Screening at the Dental Office: An Opportunity for Bridging the Gap in the Early Diagnosis of Hypertension and Diabetes in Ghana

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Abstract

Background: The prevalence of hypertension and diabetes is increasing in Ghana and sub-Saharan Africa. Screening is a useful tool in improving the early detection of both diseases to reduce the mortality and morbidity associated with the conditions. This study set out to determine the prevalence of patients with hypertension and hyperglycemia attending a dental clinic in Accra. **Methods:** A cross-sectional study, modeling a screening exercise, was conducted in a major dental clinic in Accra. Hypertension and diabetes were screened for with serial blood pressure checks at rest and random blood glucose measurements, respectively. Other variables were the pulse rate, the respiratory rate, and the background characteristics of respondents. Data were analyzed with Stata Version 14, and descriptive statistics were generated and reported. **Results:** There were a total of 175 participants in the study, comprising 76 males (43.4%) and 99 females (56.6%). This represented a male-to-female ratio of 0.8:1. The ages ranged from 18 to 86 years, with the median and mean ages of 40 years and 43.1 years (±16.9), respectively. This study found the prevalence of hypertension and hyperglycemia in the dental clinic to be 31.4% and 24.6%, respectively. **Conclusion:** The results of this study demonstrate the importance of the dental clinic in detecting both undiagnosed hypertension and diabetes, as well as those who have previously been diagnosed, but do not have their blood pressure and blood sugar under adequate control. With efficient referrals and follow-up systems in place at dental offices, they could be harnessed as a fertile place for hypertension and diabetes screening.

Keywords: Dental office, diabetes mellitus, Ghana, hypertension, periodontal disease, screening

Résumé

Contexte: La prévalence de l'hypertension et du diabète augmente au Ghana et en Afrique subsaharienne. Le dépistage est un outil utile pour améliorer la détection précoce des deux maladies afin de réduire la mortalité et la morbidité associées à ces affections. Cette étude visait à déterminer la prévalence de l'hypertension et de l'hyperglycémie chez les patients fréquentant une clinique dentaire à Accra. **Méthodes:** Une étude transversale, modélisant un exercice de dépistage, a été menée dans une grande clinique dentaire à Accra. L'hypertension artérielle et le diabète ont fait l'objet d'un dépistage au moyen d'une vérification sérielle de la tension artérielle au repos et de mesures aléatoires de la glycémie, respectivement. Les autres variables étaient le pouls, la fréquence respiratoire et les caractéristiques de base des répondants. Les données ont été analysées à l'aide de la version 14 de Stata, et des statistiques descriptives ont été produites et présentées. **Résultats:** Au total, 175 participants ont participé à l'étude, dont 76 hommes (43,4 %) et 99 femmes (56,6 %). Cela représentait un ratio hommes/femmes de 0,8:1. L'âge variait de 18 à 86 ans, l'âge médian et l'âge moyen étant respectivement de 40 ans et 43,1 ans (±16,9 ans). Cette étude a révélé que la prévalence de l'hypertension et de l'hyperglycémie à la clinique dentaire était de 31,4 % et 24,6 %, respectivement. **Conclusion:** Les résultats de cette étude démontrent l'importance de la clinique dentaire dans la détection de l'hypertension et du diabète non diagnostiqués, ainsi que de ceux qui ont déjà reçu un diagnostic,

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mais dont la tension artérielle et la glycémie ne sont pas sous contrôle adéquat. Avec des références efficaces et des systèmes de suivi en place dans les cabinets dentaires, ils pourraient être exploités comme un lieu fertile pour le dépistage de l'hypertension et du diabète.

Mots-clés : Cabinet dentaire, diabète sucré, Ghana, hypertension, maladie parodontale, dépistage

INTRODUCTION

Diabetes and hypertension are individually two major health challenges facing Africa as a whole, and sub-Saharan Africa (SSA) in particular, and are becoming the leading causes of morbidity and mortality in the region.[1] This same region has been reported to bear the highest burden of both communicable and noncommunicable diseases, albeit the weakest health systems.[2]

