Journal of Advanced Veterinary and Animal Research
ISSN 2311-7710 (Electronic)
http://doi.org/10.5455/javar.2017.d201
A periodical of the Network for the Veterinarians of Bangladesh (BDvetNET)

June 2017
Vol 4 No 2, Pages 200-206.

Short Communication

Gross testicular abnormalities in indigenous breeds of bulls in Eastern Ethiopia

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• **Received:** March 12, 2017 • **Revised:** March 21, 2017 • **Accepted:** March 23, 2017 • **Published Online:** March 29, 2017

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ABSTRACT

Objective: This study was conducted to assess the prevalence of different types of gross testicular disorders in bulls, and to evaluate the associations with sampling year, age, and body condition.

Materials and methods: In this study, a total of 398 apparently healthy bulls were randomly selected that were brought from different parts of eastern Ethiopia to the Haramaya University abattoir for slaughtering during the period from June 2014 to September 2016. Ante- and post-mortem examinations of the bulls were employed. Visual inspection, palpation, serial and systematic dissections into the parenchyma of the testes and scrotum were performed to determine the presence and the extent of gross pathological changes.

Results: Out of 398 bulls, 209(52.5%) were affected by one or more gross testicular abnormalities of unidentified causes. Bilateral testicular hypoplasia was the most prevalent (9.8%; n=39/398) testicular abnormality, followed by unilateral testicular hypoplasia (9%; n=36/398), testicular hematoma (9%; n=36/398), orchitis (8.3%; n=33/398), testicular degeneration (6.5%; n=26/398), scrotal wound (6.3%; n=25/398) and epididymitis (2.5%; n=10/398). Unilateral cryptorchidism was the least prevalent (1%; n=4/398). Age and body condition did not affect the prevalence of any abnormality ($P>0.05$) except in scrotal wound which was significantly varied among body condition categories ($P<0.05$).

Conclusion: This study reveals that the incidence of gross testicular abnormalities was 52.5% in bulls. Thus, attention should be given to reproductive management of bulls in Ethiopia.

KEYWORDS

Bull; Infertility; Orchitis; Reproductive organs; Scrotum; Testicular disorders

How to cite: Gemeda AE (2017). Gross testicular abnormalities in indigenous breeds of bulls in Eastern Ethiopia. Journal of Advanced Veterinary and Animal Research, 4(2): 200-206.

INTRODUCTION

Reproduction both in natural breeding and assisted reproductive management systems of livestock is precondition of efficiency and economic gain from animal production (Ball and Peters, 2004; Chenoweth, 2011). In cattle production, productivity depends on reproductive performance which depends on fertility of both cows and bulls in the herd (Ball and Peters, 2004; McEntee, 2012). Fertility in herds is influenced by factors related to cows and bulls as well as managerial and environmental conditions (Chenoweth, 2011).

However, fertility of the bull is more important than that of any individual cows in the herd because a bull can mates and breeds many cows in natural breeding or through artificial insemination (Ball and Peters, 2004; Barth, 1997). Thus, the fertility or reproductive capacity of the individual bull determines the reproductive performance of a herd (Ball and Peters, 2004) and is essential for sustainable cattle production (Kastelic, 2013). Regardless of these facts, fertility in bulls receives inadequate attention (Ball and Peters, 2004) and it is assumed that infertility is a female problem (Hopkins, 2007). Moreover, scientific and practical or management aspects of cattle production usually focused on the cows (Parkinson, 2009; Chenoweth, 2011). As a result, several aspects of male livestock reproduction are comparatively ignored (Chenoweth, 2011). Particularly, in bulls used for natural breeding fertility is rarely investigated as compared to bulls used for artificial insemination. These can lead to substantial and expensive delay in the detection of fertility problems in the cattle herd reared under natural breeding system (Ball and Peters, 2004).

Sub-fertility, infertility and sterility occur in bulls due to diverse causes (Ball and Peters, 2004), among which congenital or acquired reproductive tract abnormalities are the main (Foster, 2012). Different visible or palpable physical abnormalities of the testes, scrotum or epididymis may cause infertility in bulls and undermine productivity of the livestock (Hafez, 1993).

