PACIFIC JOURNAL OF MEDICAL SCIENCES

VOLUME 23, No. 1, SEPTEMBER 2022

PACIFIC JOURNAL OF MEDICAL SCIENCES

{Formerly: Medical Sciences Bulletin}

ISSN: 2072 – 1625

Pac. J. Med. Sci. (PJMS)

www.pacjmedsci.com. Email: pacjmedsci@gmail.com.

ISSN: 2072 – 1625 Volume 23, No. 1, September 2022

A multidisciplinary journal for publication of medical and biomedical research findings on issues pertinent to improving family health and related issues of public health

INFORMATION:

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INFORMATION

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KNOWLEDGE OF, AND ATTITUDE TOWARDS BREAST CANCER AETIOLOGY AND BREAST SELF-EXAMINATION AMONG FEMALE STUDENTS IN A TERTIARY INSTITUTION IN SOUTH WESTERN NIGERIA

Running title: Knowledge of Breast cancer, attitude and performance of Breast self-examination by female undergraduates of state University in south west Nigeria.

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Submitted: February 2022; Accepted: April 2022

ABSTRACT:
Breast cancer (CA) is the commonest malignancy occurring in women, and constitutes a major disease burden in low income countries of the world, including Nigeria, where the mortality rates are high. A good knowledge of the etiological risk factors, coupled with the uptake of screening tests, are important in attaining prevention of breast CA and also reducing the morbidity and mortality associated with the disease. This study therefore set out to assess the knowledge and attitude of the female students of a tertiary institution in South-western Nigeria towards breast cancer etiology and breast-self-examination (BSE). This was a descriptive cross-sectional study that recruited 350 respondents using multi-stage sampling technique. The study instrument was a pre-tested, semi-structured, self-administered questionnaire. Data analysis was done using IBM SPSS version 20 and results were presented using frequency tables and charts. Chi square tests and logistic regression analyses were also done as appropriate. Majority (80.6%) of the study respondents had heard of breast cancer, 78.4% of which had poor knowledge about breast cancer etiology and about two-thirds of these had a good attitude towards BSE. Only 18 (6.4%) of the 282 respondents who had ever heard of breast CA knew how to perform BSE correctly, while only 159 (56.4%) of them had ever carried out BSE. Age, knowing anyone with breast CA, previous exposure to information on BSE, and previous clinical breast examination were found to have statistically significant association with respondents' knowledge of, and attitude towards BSE. The study respondents generally had a poor level of knowledge of breast CA etiology, older respondents showed better attitude towards BSE, and only a few knew how to perform BSE correctly. We recommend the early introduction of breast CA prevention education to female students in high school.

Keywords: Attitude, Breast, Breast Self-Examination, Cancer, Knowledge, Practice

INTRODUCTION:

Breast cancer is the commonest malignancy occurring in women, affecting about a quarter of women globally. It is reputed to be second major cause of cancer deaths among women [1], after lung cancer [2]. This underscores the lethal nature of the condition. The prevalence of breast cancer among Nigerian women and women from some of her neighboring countries is as high as 45.7% [3]. Breast cancer constitutes a major disease burden in low income countries of the world, including Nigeria, where the mortality rates are high (4). Overall in Africa, the breast cancer incidence in 2018 was 27.9 per 100,000 in Central part of Africa and 48.9 per 100,000 in the Northern part of Africa. The attendant mortality rates in the regions were 15.8% and 18.4%, respectively [5].

A good knowledge of the aetiological and risk factors, accompanied with uptake of screening, are some of the right steps in reducing the morbidity and mortality associated with breast cancer. Among the several factors that have been recognized to predispose to the development of breast cancer include genetic factor, as a result of mutation in the breast cancer genes BRCA1 and BRCA2, though the majority of women that developed breast cancer did not express this factor [6]. Other risk factors are family history (in particular, first degree relatives), age, situations that predispose to increased oestrogen, such as, early menarche, late menopause, hormone replacement therapy among others [6]. Other associated factors are alcohol intake, sedentary lifestyle or physical inactivity [7, 8]. The summary is that breast cancer is a disease with multi-factorial aetiological basis [9].

Several screening and diagnostic methods are available, some of which are very expensive, some are not so expensive, and others are free and safe. Mammography is a screening tool which is key to diagnosis, but it may not be within the reach of women in poor nations, though its application can greatly reduce the morbidity and mortality associated with breast cancer [10, 11]. As a result of poor health infrastructure and low resources, breast self-examination (BSE) has been recommended by some studies for people in low-and-middle-income-countries (LMIC), although it is also applicable and relevant in the developed countries as well [12]. Application of BSE entails visualizing the breasts in a comfortable position for size, shape, firmness and general appearance; and self-palpation of the breast for consistency, presence of nodules, discharges and tenderness [13]. This is recommended to be carried out between the 7th and 10th days of the menstrual cycle when the breasts are usually soft and devoid of the tenderness occasionally associated with the menstrual cycle [13]. BSE is usually without pain, and there is no infringement on the privacy of the individual. It is important and necessary

for women generally, especially female students in institutions of higher learning to have the correct perception of the risk factors for the development of breast cancer and the available screening methods. BSE can be done by every female, once the procedure is clearly explained, and understood.

With regards to breast cancer aetiology, it is not uncommon in some developing countries, even among educated people, to find a situation in which the cause of cancer growth is attributed to attacks from enemies. Only a few studies assessing female undergraduates' knowledge of breast CA aetiology and attitude towards BSE have been carried out in Nigeria, and such studies have been conducted among market women and women belonging to certain professional groups.

From a study in Cameroon [14], 88.1% of the undergraduates surveyed had knowledge about breast cancer, though less than a quarter of this sub-population had heard about its risk factors. A little less than half (47%) of the respondents that had heard about breast cancer had heard about BSE, and only 38.5% had ever practiced it [14]. According to a study conducted in Uganda, a very high proportion (98%) of the students had heard about breast cancer and about three-quarters practiced BSE [15]. A similar study carried out in Nigeria, though not amongst undergraduates, reported outcomes similar to those from Uganda, such as a high level of awareness (80.6%) and BSE practice was 60.1% [16]. From an Ethiopian study, 75.3% of the studied undergraduates had heard about breast cancer, 85.6% had heard about BSE and 54.1% practiced BSE [17].

Our study was done to ascertain the level of knowledge of female undergraduates in Osun State University (UNIOSUN) about breast cancer, the risk factors, their attitude towards, and practice of BSE as well the predictors.

METHODOLOGY:

Study site: This study was carried out at the Osogbo Campus of the Osun State University, Osun State South-Western Nigeria. The University is a multi-campus institution with the main campus situated in Osogbo, the state capital. The main campus houses the College of Science, Engineering and Technology (CSET), as well as the College of Health Sciences (CHS).

Study design: This was a descriptive cross sectional study assessing the perceptions of respondents on the aetiology of breast cancer, attitude to and practices of BSE.

Target population: Female undergraduates in higher institutions of learning in Osun state, Nigeria.

Study population: 100 level and 200 level female students of the two Colleges (CSET and CHS) domiciled within the Osogbo campus of Osun State University.

Sample size determination: the sample size was estimated using the Leslie Fischer's formula using prevalence obtained from a previous study [18], giving a minimum sample size of 276. However, a total of 350 questionnaires were printed and administered to 350 respondents to take care of possible attrition.

Sampling: A multi stage sampling technique across levels, departments and faculties/ within the colleges was employed to recruit participants into the study.

Data collection instrument: The research instrument was a pre-tested, semi-structured, self-administered questionnaire. A purposely designed questionnaire gleaned from many relevant previous studies with Cronbach alpha >7.5 for both the knowledge of Breast cancer and the awareness of BSE sections was used for the study. Study variables collected included socio-demographic characteristics, knowledge about aetiology of cancer of the breast as well as knowledge, attitude towards, and practice of BSE. There were twenty-two questions on knowledge of breast cancer aetiology and eight questions on attitude towards BSE

Each right answer scored as having obtained one mark and wrong answer scored as zero. Respondents who scored 50% or more of the total obtainable score in each case were considered as having good knowledge or supportive attitude, while those who had less than 50% were categorized as having poor knowledge or non-supportive attitude.

In the attached questionnaire, Questions 18A through to 18V were on knowledge while questions on attitude were from 19A to 19H.

With respect to performance of BSE, knowledge of correctness of doing the BSE procedure was assessed through four questions (Q 10 to Q 13): the frequency of performing BSE (those who chose at least once a month were adjudged correct); timing of BSE (those who chose just after menstruation/ before ovulation were adjudged correct); the parts of the breast/ chest wall examined (those who chose the four quadrants of the breast, the axillary tail and the base of the nipple were adjudged correct); and finally those who will look out for other signs apart from lumps when doing BSE (e.g. skin discoloration or dimpling, discharge or puckering of the nipple) were also adjudged to be knowledgeable. Each "correct answer" was given a score of 1, making a maximum of 4. Those that have at least 75% (3 out of 4) of the scores, were finally designated as having knowledge of performance of BSE correctly.

Ethical clearance: Ethical clearance for the study was obtained from the College of Health Sciences Health Research and Ethics Committee (CHS HREC), Osun State University. Verbal informed consent was obtained from each respondent.

Data analysis: Data collected were analyzed using the IBM-SPSS software version 20. Relevant frequency distribution tables were generated. The Chi-square test was used to demonstrate relationships between categorical variables such as knowledge and/or attitude against socio-demographic characteristics. Logistic regression models were used to identify predictors for "knowledge of aetiology of breast cancer", "attitude towards BSE" and "correct performance of BSE". Level of statistical significance was set at p-values <0.05.

RESULTS:

Table 1 shows the socio-demographic characteristics of the respondents. Majority of the respondents (244; 69.7%) were in the 15 to 19 years age group (adolescents). Mean age for all the respondents was 19.0 years (SD 1.96) and age range 15 to 24 years. About three-quarters were Christians (267; 76.3%), and most of them were from the Yoruba tribe (342; 97.7%). Majority also had parents who were highly educated, fathers and mothers, 64.0% and 56.6% respectively.

One-half of the respondents were from each of the two colleges.

Of the 350 respondents, 282 (80.6%) had ever heard (awareness) of BSE, Just a little more than half of the respondents who were aware were from the College of Health Sciences (51.4%).

The commonest source of information/ awareness about BSE was Health workers (40.1%), followed by Social Media (28%); Radio/TV (27.7%); Internet (22.3%); Family and friends (21.3%) and Print media (19.9%) (Multiple response were allowed; not shown in tables).

With regards to knowledge, only 21.6 % of respondents had good knowledge of aetiology of cancer of the breast, while 78.4% had poor knowledge. Concerning attitude, 65.6% of the respondents showed a positive attitude towards BSE compared to 34.4% that showed a negative attitude.

Performance of BSE:

Out of the 282 respondents, only 18 (6.4%) knew how to perform BSE correctly while 264 (93.6%) did not know. Also, only 159 (56.4%) of them (of those who had ever heard of BSE) had ever carried out BSE; this is equivalent to less than half (45.4%) of the total number of the respondents studied (350).

Among the 159 respondents who had ever done BSE, only 16 (10.1%) knew how to perform it correctly. Majority of the 159 respondents (118, 74.2%) did BSE monthly or more frequently, but only 20 (12.6%) of them did it during the medically recommended time for performing BSE (i.e. after menstruation and before ovulation. A little more than half of the respondents (83 i.e. 52.2%) usually examined all four quadrants, nipple and the axillary tail.

In Table 2, respondents' knowledge on aetiology of breast cancer and attitude towards BSE were cross-tabulated with selected socio-demographic characteristics and other factors. With respect to knowledge, the results showed that the association between knowledge and age, not knowing a person who had cancer of the breast, having been enlightened/ educated on breast CA, and having ever had a clinical breast examination were statistically significant. Older youths (35.2%), those who did not know a person who had cancer (25.1%), as well as those who had been enlightened/ educated on breast CA (32.2%) and those who previously had a clinical breast examination (35.6%) had better level of knowledge, compared to their counterparts. With regards to attitude, respondent's College, not knowing a person who had breast CA, having been enlightened/ educated on breast CA, and having someone who did BSE regularly had statistically significant association with attitude. Respondents from the College of Health Sciences (71.7%), those who didn't know a person who has or had cancer (69.5%), as well as those who had been enlightened/ educated on breast CA (77.0%) and those who did not know anyone who did BSE regularly (71.5%) had better attitude, when compared with their counterparts.

Table 3 shows the relationship between a number of factors and the respondents' knowledge on the correct performance of BSE, as well as actual correct performance of BSE.

Age, knowledge of breast cancer aetiology as well as attitude towards BSE were found to be significantly associated with the knowledge of correct performance of BSE. A higher proportion(12.1%) of the respondents in the 'older youths' age category had good knowledge of BSE performance as opposed to only 3.7% of the younger youths. concerning respondents' knowledge on the aetiology of breast cancer, 16.4% of those who had good knowledge also had correct knowledge on BSE performance; whereas, out of those with positive attitude towards BSE, 9.7% reported correct performance of BSE, when compared with their counterparts, none of whom knew how to perform BSE correctly.

Similar results were obtained for those who actually performed BSE, with age, knowledge of breast cancer aetiology as well as attitude towards BSE found to be associated with actual performance of BSE correctly ($p < 0.05$).

Table 1: Socio-demographic characteristics of the study respondents (n =350)

VARIABLE	FREQUENCY (%)
AGE GROUPS (years)	
15-19 (Adolescents)	244 (69.7)
20-24	106 (30.3)
ETHNICITY	

Yoruba	342 (97.7)
Other tribes	8 (2.3)
FATHER'S EDUCATIONAL STATUS	
Low (no formal education to secondary education)	84 (24.0)
High (post-secondary education)	224 (64.0)
Unknown	42 (12.0)
MOTHER'S EDUCATIONAL STATUS	
Low (no formal education to secondary education)	111 (31.7)
High (post-secondary education)	198 (56.6)
Unknown	41 (11.7)
COLLEGE	
Health Sciences	175 (50.0)
Science, Engineering & Technology (SET)	175 (50.0)
RELIGION	
Christianity	267 (76.3)
Islam	82(23.4)
Traditional	1 (0.3)

Table 2: Relationship between respondents' socio-demographic and other characteristics, and knowledge on aetiology of breast cancer and attitude towards BSE

		TEST OF KNOWLEDGE OF BREAST CA & ATTITUDE TOWADS BSE (n = 282)					
Variable	**Sub variables**	**Knowledge**			**Attitude**		
		Poor n=221 (%)	Good n=61 (%)	χ2 (p-value)	Negative n=97 (%)	Positive n=185 (%)	χ2 (p-value)
Age-group	Adolescents	162 (84.8)	29 (15.2)	14.516 (0.001)	71 (37.2)	120 (62.8)	2.201, (0.155)
	Older youths	59 (64.8)	32 (35.2)		26 (28.6)	65 (71.4)	
College	CHS	116 (80.0)	29 (20.0)	0.468, (0.494)	41 (28.3)	104 (71.7)	4.956, (0.026)
	SET	105 (76.6)	32 (23.4)		56 (40.9)	81 (59.1)	
Father's educational Status (n= 249)	Low	60 (84.5)	11 (15.5)	1.989 (0.158)	31 (43.7)	40 (56.3)	1.922, (0.166)
	High	136 (76.4)	42 (23.6)		61 (34.3)	117 (65.7)	
Mother's educational Status (n=250)	Low	68 (80.0)	17 (20.0)	0.195 (0.659)	36 (42.4)	49 (57.6)	2.256 (0.133)
	High	128 (77.6)	37 (22.4)		54 (32.7)	111 (67.3)	
Having known a person with CA Breast.	Yes	54 (91.5)	5 (8.5)	7.618 (0.006)	29 (49.2)	30 (50.8)	7.199 (0.007)
	No	167 (74.9)	58 (25.1)		68 (30.5)	155 (69.5)	
Having had info on breast CA	Yes	103 (67.8)	49 (32.2)	23.382# (<0.001)	35 (23.0)	117 (77.0)	19.692# (<0.001)
	No	109 (90.8)	11 (9.2)		56 (46.7)	64 (53.3)	
	Not Sure	9 (90.0)	1 (10.0)		6 (60.0)	4 (40.0)	
Ever had a clinical breast examination.	Yes	38 (64.4)	21 (35.6)	7.896# (0.019)	17 (28.8)	42 (71.2)	2.111# (0.348)
	No	173 (82.0)	38 (18.0)		74 (35.1)	137 (64.9)	
	Not Sure	10 (83.3)	2 (16.7)		6 (50)	6 (50)	
Having someone who does BSE regularly.	Yes	99 (79.8)	25 (20.2)	0.282 (0.595)	52 (41.9)	72 (58.1)	5.573 (0.018)
	No	122 (77.2)	36 (22.8)		45 (28.5)	113 (71.5)	