While some 1 billion people worldwide are estimated to have hypertension, with an associated annual deaths of 7.1 million,[3,4] the condition is well known to be associated with chronic heart disease, stroke, coronary heart disease, heart failure, peripheral vascular disease, chronic kidney disease, end-stage kidney disease, retinal hemorrhage, and visual impairment.[5] It has been suggested that the disease burden of hypertension is highest in Africa, estimated at 46% of adults aged 25 years and older, compared to 35%–40% in other parts of the world.[6] More alarming, though, is the report that many people who are hypertensive in Africa are unaware of their status. This puts such individuals at higher risk of developing the undesirable complications of the condition.[7]

Similarly, the burden of diabetes is adversely impacting many across the continent, with some over 18 million people estimated to have the condition in the SSA by 2030,[8] and contributing to 321,100 deaths in Africa.[9] The expenditure due to diabetes by 2040, according to the International Diabetes Federation, is estimated to get to USD 5.5 billion, although it reports of uncertainty with the figure because 66.7% of people with diabetes in Africa are supposedly undiagnosed.

Both conditions, in Ghana, have received some considerable attention over the past few years, with instituted policies and public awareness, though not entirely adequate.[10] The prevalence of both conditions is reported to be rising in Ghana, with a proportionate number of affected individuals being unaware of it.[10,11] The WHO and some national policies, therefore, include early detection and screening programs as part of recommendations to reduce the chances of disease progression.[10,12]

Although it is of interest to dentists to know the hypertensive and diabetes status of their patients for several reasons, screening is not routinely done in many general dental settings.[13] The dental office offers an appropriate opportunity to screen dental patients in the fight against cardiovascular diseases, so appropriate education and referrals could be made. In demonstrating this assertion, this study aims to determine the prevalence of undiagnosed and poorly controlled patients with hypertension and hyperglycemia attending a major dental clinic in Accra, Ghana.

METHODS

This was a cross-sectional, clinical study of patients attending the Dental clinic of the Korle Bu Teaching Hospital (KBTH), Accra, from February to April 2018. With KBTH being one of the largest hospitals in Africa, and the premier referral center in Ghana, the study site also serves as the outpatient unit for the oral and maxillofacial department of the hospital.

With a calculated sample size of 163, the participants were newly registered patients of the clinic, who were 18 years and above, and had consented to be part of the study. Ill looking patients and emergencies were excluded from the study.

Parameters from all patients were taken by an oral and maxillofacial surgery resident, assisted by a subintern, with daily supervision and clinical auditing by a consultant of the department of medicine and therapeutics from the same institution of the study. Investigators underwent thorough training before the commencement of the study. Patients were seated comfortably in a chair and informed about the purpose of the study, the time involved in participation, the data anonymity, and the free will to participate. Data were collected using a computerized questionnaire. Hypertension was screened for with blood pressure readings while random blood sugar (RBS)/fasting blood sugar was done to screen for diabetes. Variables collected were as follows:

Background characteristics

The sociodemographic information of the participants was obtained by interview. These were age, sex, their presenting

Table 1: Stratification of risk to quantify prognosis in hypertension (source: WHO-ISH)			
Other risks and disease history	Blood pressure (mmHg)		
	Grade 1 (SBP 140-159 or DBP 90-99)	Grade 2 (SBP 160-179 or DBP 100-109)	Grade 3 (SBP ≥180 or DBP ≥110)
I No other risk factors	Low risk	Medium risk	High risk
II 1-2 risk factors	Medium risk	Medium risk	High risk
III 3 or more risk factors, or TOD, or ACC	High risk	High risk	High risk

SBP, systolic blood pressure; DBP, diastolic blood pressure; TOD, target-organ damage; ACC, associated clinical conditions

complaint as recorded in their folders, National Health Insurance Scheme (NHIS) status, and their salary category. It was also indicated if patients were known hypertensives and/or diabetics, the time when they last ate, or if they had any other comorbidities.

Blood pressure

Patients' blood pressures were taken three times at an interval of a minimum of 10 min. All blood pressures were taken at the left upper arm with a digital sphygmomanometer (Omron Series 3®, (BP710N), (Omron Healthcare Inc., IL, USA)). Both the systolic and the diastolic values were recorded for all the three readings, and the mean values were determined.

