



Meat Singeing Practices and Knowledge of Its Effects on Health and Environment among Butchers in Uyo, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AME, AEI and IAU designed the study, collected data and managed the literature search. Author AME wrote the first draft of the manuscript. Authors UEE, AEI, AME and AUI analyzed the data and wrote the results and discussion. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To determine the materials used in singeing meat, reasons for their use and knowledge of the health and environmental effects of using old tyres in meat singeing by butchers in Uyo, Nigeria.

Study Design: The study used a descriptive cross-sectional study design.

Place and Duration of Study: Uyo capital city territory, Akwa Ibom State, Nigeria from August 1st to 30th, 2019.

Methodology: We recruited 42 butchers (all males; mean age 25+/-6 years) from an abattoir, 2 slaughter slabs and meat processing sites on 2 major streets in Uyo capital city territory. Data collection was done using interviewer administered questionnaires and interview guide. Data was analyzed with Stata statistical software version 10.0.

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Results: The major singeing materials for goat hides were plastics 19 (45.2%) and old tyres 10 (23.8%) while firewood 13 (31.0%) was used for cattle hides. Reasons for preference of singeing materials were: old tyres burn fast 10 (100.0%), cheaper than firewood 10 (100.0%) and left no cracks on hides 10 (100.0%); Plastics were available 17 (89.5%), longer duration of flame 16 (84.2%) and the cheapest 15 (78.9%) compared to tyres and firewood while firewood was preferred because it burnt slowly. Twenty five butchers (59.5%) had poor knowledge of the effect of use of old tires in singeing on health and environment. Reported symptoms associated with singeing were cough 17 (56.7%), dizziness 16 (53.3%) and itchy eyes 14 (46.7%). Key informant interview revealed that number of animals singed, duration of flame and cost of singeing material were the major determinants of the type of singeing materials used.

Conclusion: Plastics, old tyres and firewood were mainly used by butchers in singeing hides. Poor level of knowledge of effects of use of old tires in singeing was seen. Capacity building of butchers and ban of use of these materials is recommended.

Keywords: Singeing; tyres; plastics; abattoirs; butchers; Uyo.

1. INTRODUCTION

Singeing of slaughtered animals is a major process by which fur on the skin of the animals are removed making the hide of the carcass ready for consumption and also evoke flavors in the meat which are acceptable to the consumers [1,2] In the United Kingdom, the specific hygiene rules for food of animal origin require the complete skinning of the carcass intended for human consumption due to concern over the safety for man's consumption [3]. One of such concerns is the concentrations of various heavy metals reported on hides prepared by various methods as against the recommended Maximum Permissible Levels (MPLs) by the European Commission Regulations [4]. In Nigeria and many other African countries, singeing of the hides of goats, sheep and cattle are often done over open fires using various materials which include firewood sometimes mixed with spent engine oil, spent automobile tires, plastics and liquefied petroleum gas (LPG) [1,5-7]. This process is usually carried out by butchers in abattoirs or by the road side and transported to markets where they are sold for human consumption in developing countries [6,7]. Various reasons are given for the use of these materials for singeing meat. Fire from spent tires is considered more effective and efficient when compared to firewood, and is known to selectively burn off the animal fur without cracking the hide [1,8-11]. The relative scarcity of firewood in recent times is another reason given for the use of scrap car tire in place of firewood [1].

These materials contain toxic substances which can contaminate the hides and render them unfit for human consumption [1,12]. The risk of heavy

metal contamination in such meat therefore is of great concern for both food safety and human health because of the toxic nature of these metals at relatively minute concentrations [13,14]. Toxic metals like arsenic, cadmium, nickel and lead are introduced into the meats from singeing with scrap tires and plastic wastes [1]. For example, tires which are made from natural and synthetic rubber contain a variety of compounds which include styrene butadiene, carbon black, aromatic coil, zinc oxide, stearic acid, antioxidant 6C, wax, sulphur, accelerator and extenders [5,15]. There is a risk of deposition of heavy metals in the hides of these animals which apart from compromising the quality of the meat, are also known to be bio-accumulative with different effects on various organs of the body [9].