#- Likelihood Ratio used *Continuity correction or Fisher's exact test applied

Table 3: Relationship between respondents' socio-demographic characteristics (and other variables) and knowledge of how to perform and the actual performance of BSE correctly

Factor/ Variable	Sub variables	**Knows how to perform BSE correctly n=282**		**χ2 (p value)**	**Performs BSE correctly n=159**		**χ2 (p value)**
		No n= 264 (%)	Yes n=18 (%)		No n=143 (%)	Yes n=16 (%)	
Age	15-19	184 (96.3)	7 (3.7)	7.318 (0.007)	95 (94.1)	6 (5.9)	5.199 (0.023)
	20-24	80 (87.9)	11 (12.1)		48 (82.8)	10 (17.2)	
College	CHS	132 (91.0)	13 (9.0)	3.331 (0.068)	71 (85.5)	12 (14.5)	3.706 (0.054)
	SET	132 (96.4)	5 (3.6)		72 (94.7)	4 (5.3)	
Father's educational Status n= 249/148	Low	68 (95.8)	3 (4.2)	0.562* (0.453)	42 (95.5)	2 (4.5)	1.363 (0.243)
	High	164 (92.1)	14 (7.9)		91 (87.5)	13 (12.5)	
Mother's educational Status n= 250/149	Low	80 (94.1)	5 (5.9)	0.171 (0.679)	48 (92.3)	4 (7.7)	0.176 (0.675)
	High	153 (92.7)	12 (7.3)		86 (88.7)	11 (11.3)	
Knowledge on breast CA aetiology	Poor	213 (96.4)	8 (3.6)	13.053 (0.001)	107 (94.7)	6 (5.3)	8.020 (0.005)
	Good	51 (83.6)	10 (16.4)		36 (78.3)	10 (21.7)	
Attitude towards BSE	Negative	97 (100.0)	0 (0.0)	10.081 (0.001)	46 (100.0)	0(0.0)	5.762* (0.016)
	Positive	167 (90.3)	18 (9.7)		97(85.8)	16(14.2)	
Knew/ knows person with CA Breast.	Yes	56 (94.9)	3 (5.1)	0.025* (0.873)	33(94.3)	2(5.7)	0.423* (0.305)
	No	208 (93.3)	15 (6.7)		110(88.7)	14(11.3)	
Having had info on breast CA e.g. enlightenment.	Yes	141 (92.8)	11 (7.2)	1.560# (0.458)	94(89.5)	11(10.5)	1.749# (0.417)
	No	113 (94.2)	7 (5.8)		41(89.1)	5(10.9)	
	Not Sure	10 (100.0)	0 (0.0)		8(100.0)	0(0.0)	
Ever had a clinical breast examination.	Yes	52 (88.1)	7 (11.9)	4.500# (0.105)	39(84.8)	7(15.2)	2.799# (0.247)
	No	200 (94.8)	11 (5.2)		98(91.6)	9(8.4)	
	Not Sure	12 (100.0)	0 (0.0)		6(100.0)	0(0.0)	
Knows a female who does BSE regularly	Yes	114 (91.9)	10 (8.9)	1.047 (0.306)	73(89.0)	9(11.0)	0.156 (0.693)
	No	150 (94.9)	8 (5.1)		70(90.9)	7(9.1)	

#- Likelihood Ratio used *Continuity correction or Fisher's exact test applied

TABLE 4: Logistic regression for the outcome variables and their possible predictors

Variables	**Sub-variables**	p-value	Odds Ratio	95% CI	
				Lower	Upper
"Knowledge on aetiology of breast cancer"					
Age group	Older Youths (reference)	0.002	0.409	0.230	0.728
Knows/ knew someone diagnosed with CA	Yes (reference)	0.029	2.801	1.113	7.047
Had been enlightened/ educated on breast CA	Not sure (reference)	0.001			
	Yes	0.146	4.770	0.580	39.246
	No	0.907	1.137	0.132	9.785
Had ever done a clinical breast examination	No (reference)	0.180			
		0.514	1.774	0.317	9.928
		0.968	0.967	0.183	5.109
"Attitude towards BSE"					
Knows/ knew someone diagnosed with CA	Yes (reference)	0.075	1.683	0.949	2.984
Had been enlightened/ educated on breast CA	Not sure (reference)	0.001			
	Yes	0.002	7.157	2.073	24.704
	No	0.124	2.620	.769	8.925
Knows someone who does BSE on a regular basis	Yes (reference)	0.213	1.361	.838	2.209
College	SET (reference)	0.231	1.330	.834	2.121
"Correctness of knowledge of performance of BSE"					
Age group	Older Youths (reference)	0.063	0.375	0.134	1.056
Knowledge of aetiology of breast cancer	Good (reference)	0.062	0.378	0.136	1.052
Attitude towards BSE	Positive (reference)	0.996	0.000	0.000	.
"actual performance of BSE"					

Age group	Older Youths (reference)	0.112	0.396	0.126	1.242
Knowledge of aetiology of breast cancer	Good (reference)	0.112	0.396	0.126	1.242
Attitude towards BSE	Positive (reference)	0.997	0.000	0.000	

In Table 4, four different logistic regression models were used to identify the possible predictors of the outcome variables: "Knowledge of aetiology of breast cancer", "attitude towards BSE", "correctness of knowledge of performance of BSE" and "actual performance of BSE". Concerning knowledge of aetiology of breast cancer, adolescents were found to be about two and a half times (AOR- 0.409) less likely to be knowledgeable about breast cancer compared to older youths while those who didn't know someone diagnosed with breast CA are about three times more likely (AOR- 2.801) to be knowledgeable about breast cancer than those who knew someone. With respect to attitude towards breast self-examination (BSE), those who had been enlightened/ educated on breast CA at one point in time or the other were about seven times more likely (AOR- 7.157) to have a positive attitude towards BSE than those who had not received such enlightenment.

Finally, in terms of "correctness of knowledge of performance of BSE" and "actual performance of BSE", none of the three variables considered showed any statistically significant relationship. No identifiable predictors could be determined possibly on account of the inadequate number of respondents for bivariate cross tabulations (as shown in Table 3 where the variable "attitude" had zero value in one cell each) and for the multivariate analysis too as shown in Table 4.

DISCUSSION:

Our study revealed that 282 (80.6%) of the study respondents had heard about BSE and this is in agreement with the finding of a study in Ethiopia [17]; with a slight majority (51.4%) coming from the College of Health Sciences. The health-related courses usually taught at the College of Health Sciences may be responsible for this. Respondents' sources of information on BSE were healthcare workers (leading source), social media, internet, family and friends, and the print media, with the following percentages, 40.1%, 28%, 27.7%, 22.3%, 21.3%, and 19.9% respectively. Our results were different from the finding of another study [18] where the social media were the main sources of information on BSE. However, health information obtained from social media may not be totally foolproof as many health-related write ups on social media are often not subjected to the required scrutiny.

With regard to the respondents' knowledge on the aetiology of breast cancer, only a small proportion, about one-fifth, (21.6%), had good knowledge, with the vast majority, 78. 6%, having poor knowledge; a finding contrary to that of an Ethiopian study in which a greater majority had good knowledge on the aetiology of breast

cancer [17]. This may not be surprising in this part of the world as many people, even among the elites associate diseases including cancers to spiritual attacks.

Concerning the performance of BSE among the respondents, it was found that 159 of the 282 (56.4%) had done BSE from among whom only 16 (10.1%) did it correctly and only 20 (12.6%) did it at the right time. Doing the BSE correctly and at the right time is crucial in order to obtain the much desired result.

Some of the findings of this study on breast cancer knowledge and BSE knowledge were in direct contrast with those of a Cameroonian study where the majority of their respondents (88.1%) had heard about breast cancer but less than half (47%) had heard about BSE [14]. A study from Ugandan revealed a different pattern from that of our study and the Cameroonian study. According to the descriptive study which examined breast cancer knowledge and BSE practices among female university students in Kampala, Uganda, most (98%) of the respondents had heard about breast cancer and majority (75%) had also heard about, and actually practiced BSE [15]. The pattern of results from a study carried out in Ethiopia was similar to that of Uganda but with lower figures for the considered parameters; in which case 85.6% of respondents had heard of breast cancer and 54.1% practiced BSE [17]. It may be difficult to explain the diverse results from these countries, but evidently Uganda and Ethiopia are from the same region of Africa while Cameroon and Nigeria that shared opposite pattern of results are neighboring countries. In Nigeria however, a previous study conducted among the general populace [16], mostly among rural dwellers reported a high level of breast cancer awareness (80.6%), and knowledge and practice of BSE was also high [60.1%]. This is a rather surprising result for a rural setting, although the respondents in this study are relatively older.

The significant common predictive factors for good knowledge on breast cancer and positive attitude to BSE from our study were: having known a person with breast cancer and having had information on breast cancer ($p < 0.05$). The other predictive factors for having a good knowledge of breast cancer were: belonging to the older youth's age bracket (20-24 years) and having ever had a clinical breast examination done. The other significant factors predictive of positive attitude to BSE included belonging to the College of Health Sciences and having someone who does BSE regularly. Religion, ethnicity and parents' educational status from the study did not play any significant roles concerning good knowledge on breast cancer and positive attitude to BSE by our studied students. Of importance from this study is strong association between having known a person (or persons) with breast cancer and positive attitude to BSE which was also reported by the Ethiopian study in which the P-value was 0.048 for similar attribute [17]. The memory created by the

experience could have been a driving force towards a positive attitude.

As expected, breast self-examination was done correctly by respondents in the older youth age bracket (12.1%), respondents with good knowledge of aetiology of breast cancer (16.4%) and respondents with positive attitude towards BSE (9.7%). The observed trend in this study was that adolescents were about two and a half times less likely to be knowledgeable about breast cancer than the older youths (AOR-0.409). As regards attitude toward BSE, those with prior education on breast cancer were seven times more likely to have positive attitude (AOR- 7.157).

Conclusion and Recommendations:

The study found a poor knowledge level of breast cancer aetiology among the respondents. Knowledge about breast self-examination was good, but the proportion of students that did it correctly was low. Having previously had information on BSE was associated with a positive attitude towards BSE, and more of the respondents belonging to the older youth age bracket showed positive attitude. We therefore recommend that sensitization trainings be conducted for the adolescents in the upper classes in high (secondary) schools, and universities too, where the risk factors for breast cancer, and measures to reduce the risks, especially the modifiable ones and promote early detection (including SBE) are communicated. Young girls should also be taught on how to correctly carry out BSE, and this should be a continual and regular exercise.

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CORRELATES OF ADOLESCENT DEPRESSION IN ORPHANAGE HOMES IN YENAGOA CITY, BAYELSA STATE, NIGERIA

Running title: Adolescent Depression in Orphanage Homes

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Submitted: April 2022; Accepted: June 2022

ABSTRACT:
This study was designed to investigate the correlates of adolescent depression in orphanage homes using Yenagoa, Bayelsa State as a case study in Nigeria. Adopting the attachment theory as a theoretical framework, this study adopted the respondent-driven sampling technique to study 120 adolescents in three orphanage homes in Yenagoa city. Data for this study was collected through the use of the questionnaire. Data analysis was carried out using descriptive and inferential statistics. The mean age of the respondents was 13.7±3.4 years. The results indicated that more than a quarter of the respondents have manifested depression symptoms (45.8%). Most of the respondents had manifested at least one symptom of depression. Socio-demographic variables of the respondents such as, orphan type (β = -1.795; t = -8.377; $p<0.05$), duration of stay at orphanage home (β =-0.082; t = -3.458; $p<0.05$), age (β = 0.253; t = 5.532; $p<0.05$), ethnic group (β =0.653; t = 3.532; $p<0.05$), level of education (β = 0.583; t = 2.248; $p<0.05$), mode of getting to orphanage home (β = 0.971; t = 4.711; $p<0.05$) and availability of relative(s) (β = 2.430; t = 6.549; $p<0.05$) significantly predicted adolescent depression. In conclusion, there is a high prevalence rate of depression among adolescents living in orphanage homes in the city. Thus, there is a need to increase the level of social support for adolescents living in orphanage homes to ameliorate their conditions of depression.

Keywords: Depression, Orphanage homes, Adolescent, Yenagoa city, Attachment.

INTRODUCTION:

Depression is a global illness, with an estimate of 264 million people affected across all ages [1]. It may become a serious health condition, especially when it lasts longer than usual or is severe. Besides its effects on the normal functioning of the body of the affected persons, depression is one of the leading causes of suicide, disability and death among adults and adolescents [2, 3]. About 800,000 people

worldwide have died of suicide, especially among those within the age groups of 10-19 and 15-29 years [2,3].

Specifically, several studies have reported that 3% - 9% of adolescents are depressed at one point in time or the other, while 20% of the children have been reported to have had the condition as a lifetime prevalence during the adolescence stage [4]. On the other hand, as the health condition increases among adolescents, other studies have shown that the condition is usually undiagnosed; and when its negative consequences persist in the affected persons over time, it becomes a chronic health condition throughout their life span [5].

However, while this prevalence persists among adolescents, studies have linked the causes of adolescent depression to different risk factors among the population sub-groups of the affected people [6]. Among other risk factors, Betts et al, [7] pointed out that parenting styles imbued with overprotective traits and low nurturing were associated with the increased manifestation of depressive symptoms in adolescents. Lewinsohn *et al.* [8] also found that female adolescents who usually have parental conflicts were predisposed to persistent episodes of depression. In another study conducted by Mathiesen *et al.* [9], it was observed that after puberty among adolescents, girls were 2 or 3 times more likely to manifest depressive symptoms than boys.

In the study of Skrove *et al.* [10] among adolescents, it was observed that adolescents who engaged in low levels of physical activity were more likely to report more depressive symptoms than those who engaged in high levels of physical activity.

Additionally, an earlier study by Frojd *et al.* [11] reported that perceived difficulties due to heavy schoolwork load were associated with moderate depressive symptoms among boys, while severe depressive symptoms among girls were observed. Some other studies found that early relationship problems with peer groups among adolescents that were characterized by loneliness increase the likelihood of depression among adolescents [12].

Copeland *et al.* [13] further identified that bullying of a child is a strong predictor of adolescent depression despite the general belief that it serves as positive reinforcement. This implies that it makes the victim exhibit reverse behaviour. As Pullen *et al.* [14] concluded in their study of adolescent depression, adolescent depression has been identified to have a link with an increased risk of substance abuse such as smoking and drinking alcohol, which also aggravate the severity of depressive symptoms among young adults.

Conversely, while there seems to be a reduction in the burdens of other health conditions globally; the burdens of depression and mental

disorders have been on the increase and it has become a major public health challenge [15-17]. According to Birmaher and Brent [18], early identification and effective treatment of adolescence with depressive symptoms may reduce its impacts on families and others, thereby, reducing the risk of substance abuse, suicidal thoughts and mental health disorder in a population.

Due to the undiagnosed nature of depression particularly among young adults, it is usually under-recognized. Although research interests on adolescent depression among orphans are still scanty in the body of literature, studies have shown that those who are treated in a well-run institution often experience some forms of deprivation and are prone to developing psychiatric disorders [19]. Despite this, a study reported the prevalence of depression and its associated factors among orphans in Addis Ababa centres [19]. However, this study was conducted on the prevalence and associated factors of depression outside the domain of this present research. Hence, the fundamental factors associated with the prevalence of depression among orphans living in orphanage homes in the current research setting have remained unknown.

Additionally, while Alghamdi [20] explored the relationship between orphans and their behavioural disorders in Saudi Arabia; Bhatt *et al.* [21] examined the relationship between orphans and depressive symptoms in Nepal. Despite these studies providing an empirical analysis of the relationship between orphans and behavioural disorderliness or depressive symptoms, there is still a dearth of empirical studies analyzing the relationship between orphan types and depression among adolescents living in orphanage homes in the study area. This knowledge gap requires urgent attention for future intervention programmes on orphans.