The WHO and the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure suggest readings of 140/90 mmHg as a minimum for hypertension risk in patients with no other compelling reasons.[12,14] The guidelines, as used for the study, further classify the risk of hypertension as shown in Table 1. Patients with systolic and diastolic readings of 140 mmHg and 90 mmHg, respectively, were, therefore, classified as (likely) hypertensive.[15]

Aside from routine oral hygiene education, all participants were given general health education on hypertension and appropriate referrals were made for those found to be hypertensive. All patients found with a reading of ≥180/110 mmHg were sent to the surgical/medical emergency room.

Pulse and respiratory rate

Pulse and respiratory rates were taken at similar intervals as the blood pressure measurements, and similarly, mean values were recorded.

Blood glucose

Biochemical test for blood sugars for the participants was then taken by a finger-prick test using OneTouch Select® Plus Glucometer, (Johnson & Johnson Medical Limited, High Wycombe, United Kingdom) and recorded. (Likely) hyperglycemia was defined as a random glucometer reading >11.1 mmol/l of blood glucose and fasting reading >7.0 mmol/l.[16]

Analysis

All variables were entered in Microsoft Excel 2007 and analyzed using Stata 14 software (StataCorp. College Station, TX). Background characteristics for all respondents were described, and descriptive summaries for all variables were reported. Tests of associations were done among the obtained variables and reported: *Z*-test was used to compare the mean systolic and diastolic blood pressure readings of subgroups, and Chi-square test was used to compare categorical variables with consequent test of association assuming an alpha level of 0.05. Fisher's exact test was used when applicable, for smaller subgroups.

RESULTS

There were a total of 175 participants in the study, comprising 76 males (43.4%) and 99 females (56.6%). This represented

Table 2: Background characteristics

Category	Frequency (%)
Age (years)	
<20	8 (4.6)
20-30	43 (24.6)
31-40	37 (21.1)
41-50	30 (17.1)
51-60	23 (13.1)
>60	34 (19.4)
Sex	
Male	76 (43.4)
Female	99 (56.6)
Highest educational level	
No formal education	16 (9.1)
Primary	19 (10.9)
JHS/JSS	32 (18.3)
SHS/SSS	70 (40.0)
Tertiary	38 (21.7)
Employment	
Unemployed	45 (25.7)
Employed in formal sector	87 (49.7)
Employed in informal sector	37 (21.2)
Retired	6 (3.4)
Monthly salary (GHS)	
None	45 (25.7)
100-500	38 (21.7)
501-1000	61 (34.9)
1001-2500	23 (13.1)
2501-4000	7 (4.0)
Above 4000	1 (0.6)
History of dental visit	
First dental visit	114 (65)
Previous visit	61 (35)

GHS=Ghanaian cedis, JHS=Junior higher secondary, JSS=Junior secondary school, SHS=Senior higher secondary, SSS=Senior secondary school
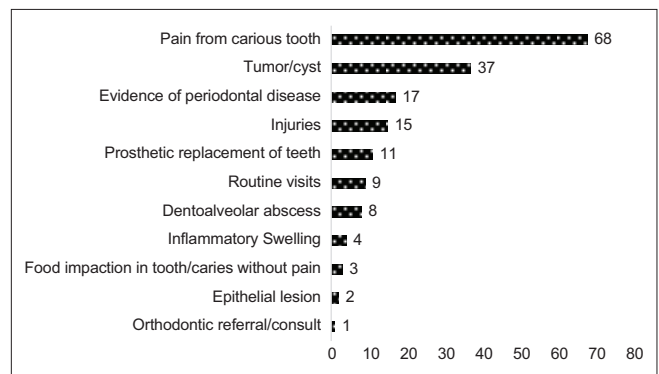

Figure 1: Reasons for attendance to the clinic

a male-to-female ratio of 0.8:1. The ages ranged from 18 to 86 years, with the median and mean ages of 40 years and 43.1 years (standard deviation: 16.9), respectively.

The 20–40 years' group together constituted 45.7% of the entire population. This was followed by patients ≥60 years of age [Table 2]. Most of the respondents had been formally educated

to at least senior high school level (40%), whereas 9.7% of them had not received any formal education. Almost half (49.7%) of the attendants to the dental clinic were people employed in the formal sector, followed by the unemployed category, of which most (82.2%) were students. Most attendants (65%) to the dentist were visiting for the first time, compared to the 35% who had a history of previous dental visits [Table 2].