In cattle production in Ethiopia, the predominant breeding management system is natural mating. Regardless of the above stated effects of the bull reproductive tracts abnormalities on the fertility and productivity of cattle production; especially in cattle production system which applies natural mating as animal reproductive management system (Chenoweth, 2011) such as in Ethiopia, there is paucity of information on testicular abnormalities of the bulls in Ethiopia since very few studies have been conducted on sub-fertility or infertility due to testicular abnormalities of the bulls. In contrast, particulars about the scope and prevalence of the different types of testicular abnormalities of bulls will help for proper diagnosis and treatment of diseases and to implement suitable prevention and control approaches thus, to maximize fertility and productivity of cattle production. In addition, data on reproductive capacity of bulls enables to realize breeding success through examination and timely detection of the reproductive problems and developing appropriate reproductive management strategies (Chenoweth, 1997; Chenoweth and Kastelic, 2007). Abnormalities of the reproductive tracts in domestic animals are efficiently studied using abattoir surveys (Alosta et al., 1998). Thus, this study was conducted with objectives of identifying and determining prevalence of the different types of gross testicular disorders in bulls slaughtered at Haramaya University abattoir and to evaluate the association between sampling year, age, and body condition and gross testicular abnormalities in bulls.

MATERIALS AND METHODS

Study area and animals: Haramaya University is located in Haramaya district at 9°26'N and 42°3'E in Eastern Hararghe Zone, Oromia Regional State, Ethiopia. Haramaya district has mean annual temperature and relative humidity of 18°C and 65%, respectively. The area has four seasons including a short rainy season which extends from March to mid-May, a short dry season which covers from May to June, a long wet season extending from July to mid-October, and a long dry season that extends from the end of October to end of February. The Haramaya area receives an average annual rainfall of approximately 900 mm, with a bimodal pattern (HADB, 2009).

The livestock population of the district is estimated to be 65,083 sheep, 84,916 goats, 76,336 cattle, 22,355 donkeys, 356 camels and 89,800 chickens (CSA, 2012). Indigenous breeds of bulls of different age and body condition scores that were brought from different parts of eastern Ethiopia for slaughter at Haramaya University abattoir were included in this study. These bulls had been kept under traditional extensive management system and were used for natural breeding and as source of meat, fertilizer and draught power for the agriculture production.

Study design, sample size and sampling: A cross sectional study was conducted on the randomly selected apparently healthy bulls slaughtered at Haramaya University (HU) abattoir during the period from June 2014 to September 2016. The study was conducted with the approval and permission of the College of the Veterinary Medicine, Haramaya University following the

ethical standards set by the university. The sample size was determined according to the formula of Thrusfield (2005); using 95% confidence interval, 5% desired absolute precision and with the assumption of 30.4% expected prevalence. Accordingly, 398 bulls were included in this study. During each visit, the study bulls were selected from cattle slaughtered at the abattoir using systemic random sampling. The age of the cattle were divided into two groups as young and adult (Pace and Wakeman, 2003). Body condition score of the animals was classified as good, medium and poor (Nicholson and Butterworth, 1986).

Ante- and post-mortem examinations: During ante-mortem examination, data on age and body condition of individual animal were assessed and recorded. The examination consisted of visual inspection and palpation of the reproductive organs. The ante-mortem examination of testes and scrotum was performed following the procedure mentioned by Parkinson (2009). Both visual inspection and palpation of the testes and scrotum were performed. Grossly lesions were typified by their size, shape, thickness, content, symmetry, consistency, resilience and location. Gross abnormalities of each part were identified and recorded (Parkinson, 2009).

During post-mortem examination, the genitalia including testes, epididymis, and scrotal sac were examined for presence of any gross pathological abnormalities as per the procedure mentioned by Parkinson (2009). Serial and systematic dissections of the parenchyma in the organs were performed to determine the presence and the extent of gross pathological changes (Hafez, 1993; Hopkins, 2007). The abnormalities were observed and recorded. The testes, epididymis, and scrotal sac were examined for presence of any gross pathological abnormalities including scrotal adhesion, orchitis, epididimitis, unilateral testicular hypoplasia, bilateral testicular hypoplasia, cryptorchidism, hematomas, abscesses, calcification, wound, and obstruction of organs, inflammatory, and degenerative changes (Hopkins, 2007; Parkinson, 2009).