On the other hand, Wenger and colleagues [22] examined the exercise effects on depression in adolescents in a systematic review of meta-analysis, Wallin *et al.* [23] looked at academic performance including externalizing disorders and depression among adolescents. Although these studies have provided the fundamental knowledge of the effects of depression among adolescents, they cover a wide range of adolescents with limited attention to orphans who are more vulnerable and lived in orphanage homes.

Finally, studies on the wellbeing and satisfaction of children in orphanages have largely focused on their psychosocial wellbeing [24], challenges faced by the orphans [25] or the experiences of orphans regarding the services rendered by the caregivers [26] among others. These studies are, however, essential for the projections of a future specific area of interventions in their merits, yet the level of satisfaction derivable by

these special groups of people has been neglected, particularly in the study area. This study, therefore, aims to analyse the level of satisfaction derived by the orphans from the services of professional caregivers in orphanage homes in Yenagoa City, Bayelsa State in Nigeria.

Theoretical framework:

This study is premised on the attachment theory of depression as proposed by John Bowlby in 1980. The theory states that children are born to be attached to parents or caregivers, which in turn organize their behaviour and thinking to maintain close relationships and social bonds through the process of socialization. It is also believed that the survival of a child is a function of the relationship that exists between a child and caregivers [27].

Karen [28] argues that the idea of John Bowlby as the founder of attachment theory was predicated on the need to challenge Freud's long-held notions of humans, who in turn posited that humans are compelled by their drives. Building on this assertion, Bowlby [29] added that humans are not only compelled by relationships but also influenced by the need, even from infancy to attach to a primary caregiver. By this, Bowlby [29] believed that every human right from infancy can internalize the experience of the earliest caregivers and that other caregivers in later life will maintain the same manner of behaviour just as the earliest caregivers did.

Bowlby [27] further argues that the theory of attachment is governed and conditioned by three types of circumstances. First, when a child's caregiver is deceased; second, when the child is unable to secure a stable relationship with the caregivers, and third when the child feels he/she is not loved by the caregiver. With these three circumstances, three depressive symptoms could emanate. First, when the child could no longer receive expected affection from the deceased caregivers, depression is bound to occur. Second, when a child could no longer receive expected love and care from an unstable relationship, he/she may feel being cheated upon and depressed. Third, when a child feels not lovable by the caregiver, withdrawal syndrome and depression may set in. Bowlby [27], therefore, proposed that the theory of attachment is key in the treatment of depression in infants and children.

Furthermore, due to its usefulness in the treatment of depression and other mental health disorders, the theory has become more useful among adults than in infants in recent times [30]. As such, Bowlby believed that the application of the theory of attachment to the treatment of depression would serve as a therapeutic regimen when applied to early family life experience till the later personality functioning and relationships with caregivers [27].

Considering the relevance of attachment theory to a romantic relationship in adults, contemporary scholars have added that many adults are motivated by the need for attachment

which is in turn similar to those of children [30]. For example, there is a need for attachment among partners who are in romantic relationships, family members and peer groups. Applying attachment theory to adulthood in this way can be considered relational and pathological in adulthood [30].

In the contribution of Slade [30] to the attachment theory, however, it is contended that children who maintain cordial relationships with a caregiver at significant cost to their advantage usually feel distorted when the caregiver is unable to meet the needs to comfort, secure and maintain their emotional stability. As Sable [31] added to the distortion between a child and his relationship with the caregivers, it was stated that environmental deficits such as behavioural inconsistency or rejection of caregiving options by the child could be a significant factor. In that, it impacts negatively on the healthy development of the child as it relates to lack of coherence in the personality of the child till adulthood stage [31]. While this serves as an outcome of environmental deficit, it consistently manifests in children as depression, anxiety, anger, and consequently disruptions in personal bonds with others.

From the onset of the theory, it is acclaimed that the increase in depressive symptoms is predicated on the stressors experienced by the victims which could also strain the existed relationships between the affected persons. Such experiences can increase depressive symptoms among adolescents when negative beliefs about the self as being adolescence feel unworthy of love and support.

This is by implication suggesting that insecurity could be experienced among depressed adolescent orphans thereby resulting in dysfunctional attitudes and low self-esteem. Among adolescent orphans, low self-esteem could be experienced as soon as they (adolescents) began to feel deprived of care and supports as compared to children with parents. The theory in this note expresses insecurity as the belief that others are not available in times of need, feelings of discomfort in becoming close to others, and fear of abandonment or the lack of love. This means that the loss of parents and inadequate care experienced by the adolescent orphans could predispose them to the manifestation of depressive symptoms.

METHODOLOGY:

Study Design and Location:

A survey research design was used to study adolescents' orphans living in orphanage homes in Yenagoa City, which is the administrative capital of Bayelsa state in the southern part of Nigeria. The major language of the people is *Epie-Atissa*. The choice of the study area is based on the fact that it is the only city in the state with a functional orphanage where a study of this nature can be carried out.

Sample and Sampling:

The sample size for this study was based on the number of orphans in each of the selected

orphanage homes in Yenagoa. The orphan's registers were made available with a moderate number of orphans in each home, all orphans present in each of the orphanage homes were selected to participate in the study. Thus, a total of 120 orphans served as the respondents in this study.

The sampling technique adopted for this study was respondent-driven sampling, where an initial selection of respondents was made through the caregivers of the adolescents/orphans before referrals of others were made until the total number of orphans in each home was included in the sample. This sampling technique was necessitated because no orphan could be easily identified by the researcher except through the initial identification of the orphans from the caregivers before referrals of adolescents in the orphanage homes were made. They remain hidden from the researcher and research assistants until when they were identified and introduced to the researcher and research assistants for the administration of the research instruments by the caregivers.

Data Collection:

A self-designed structured questionnaire was used as the research instrument to gather relevant information from the respondents in their respective orphanage homes. However, the design of the structured questionnaire was based on the specific objectives of the research which were made to be varied by sections.

Measurement and Definition of Variables:

The dependent variable in this study is adolescent depression. However, while depression is described as a mood disorder accompanied by feelings of sadness or anger that may interfere with an individual's daily activities, Kutcher's adolescent depression (KAD) scale (11 items) was adopted measuring each of the items in the scale in the constructs with (1) hardly ever (2) much of the time (3) most of the time (4) and, all of the time [32].

In these measures, any respondent who had indicated 'hardly ever' was categorized as having no depression, while any respondent who indicated either 'much of the time', 'most of the time' or 'all of the time' was regarded as manifesting adolescent depression, hence, scored '1'. These scores were further summed up as ordinal variables.

The independent variables in this study are the socio-demographic variables of the respondents which ranged from gender (nominal), age group (interval or ordinal), religion (nominal), ethnic group (nominal), level of education (ordinal), age at the entrance into orphanage home (ordinal or interval), orphan type (nominal), and the type of orphan/duration of stay in orphanage home.

Validity and Reliability of Research Instruments:

The instrument used in the research was validated through a pretest and face validity where the key variables in each measure were examined by the supervisor and tested with one

of the orphanage homes included in the sample before the administration of the actual instrument. On the other hand, the inter-item reliability coefficient of adolescent depression was α=0.891, which suggests that the measures for adolescent depression in the study are highly reliable.

Data Analysis:

The method of analysis of the research was based on the quantitative approach adopted for the study. Hence, the analysis of the study data was carried out using descriptive statistics and inferential statistics. While the descriptive statistics adopted the simple percentage distribution tables and the mean for the socio-demographic characteristics of the respondents among others, the inferential statistics employed chi-square and stepwise multiple linear regression at $p<0.05$ level of significance.

Ethical Approval:

Ethical clearance was obtained from the Bayelsa State Health Research Ethics Committee (BSHREC) of the Bayelsa State Ministry of Health with approval Number: BSHREC/Vol.1/21/04. In addition, permission to administer the study instrument was sought from the heads of the various orphanage homes visited before the administration of the instrument.

Permission was also sought from the guidance and caregivers of the orphans while assuring them of the confidentiality of their responses *via* verbal consent.

RESULTS:

Socio-Demographic Characteristics of the Respondents:

Table 1 shows the socio-demographic characteristics of the respondents. About half (51.7%) of the respondents were females. The mean age of all the respondents was 13.7±3.4 years. All the respondents were adherents of Christianity and 48.3% were predominantly Ijaw by ethnicity. Most of the respondents (69.2%) were in or have attained primary school certificates, while only a few (6.7%) of them had attained educational levels above primary school. The age of entrance of the respondents into orphanage homes revealed that a large majority of them (73.3%) entered when they were less than 5 years old. Most of the respondents were brought into orphanage homes by welfare officers (83.3%) when compared to other categories of persons. On the orphan type, majority of the respondents were of double or both orphan types (80.0%).

A large majority of the respondents (75.8%) at the orphanage home had stayed for less than 5 years. With regards to the presence of biological relatives, majority of the respondents (84.2%) did not have their biological relatives at the orphanage homes.

Prevalence of depression among adolescent children living in orphanage homes:

Assessing the prevalence of depression among the adolescents living in orphanage homes, Kutcher's Adolescent Depression Scale (11 items) was adopted [32]. For the implementation of the scale, any respondent with either 'much of the time', 'most of the time' and 'all of the time' as the response for the question constructs was re-categorized as depressed, while any respondent who subscribed to 'hardly ever' was re-grouped and named non-depressed. Based on this re-categorization, majority of the respondents (54.2%) were non-depressed, and 45.8% manifested depression. Using Kutchers' adolescent depression scale (11 items), table 2 reveals the constructs of depression among the adolescents in orphanage homes.

Table 1: Distribution by socio-demographic characteristics of the respondents

Variables	**Categories**	**Frequency (n=120)**	**Percentage (%)**
Gender	Male	58	48.3
	Female	62	51.7
Age group (Mean=13.7±3.4 years)	10-12 years	40	33.3
	13 – 15 years	54	45.0
	16 and above	26	21.7
Religion	Islam	-	-
	Christianity	120	100.0
	Traditionalist	-	-
Ethnic group	Igbo/Ikwere	3	2.5
	Ijo/Ijaw	58	48.3
	Ogbia/Epie-Atissa	44	36.7
	Nembe	15	12.5
Level of education	No formal education	29	24.2
	Primary	83	69.2
	Secondary	5	4.2
	Tertiary	3	2.5
Age of entrance into orphanage home	Less than 5 years	88	73.3
	5 – 9 years	32	26.7
	10 – 14 years	-	-
	15 – 19 years	-	-
The person that brought the orphan	Friends of my parents	5	4.2
	Uncle	3	2.5
	Aunt	3	2.5
	Welfare Officers	100	83.3
	Others	9	7.5
Orphan Type	Maternal	13	10.8
	Paternal	11	9.2
	Double or Both	96	80.0
Duration at Orphanage Home	Less than 5 years	91	75.8
	5 – 9 years	29	24.2
Presence of biological relative	No	101	84.2
	Yes	19	15.8

Table 2: Distribution of respondents by Kutcher's adolescent depression scale (11 items)				
Constructs of depression	**Response Categories**	**Frequency (%)**	**Mean**	**Remarks**
Low mood, sadness, feeling blah or down, depressed, just can't be bothered.	Hardly ever Much of the time Most of the time All of the time	97 (80.8) 13 (10.8) 10 (8.3) 0	0.28	Significant
Irritable, loosing your temper easily, feeling pissed off, loosing it.	Hardly ever Much of the time Most of the time All of the time	89 (74.2) 18 (15.0) 13 (10.8) 0	0.37	Significant
Sleep difficulties - different from your usual (over the years before you got sick): trouble falling asleep, lying awake in bed.	Hardly ever Much of the time Most of the time All of the time	87 (72.5) 17 (14.2) 16 (13.3) 0	0.41	Significant
Feeling decreased interest in: hanging out with friends; being with your best friend; being with your boyfriend/girlfriend; going out of the house; doing school work or work; doing hobbies or sports or recreation.	Hardly ever Much of the time Most of the time All of the time	86 (71.7) 21 (17.5) 13 (10.8) 0	0.39	Significant
Feelings of worthlessness, hopelessness, letting people down, not being a good person.	Hardly ever Much of the time Most of the time All of the time	90 (75.0) 22 (18.3) 8 (6.7) 0	0.32	Significant
Feeling tired, feeling fatigued, low in energy, hard to get motivated, have to push to get things done, want to rest or lie down a lot.	Hardly ever Much of the time Most of the time All of the time	68 (56.7) 28 (23.3) 24 (20.0) 0	0.63	Significant
Trouble concentrating, can't keep your mind on schoolwork or work, daydreaming when you should be working, hard to focus when reading, getting "bored" with work or school.	Hardly ever Much of the time Most of the time All of the time	82 (68.3) 24 (20.0) 14 (11.7) 0	0.43	Significant
Feeling that life is not very much fun, not feeling good when usually (before getting sick) would feel good, not getting as much pleasure from fun things as usual (before getting sick).	Hardly ever Much of the time Most of the time All of the time	88 (73.3) 24 (20.0) 8 (6.7) 0	0.33	Significant
Feeling worried, nervous, panicky, tense, keyed up, anxious.	Hardly ever Much of the time Most of the time All of the time	68 (56.7) 33 (27.5) 19 (15.8) 0	0.59	Significant
Physical feelings of worry like: headaches, butterflies, nausea, tingling, restlessness, diarrhoea, shakes or tremors.	Hardly ever Much of the time Most of the time All of the time	42 (35.0) 30 (25.0) 45 (37.5) 3 (2.5)	1.08	Significant
Thoughts, plans or actions about suicide or self-harm.	No thoughts or plans or actions Occasional thoughts, no plans or actions Frequent thoughts, no plans or actions Plans and/or actions that have hurt	96 (80.0) 21 (17.5) 0 3 (2.5)	0.25	Significant

Table 3: Model summary and the ANOVA of the Joint Contributions of all Independent variables to Adolescent Depression among Adolescents Living in Orphanage Homes

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.462a	.213	.200	2.002
2	.844b	.713	.689	1.247

Model		Sum of Square	DF	Mean Square	F	
1	Regression	127.052	2	63.526	15.854	0.000b
	Residual	468.815	117	4.007		
	Total	595.867	119			
2	Regression	424.834	9	47.204	30.359	0.000c
	Residual	171.033	110	1.555		
	Total	595.867	119			

Table 4: Multiple Linear Regression showing the relationship between orphan type, duration of stay, socio-demographic variables and Adolescent Depression among Adolescents Living in Orphanage Homes

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	B		
1	(constant)	6.168	.950		6.491	.000
	Type of orphan*	-1.554	.279	-.457	-5.573	.000
	Duration of stay	-.417	.427	-.080	-.977	.330
2	(Constant)	-1.672	1.677		-.997	.321
	Type of orphan*	-1.795	.214	-.528	-8.377	.000
	Duration of stay*	-1.082	.313	-.208	-3.458	.001
	Gender	.226	.332	.051	.679	.498
	Age*	.253	.046	.386	5.532	.000
	Ethnic group*	.653	.185	.216	3.532	.001
	Level of education*	.583	.259	.157	2.248	.027
	Entrance age	.283	.356	.056	.796	.428
	Mode of getting to orphanage*	.971	.206	.326	4.711	.000
	Availability of relative*	2.430	.371	.398	6.549	.000

*Significant at P<0.05

Putting the minimum threshold of the mean that can be termed normal in the constructs to 0.20, all of the constructs have been found significant among adolescents. This implies that most of the respondents manifested at least one of the symptoms of depression as put forward by Kutcher in his constructs [32].

Relationship between orphan type, duration of stay in orphanage homes, and depression among adolescents living in orphanage homes:

This section examines the relationship between orphan type, duration of stay in orphanage homes, and depression among adolescents living in orphanage homes. Using stepwise multiple linear regression, Table 3 shows that the summary of the joint contribution of orphan

type and duration of stay in orphanage homes to the prediction of adolescents' depression was significant at step 1 (F = 15.854(2, 117); Adj. R2 = 0.200; p<0.05). This implies that when the independent variables are taken together, they jointly predict depression among the adolescents living in orphanage homes at step 1. It further shows the multiple regression coefficients (R = 0.462), which means that the independent variables altogether have a positive significant relationship with adolescent depression. As a result of multiple regression adjusted (Adj. R2 = 0.200) showing 0.200, it means that there were 20.0% variations in adolescents' depression that can be accounted for by the joint contribution of the independent variables at step 1. The remaining 80.0% may be accounted for by other factors rather than the independent variables included in the model.

