
Good	8 (6.2)	63 (48.84)	37 (28.68)	0.28
Poor	1 (0.78)	9 (6.98)	11 (8.53)	

*Statistically significant at $P<0.05$ (Chi-square test)

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Nil.

Conflicts of interest

There are no conflicts of interest.

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