Some amount of heavy metals including manganese and cadmium can also be released into the environment through combustion or ingested with meat products singed with fires from burning tires [2,11]. In addition, the smoke from burning tires released into the environment contain volatile organic compounds (VOCs), particulate matter and polycyclic aromatic hydrocarbons (PAHs) that reduce air quality. Soot from the tires burnt to singe hides are often washed into drains and contaminate water bodies and soil; and subsequently get into the food chain [5,16,17]. The butchers and people who live and work in environments close to abattoirs can inhale the VOCs, particulate matter and PAHs [5,18,19].

Burning of hides with plastics mixed with refuse present a significant health hazard to the population [20]. Burning of polystyrene polymers release styrene vapor which can readily be

absorbed by the hides and the long-term exposure to styrene affects the central nervous system, causing headaches, depression, and fatigue; while short-term exposure can cause eye and throat irritation [20]. In addition, Polychlorinated biphenyls (PCBs) released when plastics are burnt, contaminates the hides and the environment. The meat processors are also at risk because of the associated health hazards through inhalation of these toxic compounds [20]. The possibility of development of cancers by eating meat products contaminated with heavy metals in meat products singed with scrap tires and plastic wastes, [21] make these practices of important public health concern.

Most butchers involved in meat preparation have low level of education which could hamper the acceptability of modern and standard slaughtering practices and strict hygienic [10,22]. Poor knowledge of hygienic aspects of animal slaughtering and near total absence of training for butchers to improve their primitive practices have been reported [10,23,24]. Improving their knowledge about the hazards of improper butchering is essential to protect their health and that of the community [10].

The relative lack of studies on butchers' knowledge of the health and environmental effects of use of old tires in singeing meat prompted the conduct of this study in Uyo capital city territory.

2. MATERIALS AND METHODS

A descriptive cross-sectional study was conducted among workers involved in the processing of goat and cattle meat for sale in Uyo capital city territory from 1st to 30th August 2019.

The study was carried out in Uyo capital city territory of Akwa Ibom State, south-south geopolitical zone of Nigeria. The State has 31 Local Government Areas (LGAs) and 3 Senatorial Districts. The projected 2018 population of the State was 5,737, 270 [25].

Uyo capital city territory consists of 8 LGAs namely Uyo, the state capital, Itu, Uruan, Nsit Ibom, Etinan, Ibiono Ibom Ibesikpo Asutan and Abak [26]. The capital city territory has 2 major markets namely: Urua Akpan Andem and Urua Itam. There are two main abattoirs in the territory located at Ntak Inyang and Mbak Itam. These abattoirs are privately owned and process both

goats and cattle. The central abattoir is yet to be completed by the state government and hence not operational. Many privately owned unregistered slaughter slabs exists in Uyo capital city territory. These facilities process only goat meat for public consumption. In addition, some individual process goat meat in their homes and sell it to the public along major roads and streets in the territory. Veterinary doctors from the Ministry of Agriculture visit the abattoirs and perform ante and post slaughter inspection of animals for public consumption. These abattoirs and slaughter slabs supply meat products to these major markets and other smaller markets in the capital city territory and indeed the whole state.

The study was conducted among butchers involved in goat and cow meat singeing process in the selected abattoir, slaughter slabs and streets for public consumption in Uyo capital city territory. Butchers who refused to give consent and those not present on duty on the dates of visitations were excluded from the study. A minimum sample size of 39 was determined using the formula for estimating single proportion for cross-sectional studies with a prevalence of 0.026 being the prevalence of use of tyre in de-furring cows in a previous study [27], z of 1.96 and sampling error of 0.05. The sample size was, however, increased to 42 after adding 10% attrition rate.

Multi-stage sampling method was used in the study. Stage one involved selecting the abattoirs slaughter slabs and major roads where individuals slaughter and sell goats. From the two cattle abattoirs in Uyo capital city territory, one abattoir, located in Ntak Inyang, Itu LGA off Calabar-Itu road was selected by simple random sampling method for the study.

Five goat meat slaughter slabs which supply goat meat to the 2 major markets in Uyo capital city territory were identified. The total number of such facilities could not be determined as many of them are not registered. Among these, one goat meat slaughter slab each was selected by simple random sampling method that supplies goat meat to each of the 2 major markets in the territory. One is located along Usanga Udo Street and supplies goat meat to Urua Akpan Andem market and the other is situated beside the major cattle abattoir in Ntak Inyang, Itu LGA in Uyo capital city territory. Uyo is a city with 4 major roads viz: Aka road, Abak road (Olusegun Obasanjo way), Ikot Ekpene and Oron roads.