When the socio-demographic variables of the respondents were included in step 2 of the model, the joint contribution of orphan type, duration of stay and socio-demographic variables to the prediction of adolescents living in orphanage homes is significant at (F = 30.859(9, 110); Adj. R2 = 0.689; p<0.05). It further shows that the R = 0.844, which suggests a positive relationship with adolescents' depression at step 2. As a result of the multiple regression adjusted (Adj. R2 = 0.689) showing 68.9%, it means that 68.9% variations in adolescents depression is accounted for by the joint contribution of the independent variables and the socio-demographic characteristics in step 2. The remaining 31.1% may be accounted for by other factors rather than the independent variables and socio-demographic variables included in the model.

Furthermore, Table 4 presents the relative contributions of orphan type, duration of stay at orphanage homes and socio-demographic variables to adolescent depression. At the STEP 1 of the MODEL using unstandardized coefficients, the relative contributions of orphan type (β = -1.554; t = -5.573; p<0.05) was significantly related to adolescent depression, while duration of stay at orphanage home (β =-0.417; t = -0.997; p>0.05) was not significantly related to adolescent depression.

At the STEP 2 of the MODEL when the socio-demographic variables of the respondents were included, orphan type (β = -1.795; t = -8.377; p<0.05), duration of stay at orphanage home (β =-0.082; t = -3.458; p<0.05), age (β = 0.253; t = 5.532; p<0.05), ethnic group (β =0.653; t = 3.532; p<0.05), level of education (β = 0.583; t = 2.248; p<0.05), mode of getting to orphanage home (β = 0.971; t = 4.711; p<0.05) and availability of relative(s) (β = 2.430; t = 6.549; p<0.05) significantly predicted adolescent depression. Conversely, the gender of the respondents (β = 0.226; t = 0.679; p>0.05) and entrance age to the orphanage homes (β = 0.283; t =0.796; p>0.05) were not significantly related to adolescent depression.

This indicates that availability of the relative(s) of the orphan is the most potent variable that predicts adolescent depression which is closely followed by the mode of getting to the orphanage home and ethnic group membership of the respondents at STEP 2 of the MODEL, while orphan type at both steps is the least predictor of adolescent depression.

DISCUSSION:

The results indicate that the majority of the orphans were of double or both orphan types and had stayed less than 5 years in the orphanage homes. This suggests that the majority of the orphans had no biological parents when compared to others who still had at least one of the parents alive. This may have implications on the subject of investigation (adolescent depression) since the level of social bonding and attachment of children in that age category impact significantly on the well-being of the child.

Furthermore, with the KAD scale and its re-categorization [32], findings revealed that more than a quarter of the respondents (45.8%) manifested one form of depression or the other. This finding is similar to the earlier work done by Demoze, Angaw and Mulat [33] who reported that 36.4% of the orphan adolescents in Addis Ababa (Ethiopia) experienced adolescent depression at orphanage homes. It also affirms the work of Zuckerbrot and Jensen [4] that 3% - 9% of adolescents are depressed at one point or the other as 20% of the adolescent were reported to have had the condition as a lifetime prevalence.

In terms of the correlates of depression among orphan adolescents in our present study, the findings revealed that orphan type (especially those without any parents), duration of stay at orphanage home, age of the orphans, ethnic group, level of education, mode of getting to orphanage home (whether the orphan was taken to orphanage home by one of the biological parents or relatives) and availability of relative(s) were significantly correlated with adolescent depression. This result corroborates the findings of Demoze, Angaw and Mulat [33] that perceived social support, community discrimination, length of stay, age of entrance and the presence of visitors were associated with adolescent depression living in orphanage homes in Addis Ababa (Ethiopia).

Eisenberg et al [34] reported that adolescents suffering from depression spend less time on assignments and achieve lower grade points. Our present study also found that there were pockets of low attendance in school, academic performance and inactive involvement in social activities either at school or around the orphanage. This finding is also in line with Hirschfeld et al, [35] that the effect of depression among adolescents in an orphanage can be seen in the impairment of functioning in several domains such as, home life, workplace, friends and school. It further corroborates the American College Health Association's [36] nationwide

survey that 30% of the students suffering from depressive symptoms find it difficult to perform basic academic functions compared to other students who had no depressive symptoms.

The attitudes of professional caregivers play a pivotal role in the well-being of adolescents. Indeed, studies have shown that deficiency in the responsibilities of caregivers towards adolescents, neglect and abuse predisposed orphan adolescents to depression [37-40]. Our study also found that majority of the orphans reported late coming to assume duties by some professional caregivers. This may have implications on the level of satisfaction derived from the services of caregivers and consequently the manifestation of depressive symptoms.

CONCLUSION

This study focused on the correlates of depression among adolescents living in an orphanage in Yenagoa City, Bayelsa State. The results show a high prevalence rate of depression among adolescents living in orphanage homes in the city. The predispositions of the orphans to depression are associated with orphan type, duration of stay at the orphanage, age of the orphan, ethnic group membership, level of education attained, mode of getting to orphanage and availability of relative(s) including poor attitudes of professional caregivers. The implications are that there is a low level of social support for adolescents living in the orphanage. As a result, the level of their attachments to relatives or institutional care has been affected and resulted in adolescent depression.

Recommendations:

Based on the findings from the study, some recommendations can be suggested for policymakers, the government and concerned agencies.

There is a need to increase the level of social support for the adolescents living in orphanage homes to ameliorate their conditions of depression while reducing the manifestations and prevalence of depressive symptoms through the services of professional counsellors at regular intervals. The relatives (if any) and religious groups should be encouraged to complement the efforts of the professional caregivers in the provision of necessary items that will reduce the incidences of depressive symptoms among adolescents living in orphanage homes through mobilization, sensitization and awareness creation.

Special attention should be given to adolescents who have been observed to manifest depressive symptoms at schools or orphanage homes by school counsellors, clinical psychologists, teachers, nurses and other caregivers to reduce or eradicate its negative effects on their academic performances and involvement in social activities.

Ethical principles underlying the discharge of professional duties by the professional

caregivers of adolescents living in orphanage homes should be emphasized by the policymakers through monitoring and evaluation of their professional bodies. This is needed to improve the services rendered by these professionals which will, in turn, improve the level of satisfaction derived from their services by the adolescents living in orphanage homes.

Conflict of interest:

There are no conflicts of interest.

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RESISTANCE TO THYROID HORMONE ASSOCIATED WITH HYPERTHYROIDISM, CHOLESTATIC JAUNDICE, GOITRE AND FAILURE TO THRIVE (WEIGHT FALTERING): CASE REPORT AND REVIEW OF THE LITERATURE

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Submitted: March 2022; Accepted: May 2022

ABSTRACT:
In this report, we describe a rare case of a Nigerian male infant who presented with resistance to thyroid hormone associated with hyperthyroidism, cholestatic jaundice, a huge goitre and failure to thrive (weight faltering). He had delayed developmental motor milestones and at the age of 7 months, he has developed craniosynostosis. The hyperthyroidism persisted despite treatment with beta-blocker for tachycardia and antithyroid medications. The challenges encountered in the management of the patient are discussed.

Keywords: Resistance to thyroid hormone, Hyperthyroidism, Cholestatic jaundice, Craniosynostosis, Failure to thrive, Goitre, Weight faltering.

INTRODUCTION:

Resistance to thyroid hormone (RTH), also known as Refetoff syndrome [1], is a tissue-specific syndrome of decreased thyroid hormone responsiveness due to genetic defects in the thyroid hormone receptor [2]. Most cases are inherited as an autosomal dominant mutations in the thyroid hormone receptor beta gene (THRß) [2] but autosomal recessive inheritance occurs less commonly. About 15% of cases are sporadic [3]. The mutant receptor has a lower binding affinity for thyroid hormone, and as a consequence, thyroid-stimulating hormone (TSH) level remains unsuppressed despite elevated thyroid hormones [4]. The estimated incidence is one case per 40,000 to 50,000 live births [5,6], without gender predominance. Patients with RTH come to medical attention for a variety of reasons, particularly goitre which occurs in 75% of cases [7]. The clinical manifestation depends on the type of thyroid hormone receptor affected and the magnitude of the resistance. Symptoms often change with time and may improve spontaneously [2]. The characteristic biochemical profile is persistent hyperthyroxinaemia in a setting of non-suppressed thyroid-stimulating hormone (TSH)

level [3,4]. This pattern indicates defective feedback inhibition of the hypothalamic-pituitary-thyroid (HPT) axis and is presumably due to impaired pituitary responsiveness to thyroid hormone. Thyroid status varies among affected individuals, such that the patient may appear clinically euthyroid, hypothyroid or hyperthyroid [2]. There are no guidelines or expert consensus for the management of RTH [6].Therefore, approach to treatment must be individualized to the particular patient in question. Although cholestatic jaundice is more commonly associated with hypothyroidism, it has been reported in congenital hyperthyroidism [8,9]. Physiologically, the existence of a relationship between the thyroid gland and the liver is well established. In this context, thyroid hormones are important for normal hepatic function while glucuronidation and sulfation of thyroid hormones occur in the liver before excretion into the bile. The hepatic dysfunction is attributed to hypermetabolic state in thyrotoxicosis that increases hepatic oxygen consumption without increasing hepatic blood flow, accentuating the low oxygen tension in the centrilobular zones, resulting in dysfunction of the centrilobular hepatocytes [8]. Wafa et al [9] reported that the hepatic disorder rapidly improved after commencement of treatment for hyperthyroidism in their patients.

Failure to thrive (FTT), more appropriately called weight faltering, is characterized by sustained weight loss, failure to gain weight or persistent drop in weight from the child's normal growth percentile curve. In general, FTT results from three mechanisms, namely inadequate caloric intake, defective utilization of calories or increased metabolic demand. Hyperthyroidism is a typical example of FTT due to increased metabolic demand. Definition of failure to thrive (FTT) is controversial. Accepted definitions include weight-for-age less than fifth percentile on standardized growth charts, a decrease in weight percentile crossing two or more major percentile lines on the growth chart or less than the 80th percentile of median weight-for-height ratio [10]. It is important to identify and treat FTT because of its potential in causing developmental delay.

The purpose of this report is to increase the awareness of clinicians regarding a very rare form of thyroid disease in order to reduce the rate of misdiagnosis and consequently, inappropriate treatment.

CASE PRESENTATION:

We report a case of a 26-day-old Nigerian boy, born to non-consanguineous parents who was referred from a private-health facility. He presented with jaundice, paleness of stools, passage of dark urine noticed on the second day of life. Poor weight gain was noticed at the age of 2 weeks despite adequate feeding on breast milk and infant formula. He also had fever at presentation. The blood group of both parents is O Rhesus positive. The paleness of stools was intermittent The patient did not respond to oral Ampicillin/Cloxacillin suspension administered

by mother at home, warranting presentation in a private hospital at the age of 17 days where he was admitted for 8 days before referral to our health facility. Mother was clinically euthyroid during pregnancy and had no exposure to iodine-containing products. There was no reported family history of thyroid-related illness or autoimmune conditions. He is a product of normal delivery at 37 weeks gestation and his birth weight was 2.0kg.

Examination revealed an ill-looking male neonate, weight was 1.6kg (<3rd percentile), icteric with a greenish hue, febrile (38.2^{o}C), oxygen saturation was 96% in room air and had hepatomegaly of 4cm. There was developmental delay but no café au lait spot. At the age of 11 months, the patient is unable to sit, even with support. Craniosynostosis was present at 7 months of age. There was no galactorrhoea. A complete blood count showed WBC 14,300/µL, Lymphocyte 37.5%, granulocyte 54.5%, monocyte 8.0%, haematocrit 26.5%, platelets 215,000/ µL. The serum electrolytes and urea were normal. Tests for HbSAg, Hepatitis C, VDRL, urine for reducing sugar were negative. Mother is HIV negative. Abdominal ultrasound scan report was suggestive of biliary sludge without signs of cirrhosis. The blood clotting profile was normal. Total protein 6.7g/dl (6.0 – 8.3), Albumin 3.8g/dl (3.3 – 5.2), globulin 2.9g/dl (2 – 3.9). Results of thyroid function tests and liver function test are summarized in Tables 1 and 2, respectively.

Table 1: Summary of results of thyroid function tests

Thyroid function tests	Results	Comments
T3 (Reference interval 0.58-1.59)	6ng/ml	High
T4 (Reference interval 4.87-7.20)	24µg/ml	High
TSH (Reference interval 0.35-3.94)	37.15U/ml	Very high
Six months later:		
T3 (Reference interval 4.4-7.3)	45.4pmol/L	Very high
T4 (Reference interval 7.2-16.4)	37.69pmol/L	High
TSH (Reference interval 0.70-5.80)	52.82miu/L	Very high

Table 2: Summary of results of liver function test

Liver function test	Results	Comments
ALP (Reference interval 40-150),	312 IU/L	High
AST (Reference interval 5 – 34),	260 IU/L	High
ALT (Reference interval 0 – 55),	224 IU/L	High
Total bilirubin	12mg/dl,	High
Conjugated bilirubin	8.4mg/dl,	High

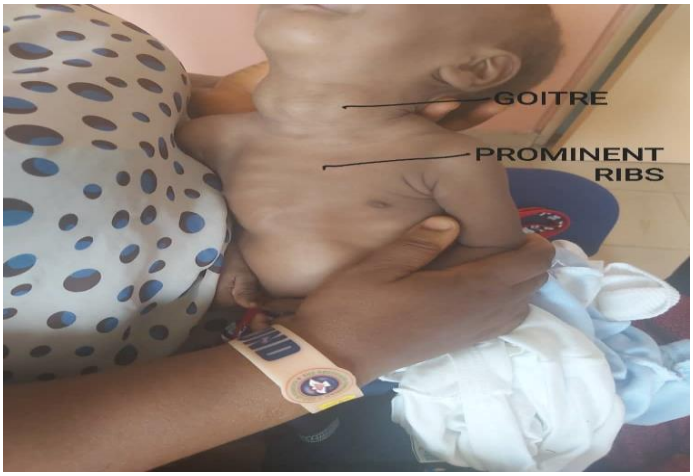

Figure 1 shows goitre and wasting in our patient

He was admitted and transfused with packed cells, commenced on antibiotics and vitamins A,D,E,K and was discharged home after 7 days. He is being followed up in the clinic. The liver function test and clotting profile were repeated 6 weeks later and found to be within normal range. On the 39th day of life, he presented with respiratory distress, stridor and a huge goitre. Jaundice was clearing, stools were pigmented, and urine was no longer dark in colour. He had tachycardia but there was no exophthalmos. A scan of the anterior neck showed enlargement of both lobes of the thyroid gland and the isthmus with no focal thyroid parenchymal mass or cyst. Maternal TSH receptor stimulating antibody was negative. An echocardiography showed a patent foramen ovale which was not structurally or hemodynamically significant. Treatment given consisted of blood transfusion, oxygen by nasal prongs (SPO_2 of 84-90%), gavage feeding, carbimazole, propranolol and antibiotics. He was discharged after 4weeks on admission. A repeat thyroid function test at the age of 6 months still showed elevated TSH, T4 and T3. We considered resistance to thyroid hormone because of the presence of elevated thyroid hormones with unsuppressed thyroid-stimulating hormone. In follow-up appointment the patient was noticed to have developed craniosynostosis by the age of 7 months.