Data analysis: All the collected data were entered into Microsoft Excel spreadsheets (Microsoft Corp., Redmond, WA, USA). Percentage values were used to summarize the data. The effects of animals' related risk factors such as age and body condition and sampling year on the occurrence of gross testicular disorders were evaluated using a *chi*-square and fisher's exact test analysis. Risk factors that were significant in a *chi*-square and fisher's exact test analysis were further analyzed using logistic regression model analysis to assess associations between incidence of the gross testicular disorders and the considered risk factors. The analysis of the considered risk factors was performed using SPSS for Windows version 17.0 (SPSS Inc., Chicago, IL, USA). Differences were considered significant at value of $P<0.05$.

RESULTS

Overall, 209(52.5%) of the 398 examined bulls were affected by one or more gross testicular abnormalities of unidentified causes. Evidences of the gross lesions observed in the testes of the bulls are shown in **Figure 1**. Bilateral testicular hypoplasia was the most common disorder with an overall prevalence rate of 9.8% (n=39/398) followed by unilateral testicular hypoplasia (9%; n=36/398), testicular hematoma (9%; n=36/398), orchitis (8.3%; n=33/398), testicular degeneration (6.5%; n=26/398), scrotal wound (6.3%; n=25/398) and epididymitis (2.5%; n=10/398). Unilateral cryptorchidism (1%; n=4/398) was the least prevalent among the gross disorders.

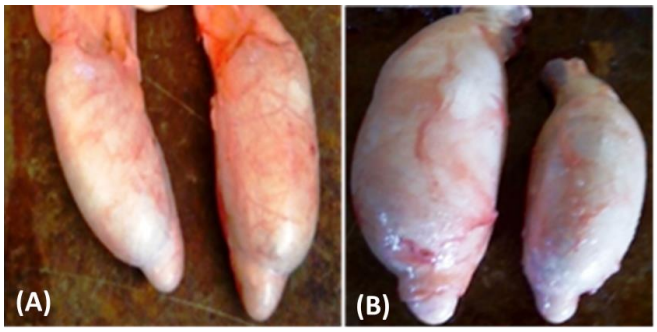

Figure 1: Gross testicular abnormalities in bulls: (A) Bilateral testicular hypoplasia. (B) Unilateral testicular hypoplasia (normal on the left)

Type and prevalence of gross testicular abnormalities in bulls in relation to sampling year, age and body condition are shown in **Table 1**. It was observed that the prevalence of scrotal wound, orchitis, testicular hematoma, unilateral and bilateral testicular hypoplasia significantly varied with sampling year ($P<0.05$). On the other hand, the prevalence of epididymitis, testicular degeneration and unilateral cryptorchidism was not significantly varied among sampling years ($P>0.05$). Furthermore, age and body condition score of the study bulls had not caused significant discrepancy in prevalence of all gross testicular abnormalities ($P>0.05$) except in scrotal wound in which it was higher in the bulls of good body condition category (10.9%) as compared to poor (5.9%) and medium (4.1%) conditioned bulls ($P<0.05$).

The occurrences of gross testicular abnormalities in relation to sampling year, age and body condition were analyzed using logistic regression model (**Table 2**). The

Table 1: Types and prevalence of gross testicular abnormalities in bulls in relation to sampling year, age and body condition

Variables	Categories	Total	SW (%)	ORC (%)	EP (%)	TH (%)	UTH (%)	BTH (%)	TD (%)	UCR (%)
Year	2014	129	2(1.6)	2(1.6)	2(1.6)	1(0.8)	1(0.8)	1(0.8)	4(3.1)	1(0.8)
	2015	130	9(6.9)	14(10.8)	6(4.6)	24(18.5)	15(11.5)	20(15.4)	11(8.5)	2(1.5)
	2016	139	14(10.1)	17(12.2)	2(1.4)	11(7.9)	20(14.4)	18(12.9)	11(7.9)	1(0.7)
	$\chi 2(P)$		9.18(0.01)	13.8(0.00)	2.97(0.25)	26.9(0.00)	20.8(0.00)	23.1(0.00)	3.96(0.14)	0.72(0.84)
Age	Young	173	6(3.5)	14(8.1%	4(2.3)	15(8.7)	16(9.2)	11(6.4)	12(6.9)	1(0.6)
	Adult	225	19(8.4)	19(8.4)	6(2.7)	21(9.3)	20(8.9)	28(12.4)	14(6.2)	3(1.3)
	$\chi 2(P)$		4.11(0.06)	0.02(1)	0.05(0.86)	0.05(0.86)	0.02(1)	4.10(0.06)	0.08(0.84)	0.56(0.64)
BSC	Poor	34	2(5.9)	1(2.9)	0	4(11.8)	4(11.8)	0	1(2.9)	1(2.9)
	Medium	245	10(4.1)	17(6.9)	7(2.9)	18(7.3)	18(7.3)	23(9.4)	17(6.9)	1(0.4)
	Good	119	25(10.9)	15(12.6)	3(2.5)	14(11.8)	14(11.8)	16(13.4)	8(6.7)	2(1.7)
	$\chi 2(P)$		6.05(0.04)	4.24(0.11)	0.99(0.72)	2.51(0.26)	2.51(0.26)	5.99(0.05)	0.47(0.86)	3.46(0.11)