Two of the major roads were selected by simple random sampling (balloting) method viz: Oron and Abak roads.

Stage two involved selecting respondents for the study. All the butchers met on the visiting days to the selected facilities who gave consent were consecutively recruited into the study until the minimum sample size was obtained. Twenty three goat meat processors from the 2 slaughter slabs and 13 cattle meat processors from the selected abattoir were recruited. A drive through the 2 major selected roads was carried out by 6.30 am and six (6) goat meat processors present that morning were identified and consecutively recruited into the study after obtaining informed consent from them. In all, a total of 42 meat processors were recruited.

An interviewer-administered questionnaire based on the specific objectives of the study was developed after a thorough literature review. It was pre-tested among butchers at a market in Abak LGA, a nearby local government area and was further evaluated by experts in public health to ensure quality and content validity. Data was collected by research assistants who were resident doctors previously trained on how to administer the questionnaires.

The questionnaire consisted of 4 sections (A-D). Section A obtained respondent's socio-demographic data. Section B obtained information on materials used for singeing meat and reasons for using them; Section C dwelt on the questions to test the knowledge of the health effects of use of old tires in singeing meat and Section D assessed the short term health effects respondents experienced from their work of singeing meat with various substances and the personal protective devices, PPDs used by respondents. The section on knowledge of the health effects of use of old tyres in singeing meat had 6 questions. Each correct response to a question was scored one point and zero point given for an incorrect or don't know response. Maximum score was 6 and scores less than or equal to 3 were considered as poor level of knowledge while scores of 4 and above were considered good level of knowledge.

Key informant interviews were also conducted to obtain detailed information on experiences, perceptions and opinions concerning meat singeing, using an interview guide. Four (4)

butchers were interviewed and included one head of cattle abattoir, two heads of goat slaughter slabs and one roadside butcher.

Data obtained was collated and analyzed using Stata statistical software version 10.0 for windows. Categorical variables were summarized using frequency and percentages while quantitative variables were summarized using the appropriate measures of central tendencies (mean and standard deviation or median and interquartile range).

3. RESULTS AND DISCUSSION

All the respondents were males, Christians and indigenes of the state. Twenty-three (54.8%) were below 25 years of age with a mean age of 25.0+6.0 years. Twenty-seven (64.3%) practiced for less than 5 years with a median duration of practice of 3.0 years. Twenty-four (57.1%) had secondary level of education. Goat singeing was done by twenty-nine (69.1%) of the respondents. Thirty three (78.6%) were trained mainly through apprenticeship. Most 36 (85.7%) carried out their business in the abattoir (Table 1).

Plastics 19 (45.2%) and tyres 10 (23.8%) were the major singeing materials for goats while cattle hides were mainly singed with firewood 13 (31.0%). Most 20 (47.6%) believed that firewood was the best materials for singeing. The top three reasons for preference of old tyres were that it burns faster 10 (100%), is cheaper 10 (100%) and leaves no crack on the skin of the animals 10 (100%). In addition, the top three reasons for preference of plastics as singeing materials were its ready availability 17 (89.6%), longer duration of flame 16 (84.2%) and lower cost compared to firewood and old tyres 15 (78.9%). A few 12 (28.6%) of the butchers had been advised not to use old tyres to singe meat. Customers 10 (83.3%) were the majority of those who advised the butchers against the use of old tyres in singeing meat. (Table 2).

Regarding the knowledge of the dangers of use of old tyres as singeing materials, only a few 8 (19.1%) knew that their use may be associated with cancers in consumers. Some 18 (42.9%) knew that their use could affect meat quality and impart smell on the meat. Fifteen (35.7%) of the respondents were aware that its use can deposit toxic materials on the meat. The majority 37 (88.1%) knew that use of tyres singeing pollutes the air, 29 (69.0%) knew it pollutes the soil but a smaller proportion 15 (35.7%) knew that the