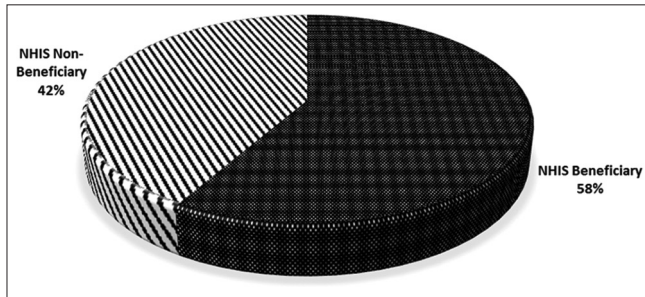Toothache from caries was the most common reason for attendance followed by maxillofacial swellings, periodontal disease, injuries, and missing teeth [Figure 1]. Furthermore, majority of the patients (58%) were beneficiaries of the NHIS [Figure 2].

Among the study participants, 31.4% were hypertensive. Of these, 76.4% were unknown, whereas 23.6% had previously been diagnosed. Furthermore, the burden of hyperglycemic
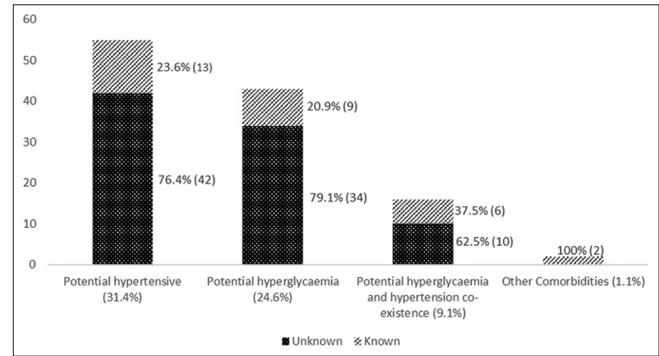

Figure 2: Proportion of National Health Insurance Scheme beneficiaries

Figure 3: Prevalence of potential hypertensives and hyperglycemics among dental patients

Table 3: Comparison of mean blood pressure and mean random blood sugar among variables						
Variable	Mean BP (mmHg)±SD	Test statistics	*P*	RBS (mmol/L)±SD	Test statistics	*P*
Age (years)						
<20	115.7/73.8±15.6/10.9	ANOVA (*F*)=6.68	<0.001*	6.25±1.29	ANOVA (*F*)=1.52	0.186
20-30	118.3/80.9±15.9/12.2			6.93±2.61		
31-40	127.9/82.1±17.7/11.1			7.39±4.05		
41-50	136.4/85.1±19.2/12.4			7.29±2.66		
51-60	140.0/90.5±22.2/14.6			8.67±4.31		
>60	140.3/85.8±28.4/14.6			8.59±4.40		
Sex			0.691			
Male	130.0/83.6±23.62/13.6	Z=0.39		7.23±2.76	Z=−1.28	0.202
Female	131.8/84.3±21.46/12.9			7.83±4.13		
Educational level						
None	144.7/94.6±27.3/15.3	ANOVA (*F*)=1.85	0.121	8.10±4.42	ANOVA (*F*)=3.89	0.004*
Primary	130.9/82.6±19.7/10.0			10.49±6.20		
JHS/JSS	127.1/80.3±17.5/10.4			6.85±2.72		
SHS/SSS	129.7/84.3±21.8/12.9			7.33±2.88		
Tertiary	130.0/82.1±24.9/14.6			7.23±2.87		
Employment						
Unemployed	129.7/82.6±20.8/13.0	ANOVA (*F*)=1.85	0.636	7.95±4.25	ANOVA (*F*)=0.38	0.765
Formal sector	132.7/84.6±23.5/13.5			7.49±3.52		
Informal sector	127.3/83.0±21.6/13.6			7.42±2.91		
Retired	133.5/87.5±23.3/9.9			8.73±4.53		
Monthly salary (GHS)						
None	129.2/84.4±22.5/13.6	ANOVA (*F*)=3.71	0.003*	7.93±4.32	ANOVA (*F*)=0.27	0.928
100-500	132.6/85.3±21.2/13.3			7.57±3.46		
501-1000	131.0/83.1±22.2/13.2			7.68±3.68		
1001-2500	128.3/82.4±20.0/12.5			7.50±2.86		
2501-4000	124.8/79.4±12.8/6.2			6.30±1.31		
Above 4000	220/120			6.5		
Dental visits						
First dental visit	131.8/83.7±24.5/13.5	Z=−2.05	0.039*	7.84±3.97	Z=3.659	<0.001*
Previous visit	129.0/84.1±17.9/12.8			7.26±2.88		