DISCUSSION:

RTH is a very rare condition which is often misdiagnosed and mistreated [11]. The combination of persistently elevated serum levels of thyroid hormones with elevated thyroid-stimulating hormone (TSH) occurs uncommonly. In this clinical setting, once laboratory errors are excluded, the differential diagnoses should be between TSH-secreting

pituitary adenoma and resistance to thyroid hormone [2, 12]. We excluded laboratory error by performing the test in three different laboratories (using alternate assay platform) and by performing serial dilutions to confirm linearity. The results from all three laboratories revealed elevated thyroid hormones with markedly elevated TSH levels. Among patients presenting with hyperthyroidism, pituitary adenoma accounts for less than 1% of cases [13] and represents 0.5-3% of all pituitary adenomas [13,14] The explanation for its rarity is that thyrotropic cells comprise less than 5% of all pituitary cells [15].The reported prevalence is one in a million [6]. Yang et al [16] in China reported that age of onset of symptoms was 6.8-17.0 years with female to male ratio of 2:1. In contrast, the index patient presented at the age of 26 days. These epidemiological characteristics make TSH-secreting pituitary adenoma unlikely in our patient. The diagnosis of hyperthyroidism in the index patient was clearly established from the thyroid function test results. The absence of thyroid antibodies and the persistence hyperthyroidism beyond 4 months of age negates the diagnosis of neonatal Graves' disease. In literature, the key physical features in our patient (cholestatic jaundice, goitre and failure to thrive in early infancy) have been reported in hyperthyroidism [17,18]. According to Refetoff and Dumitrescu [5] the finding of elevated serum thyroid hormone levels associated with non-suppressed TSH usually leads to the diagnosis, as is the case in the index patient. Although gene sequencing is the gold standard for diagnosing RTH, this genetic testing service is not available in our country's health institutions.

Some of the clinical features present in our patient are worthy of note. The clinical features in RTH are goitre, tachycardia, hyperactivity, developmental delay and learning disability [3]. Our patient had goitre and in literature, this is found in 75% of cases [13]. The presence of delay in developmental motor milestones in our patient further points to the adverse effect of hyperthyroidism on the neurodevelopment of the infant. In the present patient, this is indicated by his inability to sit, even with support at the age of 11 months. The presence of tachycardia and failure to thrive suggests that the peripheral tissues were responding to thyroid hormone, at least partially. Despite the markedly elevated thyroid hormone levels in the index case, eye signs of thyrotoxicosis were absent. Absence of typical signs of hyperthyroidism is a recognized feature of RTH [12]. Jaundice in patients with hyperthyroidism has been attributed to various factors such as the relative changes in hepatic blood flow associated with hyperthyroidism itself, treatment with antithyroid drugs and conditions associated with autoimmune thyroid disease [19]. However, in the index case, there was no history of prior treatment with antithyroid drugs or conditions associated with autoimmune thyroid disease. Therefore, we postulate that it is due to the haemodynamic changes in blood flow in the centrilobular zone of the liver in

relation to hypermetabolism associated with hyperthyroidism. This is supported by the clearance of the jaundice with antithyroid drug therapy which decreased the metabolic demand on the liver. Antithyroid medication is aimed at bringing TSH level to near normal while following growth, bone maturation and cognitive development. Another reason for antithyroid medication in our patient is the presence of craniosynostosis, suggesting advanced bone maturation [20]. In two separate studies, skeletal survey at the age of 4.5 months [21] and at the age 5 months [22] confirmed advanced bone maturation. Affectation of the heart (tachycardia) and the bone (advanced bone maturation) in the index patient is not surprising because the heart and the bone express predominantly thyroid receptor alpha gene, thereby allowing high endogenous thyroid hormone levels to produce hyperthyroid effect on them [7,23]. Our propositus also had stridor and marked respiratory distress, suggestive of upper-airway obstruction due to the goitre. Similar presence of stridor in patients with goitre has been reported by Chester et al [21]. It is expected that reduction in serum TSH level will decrease the size of the goitre.

The failure to thrive (FTT) observed in our patient suggests, at least, partial response to thyroid hormones at the tissue level. The same is true of the tachycardia present in our patient. Chester et al [21] reported FTT in their patient at the age of 2 months. In principle, management of FTT involves identifying the underlying aetiology and addressing the caloric deficit. We identified the cause (hyperthyroidism) of FTT in our patient and commenced antithyroid medication to reduce the hypermetabolic state of the patient. To address the caloric deficit, effort was made to increase caloric density of the patient's feeds. The volume of feeds could not be increased significantly because of the limited gastric capacity of the patient. The resultant effect of this management approach was a modest increase in weight from 1.6kg at presentation to 4.4kg at the age 6 months. His weight at the last clinic visit 3 months ago was 5.9kg, representing a total increase of approximately 73.0%.

We encountered some challenges in the management of this patient. First, there is currently no available therapy to fully correct the thyroid hormone beta gene defect. Therefore, management of RTH is tailored to the specific symptoms of thyroid hormone excess or inadequacy encountered in the affected individual patient. In literature, it is stated that patients who present with symptoms of hyperthyroidism should be treated symptomatically with beta-blockers or antianxiety medication, depending on the dominant symptom [24]. Our patient has tachycardia, we therefore placed him on a beta-blocker to prevent heart failure. A challenging decision for us was whether to use antithyroid medication, knowing they can result in hepatic complications, particularly as our patient had cholestatic jaundice. The estimated incidence of

antithyroid-drug-associated hepatotoxicosis is 0.1-0.2% and higher doses of antithyroid medication is a risk factor for hepatic injury [25]. In general, treatment with antithyroid medication is not supported. The young age (11 months) of our patient precluded the use of ablation radiotherapy. Expertise for thyroidectomy in that age is not readily available in the area where we practice. Referral to outside health facility with the requisite human and material resources is out of the question because of financial constraint in the index family. Currently, 3,5,3-triiodothyroacetate (TRIAC), a physiological metabolite of T3, is the most promising drug for reducing thyroid hormone and TSH levels [11,26] but it is not readily available. Reduction in TSH level has the potential to reduce the size of the goitre. Our ultimate plan for the patient is total thyroidectomy because of symptomatic goitre (indicated by stridor) and advanced bone maturation (indicated by craniosynostosis with its implication for brain growth). The resultant hypothyroidism will be managed with supraphysiological doses of Levo-thyroxine. To avoid iatrogenic thyrotoxicosis, regular assessment of TSH and indices of peripheral thyroid hormone action are required. Financial constraint as well as non-availability of the required expertise are hampering this proposed approach of treatment. It has been documented that the goitre tends to re-occur after thyroidectomy [27]. Another management challenge was lack of access to genetic testing services for confirmation of diagnosis and determination of type of mutation in the index patient. We could not perform thyrotropin-releasing hormone (TRH) stimulation test to assess the response of TSH which would have enabled us to further exclude TSH-secreting pituitary adenoma, a condition in which there is no TSH response. We could not perform pituitary imaging with magnetic resonance imaging (MRI). Inadequate laboratory facility in area where we practice hindered performance of some investigations. Additionally, financial constraint prevented sending the relevant sample abroad. Despite this shortcoming, we strongly believe this is a case resistance to thyroid hormone based on the typical biochemical profile, absence of typical features of hyperthyroidism and presence of goitre in our patient. Goitre is present in 75% of cases of RTH [13]. Additionally, the age of the patient at manifestation of the disease negates TSH-secreting pituitary adenoma. In summary, available literature indicates that treatment of RTH remains challenging and individualized treatment is advocated, according to the patient's clinical manifestations.

CONCLUSION:

Although RTH is a rare clinical condition, it should be considered in the differential diagnoses of any patient presenting with goitre, elevation in thyroid hormones and non-suppressed serum TSH level in order to avoid misdiagnosis and unnecessary treatment. In addition, it is suggested that the presence of

FTT and craniosynostosis in early infancy should direct the clinician to perform thyroid function test to exclude hyperthyroidism.

Conflict of interest: We have no conflict of interest

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ASSESSMENT OF FEMALE STUDENTS' KNOWLEDGE, ATTITUDES AND PRACTICES (KAP) REGARDING MENSTRUAL HYGIENE MANAGEMENT

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Submitted: December 2021; Accepted: March 2022

ABSTRACT:
Hygienic practices during menstruation are of great importance. The lack of which increases emotional distress, anxiety, low self-esteem, feeling unclean and discrimination as well as the susceptibility of an individual to reproductive tract infections. This prospective study was an assessment of female students' perception (knowledge, attitude and practices) regarding menstrual hygiene management (MHM) at the School of Medicine and Health Science (SMHS), University of Papua New Guinea (UPNG). Pretested questionnaire was distributed to 80 female students using a quantitative approach for data collection after obtaining ethical clearance. The responses were recorded in Excel Spread sheets. The data was statistically analysed using Microsoft Excel 2013. All the participants learned through education that menstruation is a natural process in all females after puberty. Majority (90%) of the participants agreed with the proposed concept of free-distribution of sanitary pads to all female students by the SMHS student services. Further research on menstrual management options that are practical, sustainable and culturally acceptable must be conducted to inform future programs and policies that aim to empower young girls as they transition into womanhood.

Keywords: Menstruation hygiene management, Sanitary pads, Female students, Perception

INTRODUCTION:

Menstruation, a unique event in the life of a developing girl child, is one of the milestones of puberty [1]. Menstruation is the periodic discharge of blood, tissue fluid, mucus, and epithelial cells that usually lasts for about five days and affected about 1.9 billion females aged 15 to 49 in 2020 [1, 2]. Though menstruation is a natural process, women and girls in Papua New Guinea (PNG), Solomon Island (SI) and Fiji were categorized as 'unclean' and 'dirty' because of the cultural and religious beliefs [3]. While different countries may consider menstruation as a taboo topic, the importance of menstrual health is increasingly recognised globally [2].

Menstrual Hygiene Management (MHM):

Menstrual Hygiene Management (MHM) refers to management of hygiene associated with the menstrual process [5]. The Joint Monitoring

Programme (JMP) of World Health Organization (WHO) and United Nations Children's Fund (UNICEF) has defined MHM in terms of availability of clean water, sanitation, and hygiene [5]. MHM is basically about women and adolescent girls using a clean menstrual management material to absorb or collect menstrual blood, changed in privacy as often as necessary for the duration of a menstrual period, using soap and water for washing the body as required, and have access to safe and convenient facilities to dispose of used menstrual management materials [5]. In order to manage menstruation effectively and hygienically, girls and women need access to information about the menstrual cycle and how to manage it [4].

However, for many women and girls; especially those in low- and middle-income countries (LMICs), menstruation present numerous challenges [3,6]. These include: discriminatory attitudes; inadequate social support; ongoing gender inequality; beliefs, social norms and taboos relating to menstruation; lack of access to affordable and effective menstrual hygiene materials; and lack of access to appropriate water, sanitation and hygiene (WASH) facilities [3 - 6, 7]. Globally, attitudes, beliefs and social norms relating to menstruation vary widely, and these variations impact on practices during menstruation [3]. For example, multiple evidence documented among young adolescent school girls' experiences in some African countries [7-11] reported on the lack of information about menstruation, the reasons for that lack, sexual ideologies surrounding menstruation, impact of their culture, traditions, and myths, impact of poverty, and lack of access to WASH facilities affecting MHM practices. Similar evidence on menstruation-related beliefs contributing to restrictive practices were reported in PNG, SI and Fiji [3]. It is however important to note that providing increasing knowledge on menstruation through education [1] and intervention of MHM practices such as free-distribution of sanitary pads in schools will have a positive impact on young adolescent girls' wellbeing and reduce absenteeism in schools [12-13].

Impact of Cultural and Religious Beliefs on Menstruation:

In some cultural and religious beliefs, including that of the Pacific, menstrual taboos and norms direct girls and women to avoid cooking or eating certain foods, girls were expected to stay away from their peer group, avoid male community members, and not visit certain locations, such as churches, restricting women to touch raw or fresh food or take up some roles [3, 14-16]. These stigmas have built up causing unwillingness and discrimination; thus resulted in considerable psychosocial implications [3,14]. However, in some cases such restrictions are perceived as positive by women and girls; for example, providing welcome opportunities to

rest and spend time with other women [17]. Similar conducts have been practiced in some places in India were menarche signifies womanhood and thus doing celebrations [16].

Health Impacts Associated with Poor MHM Practices:

Poor MHM practices are associated with pain, discomfort [18] and other health impacts [14]. Several qualitative research conducted among adolescent school girls in Solomon Islands [19], Indonesia [20] and elsewhere [21] reported that using inappropriate MHM materials and prolonged wearing of MHM materials can lead to genital itching and discomfort, and may contribute to infections. Anecdotal reports from Bangladesh garment factories [22] also suggest that most women use cloth torn from old saris to absorb menstrual blood and that these reusable clothes are often not washed or dried properly, causing extreme discomfort and reportedly causing infections [18].

Many girls do not have the resources to manage menstrual pain [18], reflective of poor socio-economic background. A study in Indonesia [20] and several countries in Africa [7-11,21] found that many girls and women lack the information or other resources to access and use basic analgesics to manage menstrual pain, and that can negatively impact on participation and attendance at school and employment [20], which can affect health outcomes for the individual woman and subsequently for her children [18,23].

Impact of Providing MHM Education and Provision of Sanitary Pads:

Education and knowledge of MHM is of paramount importance since women and young girls will feel safe and confident when using the appropriate provision of sanitary pads. A pilot intervention in Ghana found that after 5 months of free sanitary pad provision, girls missed significantly less school, and they reported an improved ability to concentrate in school, higher confidence levels and increased participation in a range of activities despite menstruating [12]. The provision of clean sanitary products (e.g., commercial sanitary pads), truly reduces discomfort, anxieties, associated stigma, ridicule, and embarrassment which deters women and girls from attending school or work [13,24]. In Ghana, Dolan and colleagues [25] reported that over three quarters of school girls were found to have confidence and participated effectively in organized activities. Further evidence in the pilot study in Ghana revealed that school attendance improved by 9% after 5 months with the provision of disposable sanitary pads [12]. It is important to note that combined interventions of education on MHM, WASH facilities and the provision of sanitary pads [5, 12, 13-14, 24-25] will have positive impacts on women and young girls' wellbeing, education and employment opportunities.

Aims and Objectives:

Back in 1960, the School of Medicine and Health Sciences (SMHS) was known as the Papuan Medical College (PMC) and was established as the first health training institute in the then Territory of Papua New Guinea (TPNG). The PMC was tasked to train doctors, pre-service nurses, medical assistants, medical and hospital orderlies, nurse aides, physiotherapist, and even pre-school teachers. The PMC then became the Faculty of Medicine of the University of Papua New Guinea (UPNG) in 1971 to 1972. In the early 1990s, the Faculty of Health Sciences was established. With the decline in government funding in the late 1990s, the Faculty of Medicine and Faculty of Health Sciences were amalgamated into the SMHS. The major divisions in the SMHS are: Clinical Sciences, Basic Medical Sciences, Pathology, Public Heath, Dentistry, Nursing, Health Sciences – under the latter are disciplines including Pharmacy, Medical Laboratory Sciences and Medical Imaging Sciences [26-27]. SMHS is similar to other higher institutions within PNG and other LMICs where majority of the female students are not working and could not afford purchasing of sanitary pads every month [4,18].

Menstruating female students have missed classes due to insufficient sanitary pads, shying of going to the dining hall (mess), limiting social activities like playing sports, attending meetings and church fellowships [3, 14,16]. Although there are no restrictions and regulations endorsed by the university for girls that are menstruating, they naturally feel discriminated and unclean because they have come from societies where restrictions have been placed by the forefathers that are still believed and practiced today [3, 18].

Managing menstruation effectively and with dignity is a challenge for girls and women in LMICs such as PNG. Multiple evidence documented among young adolescent school girls' experiences in some African countries [7-11] and elsewhere [15-17] reported on the lack of information about menstruation, the reasons for that lack, sexual ideologies surrounding menstruation, impact of their culture, traditions, and myths, impact of poverty, and lack of access to WASH facilities affecting MHM practices. Evidence from the Pacific Region [3,18] suggests similar challenges, and these may be a barrier to school participation and attendance, employment and income generation during menstruation.

MHM is genuinely of paramount importance in PNG and the Pacific Region but currently research is scanty. There are no published studies on MHM practices in a medical tertiary institution in PNG. The major objective of this study was to prospectively assess the female students' perception on MHM practices at the SMHS, UPNG.

METHODOLOGY:

This was a cross-sectional, descriptive study conducted at the SMHS, UPNG [27]. SMHS is one of the five schools in the UPNG. The UPNG also affiliates with the science faculty in the Pacific Adventist University (PAU) as well as other universities in the various countries in the Pacific. SMHS is located in Korobosea, a suburb of Port Moresby in the National Capital District (NCD). Geographically, it is located close to the sea and is few kilometres away from the UPNG main campus. The female students represent a cross-section of the PNG population and the Pacific Region.