Table 1. Socio-demographic characteristics of respondents

Characteristics	Frequency (n=42)	Percent
Age (years)		
Less than 25	23	54.8
25 and above	19	45.2
Mean age [in years] ± SD	24.9 ± 6.0	
Number of years of practice		
Less than 5	27	64.3
5 years and above	15	35.7
Median [IQR] years of practice	3 [2-6]	
Level of education		
Primary	15	35.7
Secondary	24	57.1
Post-Secondary	3	7.1
Business type		
Goat	29	69.1
Cattle	13	30.9
Tribe		
Ibibio	41	97.6
Annang	1	2.4
Received training before practice		
Yes	33	78.6
No	9	21.4
Location of business		
Road side	6	14.3
Abattoir	36	85.7

SD= standard deviation; IQR= interquartile range

practice can pollute nearby surface water bodies. Overall, knowledge was poor for more than half 25 (59.5%) of the respondents (Table 3).

Table 4 displays the self-reported acute health symptoms of the butchers from the meat singeing practices and their use of personal protective devices at work. The majority, 30 (71.4%) reported at least one symptom. Commonly reported symptoms associated with singeing were cough 17 (56.7%), dizziness 16 (53.3%), itchy eyes with tears 14 (46.7%) and skin rashes 13 (43.3%). Chest Pain 2 (6.7%) and black sputum 6 (20.0%) were the 2 least reported symptoms. None of the butchers used any form of personal protective device at work.

3.1 Key Informant Interview with Heads of the Abattoirs

The key informants were four male butchers between the ages of 28 to 50 years and had practiced meat singeing for 5 to 20 years. One of the butchers was the head of an abattoir, two were heads of goat slaughter slabs and one was a roadside butcher. They were asked about preferred materials for singeing and reasons for its use, methods of cleaning the singed hides, effects of their practice on environment and

health effects of use of old tyres in singeing. Responses are presented in three thematic categories below.

Key informants agreed that they use various materials and the choice was dependent on the number of animals being singed and duration the flame was desired to last. The head of the cattle abattoir puts it thus 'the slow heat from firewood was preferred because it does not get the hide cracked' while the roadside butcher also preferred firewood for the reason that 'I only have to singe a goat for sale so I have to take time and control the slow flame that burns from firewood.'

The interviewees from the goat slaughter slabs preferred old tires or plastics because firewood was more expensive. One of them reported that: 'One hundred naira (N100) worth of old tyre (one old tire) could effectively singe 3 goats while N300 worth of firewood could only singe one goat'. Plastics were also reported to be cheaper than old tires and easily available as households commonly disposed of them. Types of plastics used include broken jerry cans, chairs and plastics found in the bonnet of cars. The interviewee that preferred plastics commented 'I do not buy plastics as I can pick them from

refuse heaps'. He added thus: 'the skin of goats singed with plastics are usually lighter and finer in color and not as dark as that singed with old tires' All the respondents knew that hides could be boiled and the fur scrapped off with knives/blades but did not practice this, because they considered the method too tasking and time consuming.

Key informants were asked how they wash the singed hides and the effect of the waste water on the environment. They noted that after singeing, hides are scraped with a knife, then scrubbed

with a metal sponge and later washed with water fetched from a nearby stream (the same surface water into which the soot from the singed meat flows) or a borehole. On the effect of the effluents on the environments, they all agreed that the effluents could pollute the soil but did not think that there was any effect on the nearby water bodies. An interviewee responded thus, 'it has no effect on the animals in the water and does not affect the water quality as the water will wash the soot away.' They also reported that they use the water themselves and have not fallen ill since.

Table 2. Types of materials used for singeing hides and reasons for its use by respondents