*Significance is *P*<0.05. RBS=Random blood sugar, SD=Standard deviation, BP=Blood pressure, GHS=Ghanaian cedis

patients was 24.6%. Similarly, 79.1% of this proportion were not aware, whereas 20.9% knew that they had diabetes. Furthermore, the prevalence of patients who were both hypertensive and hyperglycemic was 9.1%, of which 62.5% were unknown, and 37.5% were aware of the existence of the presence of the conditions [Figure 3]. Two participants had other comorbidities, namely sickle cell anemia and peptic ulcer disease. Each of these constituted 0.6% of the population.

The mean pulse rate for the study population was 73.0 (±14.1) bpm. This did not vary statistically significantly with hyperglycemia ($P = 0.574$), but was statistically significantly different among normotensives and hypertensives ($P = 0.030$). The mean respiratory rate of 20.3 (±2.98) cpm, however, did not significantly differ with hypertension and hyperglycemia.

The mean blood pressures of the respondents significantly increased with increasing age of the participants, whereas the mean blood sugar readings were not significantly different among the different age groups [Table 3]. There was also no statistically significant difference in both blood pressure and blood sugar among males and females, with respective $P = 0.691$ and 0.202. The blood sugar control of the study participants was poorest among those with no formal education and those with primary education as their highest educational level. The difference in mean random

blood glucose among the educational levels was found to be statistically significant [Table 3]. While salary levels of the participants did not confer a significant difference in mean RBS reading, it showed a difference in blood pressure readings of the study population ($P = 0.003$). Although patients with a history of previous dental visits had both lower blood pressure readings and lower random blood glucose readings ($P = 0.039$ and <0.001, respectively) [Table 3], the association with patients being hypertensive or hyperglycemic was, however, not statistically significant ($P = 0.127$ and 0.167, respectively) [Table 4].

The presence of hypertension was notably related to the varying age groups of the participants ($P < 0.001$) as well as the educational level ($P = 0.007$) of the study participants [Table 4].

DISCUSSION

This study aimed to determine the prevalence of patients with likely hypertension and/or hyperglycemia attending a dental clinic in Accra, in demonstrating that the dental office could be harnessed to screen dental patients in complementing national efforts for the early diagnosis of hypertension and diabetes. Our study found the prevalence of hypertension to be 31.4%, whereas that for hyperglycemia was 24.6% among patients attending the dental clinic [Figure 2]. The prevalence

Table 4: Association between variables and potential hypertensives and hyperglycemics

Variables	Potential hypertensives, *n* (%)	χ^2 statistic	*P*	Potential hyperglycemics, *n* (%)	χ^2 statistic	*P*
Age (years)						
<20	1 (12.5)	19.980	0.001*	1 (12.5)	3.505	0.623
20-30	3 (7.7)			7 (18.0)		
31-40	11 (28.2)			9 (23.1)		
41-50	14 (46.7)			7 (23.3)		
51-60	12 (50.0)			8 (33.3)		
>60	14 (40.0)			11 (31.4)		
Educational level						
None	11 (68.8)	14.183	0.007*	3 (18.8)	6.462	0.168
Primary	7 (36.8)			9 (47.4)		
JHS/JSS	6 (18.8)			6 (18.8)		
SHS/SSS	18 (25.7)			17 (24.3)		
Tertiary	13 (34.2)			8 (21.1)		
Monthly salary (GHS)						
None	15 (33.3)	4.098	0.535	9 (20.0)	4.408	0.492
100-500	14 (36.8)			11 (29.0)		
501-1000	17 (27.9)			18 (29.5)		
1001-2500	7 (30.4)			5 (21.7)		
2501-4000	1 (14.3)			0		
Above 4000	1 (100)			0		
Dental visits						
First dental visit	40 (35.4)	2.332	0.127	24 (21.2)	1.911	0.167
Previous visit	15 (24.2)			19 (30.7)		
BP						
Potential hypertensive	-			16 (29.1)	0.884	0.347
Likely normotensive	-			27 (22.5)		

*Significance is *P*<0.05. BP: Blood pressure, GHS=Ghanaian cedis

of hypertension in Ghana has been reported to range from 19% to 48% in other studies.[17] Findings from our study population, therefore, seem to corroborate the overall national prevalence of the condition.