BCS=Body condition score, SW=Scrotal wound, ORC=Orchitis, EP=Epididymitis, TH=Testicular hematoma, UTH=Unilateral testicular hypoplasia, BTH=Bilateral testicular hypoplasia, TD=Testicular degeneration

Table 2: Summary results of binary logistic regression for testicular abnormalities in bulls

Disorders	Variables	Categories	Total	Prevalence (%)	OR	*P*-value	95%CI OR
SW	Year	2014*	129	2(1.6)	1	-	-
		2015	130	9(6.9)	3.33	0.14	0.66-16.7
		2016	139	14(10.1)	5.29	0.03	1.13-24.8
	Age	Young*	173	6(3.5)	1	-	-
		Adult	225	19(8.4)	1.99	0.16	0.76-5.19
	BSC	Poor*	34	2(5.9)	1	-	-
		Medium	245	10(4.1)	0.60	0.54	0.12-2.98
		Good	119	25(10.9)	1.30	0.75	0.26-6.43
ORC	Year	2014*	129	2(1.6)	1	-	-
		2015	130	14(10.8)	6.55	0.02	1.41-30.5
		2016	139	17(12.2)	8.16	0.01	1.80-36.9
	Age	Young*	173	14(8.1)	1	-	-
		Adult	225	19(8.4)	0.82	0.60	0.39-1.73
	BCS	Poor*	34	1(2.9)	1	-	-
		Medium	245	17(6.9)	2.03	0.50	0.26-16.2
		Good	119	15(12.6)	2.89	0.32	0.36-24.4
TH	Year	2014*	129	1(0.8)	1	-	-
		2015	130	24(18.5)	33.1	0.001	4.28-255
		2016	139	11(7.9)	12.4	0.018	1.55-99.1
	Age	Young*	173	15(8.7)	1	-	-
		Adult	225	21(9.3)	0.94	0.79	0.43-1.87
	BCS	Poor*	34	4(11.8)	1	-	-
		Medium	245	18(7.3)	0.43	0.19	0.12-1.50
		Good	119	14(11.8)	0.42	0.19	0.12-1.52
UTH	Year	2014*	129	1(0.8)	1	-	-
		2015	130	15(11.5)	18.2	0.006	2.31-144
		2016	139	20(14.4)	24.5	0.002	3.17-189
	Age	Young	173	16(9.2)	1.42	0.34	0.69-2.9
		Adult*	225	20(8.9)	1	-	-
	BSC	Poor*	34	4(11.8)	1	-	-
		Medium	245	18(7.3)	0.42	0.17	0.12-1.44
		Good	119	14(11.8)	0.51	0.29	0.14-1.80
BTH	Year	2014*	129	1(0.8)	1	-	-
		2015	130	20(15.4)	20.8	0.004	2.67-161
		2016	139	18(12.9)	16.1	0.008	2.09-124
	Age	Young*	173	11(6.4)	1	-	-
		Adult	225	28(12.4)	0.56	0.13	0.26-1.18
	BCS	Poor	34	0	0.00	0.99	-
		Medium	245	23(9.4)	1.11	0.76	0.55-2.30
		Good*	119	16(13.4)	1	-	-