Study design and sampling: The female students' perception (knowledge, attitude and practices) regarding MHM for the first time during the study period were eligible for enrolment in the study at the SMHS, UPNG. Since the number of female students present during the study period was very small, convenience sampling technique was used [28].

Sampling size: A total of 125 questionnaires were randomly distributed among female students aged 21-35. Of these, the final sample size was 80 female students that participated in the study.

Data collection: A pre-tested questionnaire comprising close-ended questions was randomly distributed to a group of female students using a quantitative approach for data collection [29-30]. The questionnaire contains four sections. The demography of the participants; information collected included age, nationality, ethnicity, study programs and year level of study. In the other three sections variables collected included the students' participation and knowledge on menstruation through education, culture and religion; students' behaviour, attitude and practices during menstruation; and students' perception on source of income, menstrual absorbent material and the concept of free-distribution of sanitary pads to female students every month. The data were recorded in Microsoft (MS) Excel Spreadsheets.

Exclusion criteria: Participants excluded from the study were those from the nursing program. Data with irrelevant information such as residential status, repeated and unanswered questions were also excluded from the study.

Data analysis: The data was analysed statistically using the MS Excel Spreadsheet data pack version 2013. Ethical approval for this study was granted by the School of Medicine and Health Science Research and Ethics Committee (SMHS REC). Participation in the student survey was entirely voluntary.

RESULTS:

During the duration of the study in 2020, a total of 125 female students who were enrolled in various medical and health science programs offered at SMHS participated in the study.

However, because of the exclusion criteria in the present study only 80 (64%) students' responses with complete data were found suitable for analysis. Of the 80 participants included in the study, 35 (44%) were in the age range 21-23 years, followed by 25 (31%) in the age range 24-26 years, 16 (20%) in the age range of 18-20 years and 4 (5%) age range 27 years and above. Majority (97.5%, n=78) of the participants were from PNG and only 2 (2.5%) participants were from the Solomon Islands. Of the 78 participants from PNG more than half (53%, n=41) were from the Highlands region followed by New Guinea Islands region with 22% (17) participants, Momase with 14% (11) and 11% (9) from the Southern region.

Table 1 shows the distribution of all the participants according to study programs and year level of study. Most of the participants were studying the MBBS program followed by BMIS, B. Pharm, BMLS and BOH/BDS programs, respectively. Table 1 also shows that majority (39%, n=31) of the participants were in the 2nd year followed by 3rd year, 4th year and 5th year level of study.

Table 1: Percent (n) distribution of all the participants according to study programs and year level of study

Study Programs (%, n)	Year Level of Study (%, n)
MBBS (29%, 23)	Year 2 (39%, 31)
BOH/BDS (15%, 12)	Year 3 (29%, 23)
BMLS (16%, 13)	Year 4 (25%, 20)
BMIS (21%, 17)	Year 5 (7%, 6)
B Pharm (19%, 15)	
Total (100%, 80)	Total (100%, 80)

Effect of education, culture and religion on the knowledge about menstruation:

In this section the participants were asked questions about their education, culture and religion on their knowledge about menstruation. When asked the first time that they heard about menstruation, half (50%, n=40) of the participants said through their teachers in the primary school, whilst the other half said from other sources. All the participants learnt through education that menstruation is a natural process in all females after puberty. When asked about their cultural beliefs, 62.5% (n=50) of the participants learned from their cultural beliefs and agree that though menstruation is a natural process, certain rules, such as, restrictions in touching males' food, certain household items and food preparation must be followed, whilst 37.5% (n=30) disagree with this belief. In response to another question on cultural belief, 12.5% (n=10) of the participants agreed that based on their cultural and religious beliefs menstruating women are unclean; however, the majority (87.5%, n=70) disagreed. All the 80

participants were Christians and agreed that they attended and participated in church activities on Saturdays and Sundays. About half (51%, n=41) of the participants who attended church services said they heard sermons about menstruating women and the related taboos.

The behaviour, attitude and practices during menstruation:

In this section, the 80 participants were asked questions about their behaviour, attitude and practices during menstruation. Majority (70%, n=56) of the participants said that they restrained themselves from touching males' food during their menstruation period. In response to another question, more than half (56%, n=45) of the participants felt guilty whenever they touch or prepare food for the males. When asked about their attendance and participation in various events, majority (66%, n=53) of the participants said that they always go to the library, mess and classes during menstruation.

Perception on sources of income and concept of free-distribution of sanitary pads during menstruation:

The participants were asked questions about their perception on sources of income, menstrual absorbent material and the concept of free-distribution of sanitary pads during menstruation. In response to question about their sources of income, 72.5% (n=58) of the participants do not have any source of incomes. When asked about the use of sanitary pads, majority (75%, n=60) of the participants were able to afford sanitary pads whenever they have money, a few (25%, n=20) of the participants used materials, such as, napkins and rags as absorbent materials. In response to the question about health risk of the long-term use of pads or absorbent materials, 75% (n=60) of the participants were aware of the long-term health implications associated with the use of the same absorbent materials and sanitary pads for a long time. The participants were also asked if they support the proposed concept of free-distribution of sanitary pads to all female students by the SMHS student services. Majority (90%, n=72) of the participants agreed with the concept.

DISCUSSION:

Of the one hundred and twenty-five (125) questionnaires distributed, only 80 were completed and found suitable for analysis. This gave a response rate of 64%. Most (80%) of the participants were in the age range 21-27 years, representing young adults [31]. Majority (98%) of the participants were from PNG. This is expected as the SMHS remains the only training institution in PNG producing medical and health professional graduates [27] and is located in the capital city, Port Moresby. Most (29%) of the participants were medical students doing the Bachelor in Medicine Bachelor in Surgery (MBBS) programme. The MBBS is the main

programme at the SMHS that admits students from Science Foundation Years (SFY) of the UPNG and PAU, students with a science degree, and students from the Pacific islands who have completed high school with high grades [27]. Majority (39%) of the participants were in the second year. One explanation is because the second year is the entry year into all the degree programmes at the SMHS.

All participants learned through education that menstruation is a natural process which every female will experience after attainment of puberty. This finding concurs with studies done elsewhere [1, 10, 32-33] reflecting accurate knowledge on menstruation through medical education curriculum. In the present study 50% of the participants first learnt about menstruation in primary school, 63% of all the participants agreed that menstruation is a natural process and that menstruating women must follow certain rules. These findings differ from those reported in some studies done in African countries [8-9] and elsewhere [7] on the limited or lack of knowledge of menstruation and related issues of reproductive health through primary and secondary schools. These differences could be attributed to the many restrictions imposed by religion and culture, including certain beliefs and taboos associated with menstruation [3, 5, 8, 15-18]. It is however important to note that the present study did not ask participants who first informed them about menstruation in primary school; whether their teachers, friends, relatives or their primary school curriculum [1, 9, 16, 18, 32]. In terms of culture and religion, majority (87.5%) of the participants in the present study did not support the notion that menstruating women are unclean. All of them participated in church activities during menstruation, but about half of them (51%) heard sermons on menstruating women in church. These findings differ from a recent study by Mohamed and colleagues [3] on the restrictive practices associated with the beliefs and attitudes where all the participants in their study perceived menstrual blood and menstruating women and girls as ‘dirty’ and ‘unclean’. Other similar studies in some African countries [7-11] and elsewhere [15-18] reported on the impact of participants’ culture, traditions, religious beliefs and myths associated with menstruation. The differences in perception with those studies and our study is that, our participants were all enrolled in various medical and health science programs in a medical school and are well aware of menstruation as a natural process in all females’ after attainment of puberty. It is important to note that, in most cases, as female students move to higher levels in education, their knowledge on menstruation and their menstrual hygiene practice increases [1, 16, 32], thus reducing the negative impacts of cultural, stigma and religious beliefs associated with menstruation [16].

With regards to behaviour, attitude and practices during menstruation, majority (70%) of the participants in the present study avoided touching males' food; if and when they touched or prepared food, they admitted feeling guilty of what they have done. These findings are similar to the results obtained in a recent study on menstruation-related restrictive practices in Fiji, SI and PNG [3]. The same study reported that in rural and urban settings in PNG and SI, participants commonly believed that foods prepared or cooked by menstruating women are harmful to men and boys, causing them to age faster or making them sick [3]. Although our study participants are highly educated and have adequate knowledge on menstruation, they come from diverse cultural backgrounds interconnected with beliefs, taboos and fears about menstrual blood, which may influence their behaviour, attitudes and practices during menstruation. Interestingly, majority (66%) of them continue to attend library, mass or classes during menstruation. This finding confirms the evidence that increasing knowledge on menstruation has positive and significant effects on practice of good menstrual hygiene [1, 4, 10], thereby allowing women and young girls to participate effectively in their daily activities [25].

According to the results in the present study, majority (73%) of the participants do not have any source of income. This result is similar to those from other low-and-middle-income countries (LMIC) [7-11] where majority of the female students are not working and could not afford purchasing sanitary pads every month [4, 18]. The present study also revealed that a quarter (25%) of the participants used materials such as napkins and rags as absorbent materials. Such practices are potential risk factors and sources of infection that can affect the health and wellbeing of those students. The provision of clean sanitary products, such as, commercial sanitary pads and clean re-usable menstrual pads are options that can truly reduce discomfort, anxieties, associated stigma, ridicule, and embarrassment which deters women and girls from attending school or work [5, 13, 24]. Majority (75%) of the participants were aware of the long-term health implications associated with the using of the same materials or sanitary pads for a long time. This finding supports the evidence that as female students move to higher levels in education, especially in medical schools, their knowledge on menstruation and their menstrual hygiene practice increases [1, 16, 32].

The result shows overwhelming support for the proposed concept of free-distribution of sanitary pads to all enrolled female students by the SMHS student services. This finding aligns with a recent policy memorandum on free provision of period products (e.g. sanitary pads and tampons) by the Scottish Government to tackle 'period poverty' [34] and studies done elsewhere [12-14, 24-25, 35] on the importance of

promoting access to affordable sanitary pads to women and young school girls. Although, the present study did not ask participants about the accessibility of WASH facilities at the SMHS, it is logical to assume that their responses to some of the questions, fully support the multiple evidence that combined interventions of education on MHM, WASH facilities and the provision of affordable sanitary pads [5, 12-14, 24-25, 34-41] will have positive impacts on women and young girls' wellbeing, education and employment opportunities.

Limitation of the study:

The present study did not ask participants how often they change their menstrual products after daily use, whether or how often they wash themselves during menstruation, and how they dispose of used sanitary products. These are important issues that will be included in further studies to be carried out among female students in the whole university of PNG.

CONCLUSION:

The results obtained in the present study support the multiple evidence that combined interventions of education on MHM, WASH facilities and the provision of affordable sanitary pads should have positive impacts on the health, academic performance and general wellbeing of female students in the SMHS UPNG.

Acknowledgement:

The authors would like to thank the female students at SMHS for their invaluable contribution in participating in this research study.

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ASSESSING PREVENTATIVE MAINTENANCE AND SUSTAINABILITY OF OXYGEN CONCENTRATORS IN HEALTH FACILITIES IN PAPUA NEW GUINEA

Running title: *Importance of Equipment Maintenance*

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Submitted: June 2022; Accepted: July 2022

ABSTRACT:
The lifespan of medical equipment depends on preventative maintenance. Properly functioning oxygen concentrators are the only practical sources of oxygen in many Low & Middle Income Countries and their use reduces mortality in hospitalised children. We provided 82 concentrators with pulse oximeters, split flow meters, oxygen tubing, and an oxygen analyser to 38 health facilities. Training and instructions on how to perform preventative maintenance were provided. The concentrators were monitored for three years after they were installed, by assessing the proportion of concentrators still producing optimal oxygen at greater than 85% purity, the proportion that underwent weekly maintenance checks, and the proportion that were faulty and repaired. A logbook for weekly documentation of performance, maintenance, faults and repairs, was employed. Faults were additionally identified by a biomedical engineer during the visits. Twenty nine oxygen concentrators underwent regular maintenance checks, 25 (86.2%) of which had a median of 30 (IQR: 9 - 65) checks. Twenty-four were functioning well throughout the three years. One concentrator was used for 23,807 hours before requiring repair. Fourteen (24%) of the 58 concentrators used at the start of the programme had problems, two were repaired, and 12 were replaced. Concentrator failure was mostly caused by excessive movement, dust, and leaking in the internal tubing. Routine preventative maintenance, thorough documentation of performance and reporting of problems, and having access to clinicians and a knowledgeable biomedical engineer are essential for oxygen concentrator longevity in health care facilities in low-resource settings.

Keywords: Oxygen concentrator, Preventative maintenance, Papua New Guinea

INTRODUCTION:

Preventative maintenance of medical equipment is vital to ensure it is operating within manufacturer's specifications, to enhance longevity, and to protect the health workers and patients from hazards [1-3]. Ideally medical equipment in all facilities should be checked and maintained by biomedical engineers [2]. In low resource settings, there are shortages of biomedical engineers and lack of spare parts to perform repairs and costs for technicians to travel to remote areas can be high. As a result, oxygen concentrator maintenance has been inconsistent, and many malfunction oxygen concentrators have not been repaired [4, 5].

The health workers who are using the equipment and who have been trained on oxygen concentrator preventative maintenance are now performing the maintenance as more reliable oxygen concentrators become available [2, 6-8]. Preventative maintenance practices performed by the health workers include adjusting, cleaning, calibrating output or readings, changing filters, basic troubleshooting and replacing worn out parts [2, 3]. It has been argued that decentralising preventative maintenance to health workers using the oxygen concentrators is beneficial [2, 6-8] and minimises the need for onsite checks by biomedical engineers

The benefits of oxygen concentrators in low and middle income countries (LMIC) including Papua New Guinea (PNG) are well established [6-8]. This study aimed to describe the steps in performing preventative maintenance, assess the proportion of oxygen concentrators that have undergone the weekly maintenance and performance checking, the proportion of oxygen concentrators providing greater than 85% oxygen purity as checked by oxygen analyser, and identify the problems and corrective actions undertaken at the end of three years post installation.

MATERIALS AND METHODS:

This was a prospective, follow-up study conducted from 2017 to 2019 that was part of the large effectiveness trial on oxygen concentrators powered by solar power and mains power in 38 rural health facilities in Papua New Guinea.

Ethics approval was obtained from the Medical Research Advisory Committee (MRAC No. 18.12) and School of Medicine and Health Sciences Research and Ethics Committee, University of Papua New Guinea.

The feasible steps for oxygen concentrator maintenance was designed and health care workers were instructed to apply each specific step over the period of three years. During that period, the sustainability of oxygen concentrators distributed to the health facilities were documented.

Preventative maintenance (PM) steps were:

Developing a maintenance check logbook: A simplified maintenance check logbook for health workers containing the specific tasks to be performed weekly to prevent mechanical failure was designed. The weekly duties include checking the number of hours the machine has been used, cleaning and replacing the filter, cleaning the machine external surface and checking the percentage of oxygen concentrated using an oxygen analyser.

Training of health workers by a biomedical engineer: Training workshops were conducted by a biomedical engineer with expertise in maintaining and repairing oxygen concentrators, and a senior clinician (paediatrician) with expertise in oxygen concentrator use and provision of oxygen before the installation. The biomedical engineer is a registered electrician with specific training on the Airsep Elite (Chart

Industries, New York NY, USA) oxygen concentrator: though he can service other oxygen concentrator brands.

The training for health workers (community health workers, nurses, health extension officers and doctors) was conducted in workshops held in various hospitals from 2016 to 2019 and during the investigator visits once or twice in a year from 2017 to 2019. The training covered how to operate the machines, perform the weekly oxygen concentrator checks and basic troubleshooting skills. It also covered checking the oxygen concentrators that were in active use on a weekly basis for the number of hours used; cleaning and replacing the filter; cleaning the external surface; and measuring the percentage of oxygen being generated using an oxygen analyser (Maxtec). Health workers were advised to place the machine on a stand so that it was off the floor and to place it at least 30 centimetres away from the wall, and keep it covered when not in use. These measures prevent dust from entering the machine, to ensure the flow of air into the machine is unobstructed, and to avoid a fire hazard.