On the other hand, population reports for the prevalence of diabetes were reported to be 6.5%[18] in Ghanaian adults. While our significantly higher prevalence could be a result of the false negatives from the use of the nondefinitive RBS in screening for diabetes, it goes without mention that hyperglycemia or diabetes mellitus plays an important role in the etiopathogenesis of several oral conditions, possibly accounting for its higher prevalence in our peculiar study population. Diabetes as well as its consequent halitosis and tooth loss among several populations has strongly been associated with periodontal disease.[19,20] Periodontal disease is also independently noted to affect 20%–50% of the world's population,[21] while accounting for a considerable proportion of dental interventions in some Ghanaian dental clinics.[22] Our higher prevalence of hyperglycemia could, therefore, be an indicator of the association between periodontal conditions and diabetes in the Ghanaian population.

The predisposition of diabetics to hypertension, as well as the overlap of the two etiopathologies, has been well described in literature, with the suggestion that diabetes and hypertension are found in the same people more often than would be expected to occur by chance.[23,24] This association was evident in our study with our reported prevalence of the coexistence of likely hypertensives and hyperglycemia to be 9.1%, while that for peptic ulcer disease and sickle cell anemia to be 0.6%.

The current study found an association between hypertension and age as well as the level of education. Salary levels of the participants did not confer a difference in mean RBS reading, but showed a difference in blood pressure readings of the study population (P = 0.003). Patients with a history of previous dental visits also had both lower blood pressure readings and lower random blood glucose readings (P = 0.039 and <0.001, respectively) [Table 3]. The risks of hypertension, aside from age and educational level, have been demonstrated in literature to also include increasing body mass index, increased salt consumption, family history of hypertension, excessive alcohol intake, and socioeconomic status.[18,25] Our study also showed that patients with a history of previous dental visits had both lower blood pressure readings and lower random blood glucose readings (P = 0.039 and <0.001, respectively) [Table 3]. Routines at a typical Ghanaian dental clinic, which include health education sessions, could have caused a positive health behavior response among the respondents.

Findings from this study also have implications for dental practice in Ghana, as dentists and other oral health professionals should also bear in mind the likely high prevalence of both conditions in their practice. Hypertension and diabetes could influence the dentist's treatment plan, administration of anesthesia, treatment modalities, and drug choice. Hypertensive and diabetic emergencies are also common in the dental office.[2]

Considering the likely high prevalence of both conditions among dental patients in Ghana, oral health professionals must be adequately equipped in knowledge and skill to handle potential complications which may arise from both conditions.

From the current study, nearly a third of the dental patients are hypertensives, and out of this number, three-quarters are unaware of the condition. A reported 700,000 new patients with hypertension were seen at government and missionary institutions in Ghana.[10] With increasing oral health awareness and general population attendances to dental clinics, an opportunity for integrating oral health and primary care could be explored. Significant addition could, therefore, be made to the national number of newly diagnosed cases, with the proportionate numbers which could be referred from all dental clinics.

This study is not without limitations as the choice of RBS in screening for diabetes, though economical, was crude and not precise. The use of a cross-sectional design in itself limits the ability to prove causality. As such, future studies could follow up patients with additional investigations to confirm the actual existence of hypertension and/or diabetes. Findings from this study could, however, be used to generate hypotheses for future studies in Ghana and the subregion.

Conclusion

This study found the prevalence of hypertension and hyperglycemia in the dental clinic to be 31.4% and 24.6%, respectively. The results of this study demonstrate the importance of the dental clinic in detecting both undiagnosed hypertensive and diabetic patients, as well as those who have previously been diagnosed, but who do not have their blood pressure and blood sugar under adequate control. With efficient referrals and follow-up systems in place at dental offices in Ghana, they could be harnessed as a fertile place to screen dental patients for hypertension and diabetes.

Conflicts of interest
There are no conflicts of interest.

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