Characteristics	Frequency	Percent
Main Singeing Material (n=42)		
Plastic	19	45.2
Old Tyres	10	23.8
Firewood	13	31.0
Use of Additional singeing materials (n=42)		
Yes	24	57.1
No	18	42.9
*Additional singeing materials used (n=24)		
Omentum from the slaughtered animals	11	45.8
Plastics	9	37.5
Firewood	8	33.3
Dry palm leaves/nuts	6	25.0
Best Singeing Material as perceived by butchers (n=42)		
Firewood	20	47.6
Plastics	15	35.7
Old Tyre	7	16.7
*Reasons for using Tyres in Singeing (n=10)		
Burns goat faster than firewood	10	100.0
Cheaper than firewood	10	100.0
Causes less crack on skin of goat	10	100.0
Easily available	6	60.0
Imparts better flavor on meat	6	60.0
Burns skin better	8	80.0
*Reasons for using Plastics in singeing (n=19)		
Burns faster than firewood	14	73.7
Flame last longer	16	84.2
Is cheaper than firewood or tire	15	78.9
Easily available	17	89.5
Less smoke emitted hence cleaner goat	10	52.6
No effect on taste	9	47.4
Safer to butcher, customer and environment	6	31.6
Reasons for using Firewood in singeing (n=13)		
Burns slowly	13	100.0
Causes less crack on skin	13	100.0
Told not to use old tyres to singe meat (n=42)		
Yes	12	28.6
No	30	71.4
Who told you not to use tyres (n=12)		
Customers	10	83.3
Health workers	2	16.7

**Multiple responses allowed*

Table 3. Knowledge of dangers of use of old tyres in singeing meat

Knowledge questions	Frequency (n=42)	Percent
Use of old tyres to singe meat can cause cancers in consumers		
Yes	8	19.1
No	28	66.7
Don't know	6	14.3
Use of old tyres to singe meat can impart smell on the meat/affect meat quality		
Yes	18	42.9
No	24	57.1
Use of old tyres to singe meat can deposit toxic materials on the meat and pose health hazards		
Yes	15	35.7
No	27	64.3
Use of old tyres to singe meat can pollute the air		
Yes	37	88.1
No	5	11.9
Use of old tyres to singe meat can pollute the soil		
Yes	29	69.0
No	13	31.0
Use of old tyres to singe meat can pollute surface water		
Yes	15	35.7
No	27	64.3
Level of Knowledge		
Poor	25	59.5
Good	17	40.5

Table 4. Self-reported acute health effects of butchers from singeing meats

Variables	Frequency	Percent
Symptoms Present (n=42)		
Reported at least one symptom	30	71.4
Reported no symptoms	12	28.6
Symptoms* [n=30]		
Cough	17	56.7
Dizziness	16	53.3
Itchy eyes with tears	14	46.7
Headache	13	43.3
Skin rashes	13	43.3
Drowsiness	9	30.0
Vomiting	7	23.3
Black sputum	6	20.0
Chest pain	2	6.7
Use of PPDs (n=42)		
Use of Foot wears, goggles, face mask and apron	0	0.0

*Multiple responses allowed; PPDs - Personal Protective Devices

Furthermore, the respondents agreed that soot from the singeing practice could pollute the air. One of the respondents pointed out that the roofing sheets on buildings nearby were dark due to the soot that had settled on them.

Two of the butchers did not think that singeing meat with tyres could leave any harmful

substance on the meat since they wash the meat thoroughly after singeing. To them, meat singed with old tyres do not have any effect on the health of consumers. They did not believe that the use of tyres to singe could cause cancers to those who consume the meat. One of the butchers said 'Oga, I have been doing this business for many years and I also eat the meat,

why don't I have cancer?' However, the other two felt otherwise and believed it affects meat quality and may cause cancers.

In this study, plastics and old tyres were exclusively used in singeing in the goat meat slaughter slabs. Studies in Ghana and Nigeria reported similar practices [28,1,12]. Significant health hazard to the population from the use of plastics in singeing hides have been documented. Reports from United States Environmental Protection Agency in 2013 [11] and studies in Ghana and India revealed that noxious gases and chemicals released by this process can adulterate meat and hide rendering them unwholesome for human consumption [1,11,29]. These exposures could result in short and long-term health risk to the meat processors and communities including possible increased cancer rates and neurological effects as reported in an Indian study in 2008 [29]. Environmental pollution is also reported from these activities [1,19,28,29,30]. This study confirmed the use of firewood in singeing goat and cattle meat. Other studies in Ghana and Nigeria equally reported the use of firewood as the traditional method of singeing meat products [1,27]. However, its scarcity in many African countries for several reasons has warranted the use of other materials [31]. The relatively safer fuel for singeing hides, Liquefied Petroleum Gas, LPG has been reportedly used in larger government or private company-funded abattoirs in Ghana [6] but its high cost makes its use not feasible by the private butchers.