*BCS=Body condition, SW=Scrotal wound, ORC=Orchitis, EP=Epididymitis, TH=Testicular hematoma, UTH=Unilateral testicular hypoplasia, BTH=Bilateral testicular hypoplasia, TD=Testicular degeneration, UCR=Unilateral cryptorchidism, *=reference category*

prevalence of scrotal wound was significantly ($\chi2$=9.18; P<0.05) higher (10.1%) during the study year 2016 as compared to that during the years 2015 (6.9%) and 2014 (1.6%). The odds of scrotal wound prevalence in 2016 sampling year were 5.29 times more likely than the prevalence of scrotal wound in 2014 sampling year with 95% CI=1.13-24.8. Similarly, the incidence of orchitis was significantly ($\chi2$=13.8; P<0.001) higher in 2016(12.2%) and 2015(10.8%) as compared to 2014(1.6%). The odds of orchitis prevalence in 2016 were 8.16 times more likely than the prevalence of orchitis in 2014 with 95% CI=1.80-36.9. Although, the odds of orchitis prevalence in 2015 were 6.55 times more likely than the prevalence of orchitis in 2014 with 95% CI=1.41-30.5.

Furthermore, sampling year had a significant ($\chi2$=26.9; P<0.001) effect on the occurrence of testicular hematoma where it was significantly higher in the bulls sampled during 2015 (18.5%) and 2016 (7.9%) than in bulls examined in 2104 (0.8%). The odds of testicular hematoma prevalence in 2015 were 33.1 times more likely than the prevalence of testicular hematoma prevalence in 2014 with 95% CI=4.28-255. Also, the odds of testicular hematoma prevalence in 2016 were 12.4 times more likely than the prevalence of hematoma in 2014 with 95% CI=1.55-99.1.

The prevalence of unilateral and bilateral testicular hypoplasia were significantly varied among the years of the survey (P<0.05). Logistic regression revealed that bulls that were examined in 2016 were more likely to be affected with unilateral testicular hypoplasia than those slaughtered in 2014 (OR=24.5; 95%CI: 3.17-189). Likewise, bulls examined in 2015 were more likely to be affected with unilateral testicular hypoplasia as compared to bulls examined in 2014 (OR=18.2; 95%CI: 2.31-144).

DISCUSSION

This study revealed that an overall prevalence of gross testicular abnormalities in bulls of local breeds slaughtered at Haramaya University abattoir was 52.5% (n=209/398). This overall occurrence rate of gross testicular abnormalities of unidentified causes in bulls was higher than the reports of Migbaru et al. (2014) in central Ethiopia, Barth and Waldner (2002) in beef bulls in Canada, and Silva et al. (2008) in Brahman, Nelore and Brown Swiss bulls in Mexico, where the prevalence was 30.4, 22.1, 8.37, 6.78 and 6.88%, respectively. These differences in prevalence of gross testicular disorders in the bulls among different study areas might be attributed to variations in animal management system, breeds of bulls studied and geographic and climatic conditions of areas. It had been documented that sex-related disorders in domestic animals varied depending upon the species and breed and the selection practice used by breeders (Basrur and Basrur, 2004).

The different types of gross testicular abnormalities identified during this survey were scrotal wound (6.3%; n=25/398), orchitis (8.3%; n=33/398), epididymitis (2.5%; n=10/398), testicular hematoma (9%; n=36/398), unilateral testicular hypoplasia (9%; n=36/398), bilateral testicular hypoplasia (9.8%; n=39/398), testicular degeneration (6.5%; n=26/398) and unilateral cryptorchidism (1%; n=4/398). The most common abnormality identified was testicular hypoplasia with prevalence rate of 18.8% (n=75/398), of which 9% (n=36/398) and 9.8% (n=39/398) were unilateral and bilateral testicular hypoplasia, respectively. This is in accordance with fact that testicular hypoplasia is reported to be the most common reproductive abnormality of bull encountered by veterinary practitioners (Hopkins, 2007). Significantly varied differences in the prevalence of unilateral (χ^2=20.8; P<0.01) and bilateral (χ^2=23.1; P<0.01) testicular hypoplasia between years of study were observed. Age and body condition of bulls did not significantly affect the occurrences of unilateral and bilateral testicular hypoplasia (P>0.05). Similar to this study, it has been reported that testicular hypoplasia had no significant association with the age of the bulls (Migbaru et al., 2014).