Participants were also trained on identifying problems with the machine. The basic trouble shooting skills that were taught included recognising abnormal alarm sounds: intermittent or constant- indicating problems with the internal parts; machine sound- indicating pressure problem; and difference in amber light colour: persistent orange colour after 15 minutes- indicating that the machine was not generating 85% oxygen. In addition, a preventative maintenance protocol and weekly schedule for the user's logbook was provided.

Inventory and distribution of oxygen concentrators:

A total of 82 Airsep Elite 5 Litre/minute oxygen concentrators (Chart Industries, New York NY, USA) [3, 9] with pulse oximeters, flow splitters, delivery tubing and nasal prongs were distributed to 38 health facilities. This model of oxygen concentrator is robust and capable of functioning well at high environmental temperature and humidity, and has been used in Papua New Guinea since 2005 [3, 9, 10]. The district and rural hospitals received three oxygen concentrators and each health centre received two oxygen concentrators. An inventory of 82 oxygen concentrators, containing the name of the health facility and serial number of the oxygen concentrators delivered to each health facility, number of faulty concentrators, and the faults and corrective actions taken was maintained throughout the project. This information was important in locating the machines and provide maintenance in a timely manner.

Risk assessment and reporting of faulty oxygen concentrator:

Oxygen concentrators that produced abnormal alarm sounds and persistent orange amber light or which produced oxygen concentration below 85% were reported to the biomedical engineer or the investigator. For an efficient and effective

communication, phone numbers and emails of biomedical engineer and the investigator were given to the health workers in each health facility or written on the oxygen concentrators that were in active use using stick on tape, and written in the logbook. When faults were identified, the investigator reported them to the biomedical engineer who attended to the problem if the health facilities were in close proximity and also instructed the health workers to perform basic physical rectifying strategies. Oxygen concentrators that could not immediately be fixed by health workers were stored away safely for assessment by the biomedical engineer at the next visit.

Monitoring of oxygen concentrator:

Maintenance and monitoring visits were scheduled once or twice a year during the period of three years post installation. On each visit, we checked the logbooks, provided ongoing training for the new staff and support of equipment usage, performed servicing as appropriate and ensured the concentration of oxygen delivered by concentrator was greater than 85%. The investigator also made telephone contact with each of the health facilities on a monthly basis.

Servicing the oxygen concentrator:

Servicing and maintenance was done by the biomedical engineer at each visit. The machines that were faulty were repaired and the others that were irreparable onsite were replaced or taken away for repair. We used functioning parts from concentrators that were irreparable to repair malfunctioning machines and placed an order for additional parts that were needed

Information was gathered from the logbook of oxygen concentrator checks, reports from the health workers, and documentation of events and occurrences during the visits by the paediatricians and the biomedical engineer. Oxygen equipment sustainability was assessed as the proportion of oxygen concentrators still functioning well at the end of three years of use. Data were entered into Microsoft Excel Version 2013 and analysed using IBM Statistical packages for Social Sciences (SPSS) 27. Percentages and frequencies were calculated for categorical data, median and interquartile ranges (IQR) were calculated for numerical non-parametric data.

RESULTS:

Eighty-two oxygen concentrators were distributed to 38 rural health facilities. Of the 38 health facilities, 22 (58%) were run by the Government and 16 (42%) by the churches. Of the 82 concentrators, 24 (29%) were held in reserve at the health facilities for later use and 58 (71%) were in active use from the beginning of the study. Of the 58, 14 (24%) had mechanical failure at some point in the three years; two were repaired and 12 were replaced. Regular assessments of 29 (50%) of the 58 concentrators were recorded in the logbooks in 15 (39%) of the 38 health facilities. The

remaining health facilities had no record of regular maintenance checks and it was reported that the concentrator checks did not occur as scheduled in many health facilities (table 1).

One thousand and three (1003) oxygen concentrator checks were recorded in the logbooks. Twenty-five of the 29 concentrators from 15 health facilities had complete records of regular checks. For the 25 oxygen concentrators, the median number of checks recorded per concentrator was 30 (IQR 9-65). The median hours the concentrator was used in patient care was 726 (IQR 305 to 3785). The median percentage of oxygen generated was 96.2% (IQR 93-98%) during checks throughout the three years period (table 2). Twenty-four of the 25 oxygen concentrators (96%) that were regularly checked by health workers were functioning optimally well (fraction of oxygen generated greater than 85%) throughout the three years. Only one (4.0%) of the 25 concentrator that underwent regular checks, which was used for 23,807 hours in Kundiawa General Hospital, required repairing because it was generating less than 85% (79%) oxygen (table 2) as recorded in the logbooks.

The source of faulty oxygen concentrators were from two data sources: (i) logbook of oxygen concentrator checks and (ii) documented during biomedical engineer and investigator visits. Of the 58 oxygen concentrators that were in active use for up to three years, 14 (24%) had malfunctioned at some point. Of the 14 that were functioning poorly, only one at Kundiawa General Hospital has a record of maintenance checks documented in the logbook. The remaining 13 were checked and found to be faulty. 2/14 (14%) were repaired and put back into service whilst 12/14 (86%) were irreparable because of damaged circuit boards.

Excessive movement, dust and leakage in the internal tubing were identified as the main factors associated with the concentrators' malfunctioning. It was also noted that some of these oxygen concentrators were not functioning well despite infrequent use.

Table 1. Oxygen concentrator distribution and record of checking as per oxygen concentrator logbook and documentation during the scheduled visits

Variables	**N**	**%**
Government run health facilities (n = 38)	22	58
Churches run health facilities (38)	16	42
Number of health facilities that had a record of checking concentrators (38)	15	39
Total oxygen concentrator distributed (82)	82	100
Number of oxygen concentrator in active use since the beginning of the study (82)	56	68

Number of oxygen concentrator reserved for later use (82)	24	29
Of those in use, number of concentrators checked (58)	29	50
Of those in use, no record of checks (58)	13	22
Of those in use, oxygen concentrator poorly function (58)	14	24

Table 2. Oxygen concentrators that have complete variables checked at the end of 3 years documented in the logbook weekly oxygen concentrator check, n=25.

Variables	**Values**
Number of checks per oxygen concentrator; median (IQR)	30 (9-65)
Hours used per oxygen concentrator; median (IQR)	726 (305.45-3785)
Percentage oxygen concentration per oxygen concentrator; median (IQR)	96.2 (93-98)
Number of bubble checks per oxygen concentrator; median (IQR)	28 (8-61)
Number of filter changes per oxygen concentrator; median (IQR)	28 (9-60)
Number of external surface cleans per oxygen concentrator; median (IQR)	28 (9-65)
Number of oxygen concentrators have oxygen concentration (n = 25): • Fraction of oxygen greater than 85%*: n (%) • Fraction of oxygen less than 85%: n, (%)	 24, (96) 1, (4)

IQR: interquartile ranges;
*For oxygen concentrator to function optimally well, it has to generate >85% fraction of oxygen

DISCUSSION:

There were three main findings in our study.

First, only 40% of the health facilities had evidence of checking and performing preventative maintenance. Preventative maintenance was performed and recorded on approximately half of the oxygen concentrators that were in active use. Of the concentrators that had a regular record of checking, only one had malfunctioned. The other 13 that malfunctioned had no record of maintenance checking but were identified upon our visits. Only two were able to be repaired. This study, similar to the study conducted in Gambia [6] confirms the importance of preventative maintenance.

Second, the large majority of oxygen concentrators that had a complete record of maintenance checks were operating for over 700 hours, were checked at least 30 times, and were still fully functioning three years after installation. Preventative maintenance

increases the lifespan of oxygen concentrators [6, 7], and more children who required oxygen have benefited from the oxygen generated [11, 12]. Health workers should be aware that most oxygen concentrators have lifespan of approximately 20,000 hours, mostly relating to the life span of zeolite [13]. Some oxygen concentrators can operate more than 20,000 hours if regular preventative maintenance were performed. One oxygen concentrator in our study was found to produce 79% oxygen concentration at 23,906 hours. In a study done in Nigeria an oxygen concentrator operating for 26,400 hours required maintenance [7], and in Gambia, one concentrator needed major repair at 59,424 hours [14]. There is enough evidence to suggest that oxygen concentrators can last for many years if regular preventative maintenance is performed [6, 7].

Third, a large proportion of oxygen concentrators that were not functioning well had significant mechanical failure. A damaged circuit board was the most common problem identified, and the contributing factors to the problem were excessive movement, dust and leakage in the internal tubing. Repairing was challenging because of limited spare parts, a problem common in other low resource settings [14]. To maximise the benefit of oxygen concentrator programme, all equipment should be from a single manufacturer and adequate provisions made for spare parts and replacement [8, 15].

The challenges faced by the health facilities and health workers were workforce shortages and turnover of staff; initial lack of confidence in using oxygen concentrators; irregular oxygen concentrator checks; difficult communication with investigator or biomedical engineer due to poor network coverage or cost; and new staff requiring training on oxygen concentrators.

There were further problems identified. Some patients remained hypoxemic despite using the equipment if oxygen concentrators were producing less than 85% oxygen and had not been checked using the oxygen analyser. Incorrect oxygen analyser readings occurred because of failure to calibrate the device. Incorrect regulation of oxygen flow rate to meet the patients' oxygen needs, and incorrect oxygen saturation monitoring using pulse oximetry were noted. Staff was informed and corrective actions were undertaken.

The following are required for quality improvement and sustainability of the oxygen concentrators: health facilities should improve on preventative maintenance documentation and report faulty machines; regular oxygen concentrator maintenance and performance checks using oxygen analyser, regular visits by a biomedical engineer and clinician experienced in oxygen concentrator use and oxygen administration for support, training and maintenance; ongoing training for the health workers using the oxygen concentrator; and support (financial and supervisory visits) from the provincial or national health authority).

A limitation of this study was the failure to record the number of hours used and preventative checks performed for 13 oxygen concentrators that had malfunctioned. Failures in relation to the amount of hours of usage could not be reported because hours of use data was not captured when a concentrator repair was performed. In addition, repair of oxygen concentrators requires a good level of experience, skill and spare parts.

CONCLUSION:

Most oxygen concentrators were still operational after three years. A biomedical engineer with competence in maintenance and repair; a user-friendly preventative maintenance routine; basic troubleshooting abilities; documentation of preventative maintenance practices and reporting of faulty machines; and clinical expertise are all needed.

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FREQUENCY OF TRANSFUSION TRANSMISSIBLE INFECTIONS AND POSSIBLE ASSOCIATIONS WITH THE ABO BLOOD TYPES IN BLOOD DONORS IN A REFERRAL HOSPITAL IN PAPUA NEW GUINEA.

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ABSTRACT:
Quick selection of blood free from blood borne infections is paramount during massive blood loss due to trauma and severe blood deficiencies. Therefore, the aim of this study was to determine the frequency of the ABO blood group antigens and their possible associations with Transfusion Transmissible Infections (TTIs), to help create a preliminary database for quick access to infection-free blood during such emergencies. This was an observational retrospective study which included all blood donor information recorded from January 2010 to June 2020 at the Nonga General Hospital Blood Transfusion Laboratory, East New Britain province, Papua New Guinea. All data were analyzed using Microsoft Excel Office Windows 10 version. Parametric statistics were used for analysis of the data, *p*-value less than 0.05 was considered significant. The chi-square test was used to determine if there were significant differences in infection rates between the ABO blood group antigens and variables of interest. Ethical clearance and consent were obtained from the relevant authorities. The order of frequency of the ABO blood group antigens in this population was O>A>B>AB (64%, 18%, 15%, 3%) respectively. The majority of the donors were males (74%). First time donors were 54% and voluntary donors were 85%. Most of the donors (43%) were in the 15-29 years age group. Males with blood type O were significantly associated (p=0.032) with TTIs. HBV/Syphilis co-infections and HBV/Syphilis/HIV triple infections were also significantly associated (p=<0.001) with blood type O. The prevalence rates of infections obtained in the present study were 14% among the young adults (15 to 29 years), 25% among males, 29% among voluntary donors, and 18% among first-time donors. This calls for increased public health educational awareness among the population in the study area.

Keywords: ABO blood group antigens, Frequency, Transfusion Transmissible Infections (TTIs), HIV, HBV, Syphilis, double infections, triple infections.

INTRODUCTION:

Blood and its products are widely used throughout the world for varying purposes. It is however, especially clinically important in blood transfusion practices as it is used as medicine to treat various blood component deficiencies. Apart from its therapeutic uses, it also serves as a medium to transport disease causing agents such as the human immunodeficiency virus (HIV), hepatitis C virus (HCV), Treponema *pallidum,* Plasmodium *species,* and the hepatitis B virus (HBV).

Apart from the Rhesus (Rh) blood group antigens, the ABO blood group antigens are of clinical significance because of their association with acute haemolytic transfusion reactions (AHTR) and Haemolytic Disease of the Foetus /Newborn (HDFN). They were the first blood group antigens to be discovered [1] and are exceedingly significant because individuals who do not have these antigens have antibodies against them.

Apart from associations with transfusion reactions, their association with diseases is well documented [2 – 3]. Epidemiological distribution of the ABO blood group antigens varies geographically, even within the same country [4], and consequently with frequency of disease infection associations [5 - 6]. For example; in various parts of India, the frequency of Blood type A is common in the Northern Eastern part of the country, blood group O in the Eastern, Southern and Central [4] and group B in the Northern Western part [7]. A study of healthy blood donors demonstrated that Blood group A was significantly associated with HIV and HBV infection [5], group AB with VDRL (syphilis) [8], while blood group B was associated with a lower risk of HBV infection [6]. Although Blood group O plays a protective role against Transfusion Transmissible Infections (TTIs) [5], those who are O Rh D positive are more at risk of developing TTIs [9]. They have a 12% increased risk of being infected with HBV [6]. In another study, the ABO blood types were found to have no association between HIV, HCV and syphilis, however found significant association with HBV infections [10]. In blood donors in Amman, Jordan, although the hepatitis B surface antigen was prevalent, no significant association between the ABO/Rh blood groups and TTIs were found [11], suggesting the need for continued improvement and health cultural education programs.

In Papua New Guinea (PNG), the frequency of the ABO blood group antigens and their possible associations with TTIs is sparse and therefore this study was done to determine the frequency of the blood group types and their possible disease associations to set a preliminary data base for their frequency distribution and associated TTIs in this setting.

The major objectives of this study were to determine the frequency of the ABO blood group

antigens and their possible associations with Transfusion Transmissible Infections (TTIs), to help create a preliminary database for quick access to infection-free blood during emergencies.

METHODOLOGY:

Data for this study was obtained retrospectively from Nonga General Hospital (NGH) laboratory data base in East New Britain province (ENBP), Papua New Guinea (PNG). The data included all donor information recorded from January 2010 to June 2020. The information gathered were from donors who have passed pre-screening tests; which included physical and medical checks and also serological screening.

Variables of interest included demographic information, frequency and type of donation, blood type and serological status.

Immuno-chromatographic tests (ICT) were used to screen for HIV, Syphilis and HBV. Screening for HCV was only started in 2018 and therefore was not included in this study. The ICT used for T. *pallidum* screening was the Abbott Determine Syphilis (TP) [12]. The HBV was detected using Determine TM HBsAg, Abbot Laboratories [13]. Detection of HIV follows a specific World Health Organization (WHO) approved national (PNG) algorithm; in that the initial testing is done using the Determine HIV-1/2 (Alere, MA, USA), and HIV-1/2 STAT-PAK (Chembio, Medford, NY) as confirmatory test [14]. The ABO antigens were identified using the forward and back grouping using commercial anti-sera to identify unknown antigens and known laboratory made washed red cells were used to identify the unknown antibodies in the back grouping [15]. Any inconclusive results were repeated by a second person to confirm blood phenotype.

The data was entered into Excel Spreadsheets (MS Office version 2010). Frequency and Chi-square test were used to compare differences in infections between categorical variables of interest; A *p*-value of less than 0.05 was considered statistically significant.

Ethical clearance was issued by the University of Papua New Guinea (UPNG) Research and Ethics Committee. Because of the retrospective nature of this study, consent to collect data from donors was not obtained. However, consent to use the data was obtained from the authorities in the NGH ENBP in PNG. Identification of all donors were kept confidential as approved by the ethics committee.