Reasons for use of plastics and tires such as flame efficiency, burning hides without cracks, lower cost and easy availability compared to firewood agrees with findings of other studies in Ghana and Nigeria [1,9,5]. Also, low economic class, low literacy levels and lack of awareness of the butchers of the potential risks involved are other reasons for this hazardous practice in a similar study in Nigeria in 2015 [10]. The development and implementation of tire disposal policy by government and regular trainings to raise butchers awareness may contribute to ending this practice.

In this study, only a few had ever been told not to use tires to singe meat. Customers who buy the animals for the butchers to process for them were those who advised them against this practice. This finding differs from the report from a similar study in Ghana in 2014 where the butchers had been educated by environmental health officers not to use scrap tyres in meat

singeing [9]. Consumer's awareness and education is therefore key to abolishing this practice. Community members can partner with the necessary authorities to change factors which impact their lives [32]. The role of Environmental health officers and veterinary doctors in educating and supervising the activities of butchers cannot be over emphasized.

This study found that the level of knowledge of butchers on the health effects of use of tyres in singeing hides for human consumption was poor. This finding agrees with the reports of related studies in China and India [23,24]. Few were aware that the use of these materials can lead to the deposition of toxic materials on the meat. Nevertheless, majority of the butchers knew that the use of tyres in singeing pollutes the air and soil. This is in contrast to findings of a Nigerian study in 2015 [10]. The polluted air and soil are very visible to the butchers as they singe the hides hence their better knowledge of this effect. Comparatively, a smaller proportion knew that the practice can pollute nearby surface water bodies. Unlike the effect on soil and air, the effect on water and its organisms may not be immediately visible to them as the water body was relatively far from them and the effect on the organisms may not be immediate hence the poor knowledge on this. The overall poor level of knowledge may be due to their few years of practice as butchers [median duration of practice of 3 years]. The presence of street butchers and many others practicing in unregistered slaughter slabs with little or no supervision by veterinary doctors may also account for this poor level of knowledge. Street vendors have been reported to have poor level of knowledge of basic food safety rules/regulations necessary to prevent contamination [33,34].

The majority, reported at least one symptom associated with meat singeing practices, a finding that agrees with report of a similar study [35]. Cough, dizziness and itchy eyes were commonly reported by respondents. Short term exposure to styrene, one of the products released when old tires are burnt, is reported by Agency for toxic substances and disease registry in Atlanta, USA to cause eye and throat irritation. [20], may be responsible for this observation.

None of the butchers was observed to use any personal protective equipment like goggles, gloves, foot wears, aprons or mask. Similar studies in India and Nigeria in 2019 however, reported the use of some personal protective

devices by a few of their participants [24,27]. Use of PPDs prevent meat contamination and also protect butchers from meat borne diseases [24]. The poor level of knowledge and the relative inexperience of the respondents may explain their none-use of PPDs.

Some of the limitations of this study was our inability to obtain a list of all butchers in the metropolis leading to exclusion of some butchers. This was because some operate in unlicensed slaughter slabs. Also, some refused to voluntarily participate in the study. This may not allow the generalization of our findings to the population outside study participants. However, the authors strongly believe that the findings still provide good information on the types of materials used in meat singeing and their knowledge of environment and health effects of use of tires in meat singeing in the state.

4. CONCLUSION

The study confirmed the use of plastics, old tyres and firewood in singeing hides. The overall level of knowledge on health effects of use of old tires on health and environment was poor. Various acute health problems were reported by butchers involved in singeing meats. Targeted education of butchers on the dangers to health and environment of these practices, intensified supervision of their activities and legislation and enforcement of the type of materials to be used in processing of hides for human consumption is urgently needed.

There is need for further studies to determine the effect of the recommended capacity building on knowledge and practices of butchers concerning meat singeing as well as the impact of their practices on their health and the environment.'

CONSENT AND ETHICAL APPROVAL

Ethical approval with reference number UUTH/AD/S/96/VOL XXI/345 was obtained from University of Uyo Teaching Hospital Ethical Review Committee. Permission to conduct the study was obtained from the heads of the various facilities. Informed consent was obtained from respondents. Voluntary nature of study was explained to them and non-participation attracted no penalties. They were assured of absolute confidentiality of data obtained from them

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COMPETING INTERESTS

Authors have declared that no competing interests exist

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