Hypoplasia of the testes occurs in all farm animals but, certain breeds seem to be more prone to the testicular hypoplasia, as in Swedish highland bulls, with prevalence up to 25% (Ball and Peters, 2004), which is slightly higher than the prevalence of testicular hypoplasia (18.8%) in this study. Hypoplasia of the testes was also reported in sheep (Gadisa and Amare, 2015) and goat (Igbokwe et al., 2011).

The prevalence 18.8% of testicular hypoplasia in the present study is higher than 0.66% in Algeria (Bousmaha and Khoudja, 2012), 3.45% in Brahman and 3.21% in brown Swiss breeds (Silva et al., 2008), 1.4% in Santa Gertrudis bulls and 3.1% in Brahman bulls (McGowan et al., 2002), 12.96% (Eshetu et al., 2016) and 3.6% in Ethiopia (Migbaru et al., 2014). These differences could be due to variations in the climatic condition of the study areas and breed of animas studied. Also, testicular hypoplasia is a hereditary condition with breed predisposition and its incidence rises under tropical condition (Settergren and McEntee, 1992).

Significantly varied differences in the prevalence of the scrotal wound between years of sampling and body condition score groups were observed (P<0.05). The prevalence of scrotal wound (n=25; 6.3%) in this study is

higher than 4.3% in Canada, 5.3% and 4.7% both in Ethiopia, as reported by Kastelic et al. (2001), Eshetu et al. (2016) and Migbaru et al. (2014), respectively. Orchitis was occurred in 8.3% (n=33) cases of all bulls examined, which is much higher than 4.4% (Migbaru et al., 2014) in Ethiopia and 1.32% (Bousmaha and Khoudja, 2012) in Algeria but, it is in accordance with 7.1%, as reported by Eshetu et al. (2016). However, Hopkins (2007) reported that orchitis was infrequently diagnosed in bull. The prevalence of epididymitis in this study was 2.5% (n=10) which is comparable with reports of 3.4% (Migbaru et al., 2014) in central Ethiopia and 3% in Australia (McGowan et al., 2002). Furthermore, it did not significantly varied among years, age and body conditions categories of the bulls (P>0.05).

Cryptorchidism was observed in 4(1%) cases with only unilateral cryptorchidism recorded. Cryptorchidism can be unilateral or bilateral in type (Bearden et al., 2004) although, unilateral cryptorchidism is more common than bilateral cryptorchidism (Marcus et al., 1997); this is in accordance with the findings of this study, where there was no case of bilateral cryptorchidism encountered. The current finding also agreed with the earlier report that the cryptorchidism was rare in ruminants, with prevalence of 0.15-0.5% in bulls, goats and rams (Bearden et al., 2004). Moreover, Kumi-Diaka et al. (1989) reviewed and reported that prevalence of cryptorchidism in bulls was <0.5% and Silva et al. (2008) reported that prevalence of cryptorchidism in Brahman and Brown Swiss bulls varied between 0.5-1%.

The prevalence of cryptorchidism (1%; n=4/398) in this study contradicted the finding of Migbaru et al. (2014) who reported 3.1% in central Ethiopia. But it agreed with the reports of St Jean et al. (1992) and Adeyeye and Wakkala (2013) who reported 1.7% in North America and 1.74% in Nigerian bulls, respectively. Yet, it is much higher than 0.05% (Barth and Waldner, 2002) in Canada. These variations might be due to dissimilarities in environmental conditions of the study areas such as level of estrogenic or anti-androgenic, or toxic agents (Amann and Veeramachaneni, 2007) and breed variation, as reported by St Jean et al. (1992).

CONCLUSION

Out of 398 bulls, 209(52.5%) were affected with gross testicular disorders. The most common condition was testicular hypoplasia followed by testicular hematoma, orchitis, testicular degeneration, and scrotal wound. The least prevalent abnormality was cryptorchidism. In view of these results, gross testicular disorders in the indigenous breeds of bulls in Ethiopian require special consideration.

ACKNOWLEDGEMENT

The author would like to thank all the staffs of the Haramya University (HU) abattoir for their cooperations and supports during the study. Moreover, the CVM, HU is duly acknowledged for the provision of materials and consumables.

CONFLICT OF INTEREST

The author declares no conflict of interest.

AUTHORS' CONTRIBUTION

The author AEG conducted the study starting from its inception to completion.

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