RESULTS:

A total of 7571 donors were recorded at the Nonga General Hospital Blood Transfusion Service (NGHBTS) from January 2010 to June 2020. Of these, 7477 (99%) were analyzed, the remaining 94 (1%) were excluded because of missing variables. Of the 7477 donors, the majority (74%) were males (Table 1). The mean age of the male donors was (33±12 years) and the age range was 16 to 87 years. Throughout the study period the mean age of the frequent male donors was 20±12 years. The mean age

of female donors was 35± 12 years, and the age range was 14 to 72 years. The mean age of the frequent female donors was 40±12 years.

Among the 7477 donors the frequency of the ABO blood group antigens in decreasing order was blood group O (64%), blood group A (18%), B (15%) and AB (3%). Most of these donors were males (74%), first-time donors (54%), and voluntary (85%), whose age group was 15-29 years (43%). The proportions of blood group antigens O and A in males were higher (64.0% and 18% respectively) than were B and AB (15.0% and 3.0% respectively). The same ABO antigens frequency sequence is seen in females, repeat and first-time donors, VDs and FRDs, and in the age groups (Table 1).

Of the 7477 donors, 33% (2462) were positive for TTIs. The prevalence rate of infection among the blood groups is presented in Table 2. The result shows that 21% (1562/7477) were blood group O, 6.0% (456/7477) were blood group A, 5.0% (372/7477) were blood group B, and 1.0% (72/7477) were blood group AB. Although the frequency of blood group O antigens was prevalent, using the Chi-square test and cross-tabulation, no statistically significant difference in infection rate was observed among the ABO blood group antigens (Table 2).

Among the genders, TTIs were high in males (25%; 1843/7477) than in females (8%; 619/7477). The difference was statistically significant in males with blood group O antigens than in females with blood group O antigens (p=0.032 vs p= 0.575) respectively. Although a high number of those infected were infected by a single pathogen (24%, 1805/7477), this was statistically insignificant (p=342). However, a significant difference in infection was observed among double and triple infections (p=<0.001); the majority of which were blood group O in males (Table 2).

Among repeat and first-time donors, a high proportion of TTIs were seen in first time donors (18%; 1324/7477) than in repeat donors (15%; 1138/7477). No significant difference in TTIs was observed between the different ABO blood types in both groups. This trend was also seen in VDs and FRDs, and among the sub-age groups (Table 2).

A high number of donors who had single infections were blood group O, and mostly infected with HBV (12%), followed by syphilis at 10%. The majority of those who had double infections were blood group O as well, and were mostly co-infected with HBV/Syphilis (3%), while HBV/HIV and HIV/Syphilis co-infections had equal rates of infection (2%) (Table 3). The results for triple infections are presented in Table 4. The Triple infections were also mostly seen in blood group O (1%). Infection in Blood type O was observed to be dominant in all three categories (single, double and triple) of infections.

Table 1: Distribution of the 7477 donors according to their ABO Blood group antigens, gender, type of donation, frequency and age-groups.

Blood Group	A n (%)	AB (%) n (%)	B n (%)	O n (%)	Totals n (%)
Antigens	1343 (18.0)	188 (3.0)	1120 (15.0)	4826 (64.0)	**7477**
Gender					
Males	1019 (18.0)	143 (3.0)	825 (15.0)	3536 (64.0)	5523 (74)
Females	324 (17.0)	45 (2.0)	295 (15.0)	1290 (66.0)	1954 (26)
Frequency of Donation					
Repeat	584 (17.0)	84 (2.4)	498 (14.4)	2288 (66.2)	3454 (46)
First time	759 (19.0)	104 (2.5)	622 (15.5)	2538 (63.0)	4023 (54)
Type of Donation					
VD	1122 (18.0)	154 (2.0)	964 (15.0)	4109 (65.0)	6349 (85)
FRD	221 (20.0)	34 (3.0)	156 (14.0)	717 (63.0)	1128 (15)
Age groups					
15-29	613 (19.0)	70 (2.0)	492 (16.0)	2006 (63.0)	3181(43)
30-44	425 (16.0)	84 (3.0)	380 (15.0)	1727 (66.0)	2616 (35)
45+	305 (18.0)	34 (2.0)	248 (15.0)	1093 (65.0)	1680 (22)

VD: Voluntary Donors; FRD: Family Replacement Donors

Table 2: Distribution of the 7477 donors according to frequency and prevalence of infection with TTIs among the ABO blood antigens, gender, type of infection, type of donation and age-groups. The Chi-square values are also shown.

Variables	**ABO Blood Group Antigens**				**Prevalence (95% CI)**	***p*=value (χ2)**
Blood Group Antigens	A n (%)	AB n (%)	B n (%)	O n (%)	(n=2462) 33.0 (32-34)	
	456 (6.0)	72 (1.0)	372 (5.0)	1562 (21.0)		0.281 (3.825)
Gender						
Male	343 (4.5)	61 (1.0)	258 (4.0)	1166 (16.0)	(n=1843) 25.0 (23.7-25.6)	0.032 (8.80)
Female	113 (1.5)	11 (0.2)	99 (1.0)	396 (5.0)	(n=619) 8.0 (7.7-8.9)	0.575 (0.58)
Type of Infection						
Single	314 (4.0)	37 (0.5)	284 (3.8)	1162 (16.0)	(n=1805) 24.0 (23-25)	0.342 (3.345)
Double	125 (1.8)	19 (0.3)	173 (1.0)	325 (4.0)	(n=534) 7.0 (7-8)	<0.001 (89.684)
Triple	17 (0.2)	16 (0.2)	15 (0.2)	75 (1.0)	(n=123) 2.0 (1-2)	<0.001 (56.857)
Frequency of Donation						
Repeat	192 (2.0)	36 (0.5)	169 (2.0)	741 (10.0)	(n=1138) 15.0 (14-16)	0.359 (3.219)
First time	264 (4.0)	36 (0.5)	203 (3.0)	821 (11.0)	(n=1324)	0.138 (5.508)

					18.0 (17-19)	
Type of Donation						
VD*	392 (5)	59 (0.8)	321 (4)	1373 (18)	(n=2145) 29.0 (28-30)	0.810 (0.966)
FRD*	64 (1)	13 (0.2)	51 (1)	189 (3)	(n=317) 4.0 (4-5)	0.125 (5.743)
Age-group						
15-29	198 (3)	28 (0.4)	164 (2)	681 (9)	(n=1071) 14.0 (14-15)	0.916 (0.051)
30-44	171 (2)	30 (0.4)	126 (2)	554 (7)	(n=881) 12.0 (11-13)	0.168 (5.051)
45+	87 (1)	14 (0.2)	82 (1)	327 (5)	(n=510) 7.0 (6-7)	0.844 (0.821)

*VD: Voluntary; FRD: Family Replacement Donor

Table 3: Distribution of the 7477 donors according to the prevalence of single, double and triple infections (HBV, HIV and syphilis) among the ABO blood group antigens.

Single Infections					
Blood group antigens	n	HBV n (%)	HIV n (%)	SYPHILIS n (%)	Prevalence (95%CI)
A	310	182 (2.4)	20 (0.2)	108 (1.4)	4 (3.7-4.6)
AB	49	32 (0.43)	2 (0.03)	15 (0.2)	1 (0.5-0.8)
B	284	167 (2.2)	8 (0.1)	109 (1.5)	4 (3.4-4.2)
O	1162	668 (8.9)	80 (1.01)	414 (5.54)	15.5 (14.7-16.4)
Totals	**1805**	**870 (11)**	**199 (3)**	**736 (10)**	**24 (23.2-25.1)**
Double Infections					
	n	HBV/HIV	HIV/SYPHILIS	HBV/SYPHILIS	
A	117	37 (0.5)	30 (0.4)	50 (0.7)	1.6 (1.3-1.9)
AB	19	5 (0.1)	5 (0.1)	9 (0.1)	0.3 (0.1-0.4)
B	73	17 (0.23)	18 (0.24)	38 (0.51)	1 (0.8-1.2)
O	325	86 (1.1)	84 (1.0)	155 (2.0)	4.1 (3.9-4.8)
Totals	**534**	**145 (2)**	**137 (2)**	**252 (3)**	**7 (6.6-7.7)**

Table 4: Distribution of the 7477 donors according to the prevalence of triple infections (HBV, HIV and syphilis) among the ABO blood group antigens.

Triple Infections HBV/HIV/SYPHILIS		
Blood group antigens	N (%)	Prevalence (95% CI)
A	29 (0.4)	0.4 (0.3 - 0.5)
AB	4 (0.05)	0.1 (0.00 - 0.11)
B	15 (0.2)	0.2 (0.10 – 0.30)
Q	75 (1.0)	1.0 (0.8 – 1.2)
Total	123 (1.65)	2.0 (1.4 – 1.9)

DISCUSSION:

Our results showed that the main donor population from January 2010 to June 2020 were young male voluntary donors who donated for the first time; the majority of which were blood type O, followed by blood group A, then blood group B and blood group AB (Table 1). According to some authors, a donor population comprising of young, voluntary and repeat donors represent the ideal population whose blood is supposedly low in bloodborne infections [16]. The low number of female donors in our present study is similar to the findings reported by others in some developing countries; this may be because of cultural and religious beliefs including normal physiological monthly shedding of blood in menstrual flow [17].

The high frequency of blood type O (64%) observed in the present study is similar to the results in several tribes in the Highlands region [18] and among the Gidra population [19] in Papua New Guinea. The latter authors noted that the variations seen in their study were partly due to the tribes' geographical isolation from each other and genetic drift [18], and migration [19]. Similarly, the same scenario was seen among males of the Pacific Islands Regimen in Port Moresby, which comprised of unrelated individuals serving in the disciplinary forces under the Australian administration, before independence [20].

In a country where blood is now mostly used for trauma and cancer cases [21], it is important that knowledge of the distribution of the ABO blood group antigens must be documented to assist in quick selection of the appropriate blood group for recipients, and in preventing and managing alloimmunization [7] during blood transfusion. The order of the frequency of the blood group antigens in the present study was O>A>B>AB. This is consistent with many other studies including, blood donors in the Central region of Saudi Arabia [22], Gabon [10], the National Blood Bank in Amman, Jordan [11], and the Indigenous Australians [23]; but in contrast to Prakash [24] in Eastern India and in Northern Indian [25] and also among blood donors in Gwalior, India [7]. The latter three studies in different parts of India showed frequency patterns of B>O>A>AB, while in Sikkim, India [4], the frequency pattern was A>O>B>AB. In all these studies, frequency of Blood group antigens AB was always low, similar to the value in the current study.

The distribution and frequency of the ABO blood group antigens is based on evolution over millions of years, such that a high frequency of blood group A is seen in Europe, while B and O in Asia and South America respectively [1]. Furthermore, current frequencies seen in different parts of the world are due to mix marriages between different races, migration and environmental factors including disease

epidemics. The spectrum of ABO antigens observed in this study is consistent with Ohashi et al. [18], who found that the predominant ABO blood group antigens in Oceania was O but which again varied geographically within the same region. The higher frequency of blood group O seen in this study is similar to the Gidra population of Western province but in contrast to the Balopa population of Manus Island [18]. A striking similarity between the Gidra setting and this study setting is the endemicity of malaria infections in these regions; which may have influenced the high frequency of the O blood group antigens as a result of selection pressure in malaria endemic settings favouring reduced susceptibility to P. *falciparum* infections in group O individuals [3, 26 - 27].

This study showed no statistically significant difference in TTIs between the ABO blood types and repeat and first-time donors, VDs and FRDs, age groups, females, and single infections, although TTIs were prevalent in Blood group O in all these groups (Table 2). This in contrast to Abegas [3] and Davidson [28] who reported in their reviews that red cell antigens interact and influence the risk of occurrence of both infectious and non-infectious diseases. In this study a significant difference in infection was observed between males (p=0.032) and the ABO blood types, and between double (p=<0.001) and triple infections (p=<0.001).

In contrast to the low number of female donors, who comprised an older population (mean age 40 ±12 years), the significant number of TTIs observed in males with blood group O could be due to the high number of young, male donors donating for the first time in this study. First time donors do not necessarily know their serological status and therefore the likelihood of them testing positive for TTIs is high [22], or it could be due to careless sexual behaviours as a high prevalence of donors who frequently donated throughout this period were mostly 20 years old. This is similar to Awili [29] who reported significantly high TTI prevalence in adolescent blood donors in Kenya in 2020. Moreover, the insignificantly low prevalent rate of TTI in females in this study could be due to the older female donor population who are probably more mature and educated, than a group of carefree and sexually active adolescence who were probably experimenting with perilous sex and wanted to have their tests done for free by donating blood.

The significant differences in TTIs between double and triple infections and the ABO blood types seen in this study, were mostly prevalent in blood group O donors. This is a cause for concern as this group of individuals were very young, supposed to have had vaccination against HBV infections, and therefore are supposedly healthy individuals. Apart from perilous sexual behaviour [29], factors such as insensitive tests [30], poor health education

awareness [31], scarcity of appropriate infrastructure, lack of trained personnel and financial constraints [32] are seen to be contributing to a reservoir of TTIs in blood donors in developing countries [16]. This calls for an increase in effective and efficient educational public health awareness in schools and in the media about sexually transmitted infections and their impact in this setting. In Papua New Guinea blood banks, Immunochromatographic tests (ICT) are commonly used for screening donor blood, and therefore, this could also be a contributing factor for the high number of TTIs seen among the universal donors. Lack of an effective documentation system [33] could also be a reason as positive donors could have been recorded more than once. An effective electronic data base system must be installed and sensitive confirmatory tests should be introduced to reduce the window period and also to eliminate the possibility of false positive tests resulting in the relatively high TTI counts as seen in this study.

Contrasting reports of associations of TTIs with blood group O have been reported. In some studies, blood group O was seen as playing a protective role against HBV and HIV [5, 10], while in another, it is more susceptible to all three infections, including syphilis) [11]. In this study, the most frequent disease seen was in donors with blood group O, although no significant difference in infection between the ABO blood group antigens was demonstrated (33%, 95%CI 32-34, p=0.281). This may suggest blood group O playing a protective role, similar to the findings by Batool et al. [5] but in contrast to Hrood et al. [11]. A case-control prospective study needs to be done to confirm the findings of this study to better guide selection of blood donors.

The order of frequency of TTIs in those that were infected with HBV and HIV was blood group O>A>B>AB and in those that were infected with syphilis was O>B>A>AB. In those that were infected with syphilis, infection in blood group B was higher than blood groups A and AB, after blood group O. Blood group AB was found to be significantly associated with syphilis in one study [8], which is in contrast to our present study. Although single infections were prevalent in this study (24%), no significant difference between the ABO blood antigens was seen. This could be a result of adherence to thorough pre-screening procedures or effective awareness campaigns, however, the high overall TTI prevalence observed and the significant association of blood type O with male donors and multiple infections is suggestive of perilous sexual activity as these are supposedly healthy individuals but are asymptomatic and therefore pose a high risk to recipients.

CONCLUSION:

The order of the frequency of the ABO Blood group antigens in this setting in decreasing order

is; O>A>B>AB. TTIs are prevalent in blood group antigens O and significantly associated with male donors, and double and triple infections. A review of existing pre-screening protocols is needed to reduce recruitment of infected donors.

ACKNOWLEDGEMENT:

Staff of Nonga General Hospital Blood Transfusion Service, the Pathology Department, and the Management of the hospital, East New Britain Province, Papua New Guinea.

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NARRATIVE REVIEW OF SYSTEMATIC REVIEWS ON THE ROLES OF VITAMIN D IN THE ERA OF COVID-19 PANDEMIC

Short Running Title: Vitamin D in COVID-19 review of reviews

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Submitted: January 2022; Accepted March 2022

ABSTRACT:
The severe acute respiratory syndrome coronavirus-2 (SARS-CoV2) virus has caused a worldwide COVID-19 pandemic. Vitamin D deficiency and insufficiency may have a significant impact on respiratory viral infections. This narrative review of systematic reviews describes the roles of vitamin D on COVID-19 infection prognosis and whether vitamin D supplementation has any role in improving clinical outcomes of COVID-19 patients. A literature search of PubMed and Google Scholar was conducted in October 2021. Only systematic reviews published in the English language from January 2020 through October 2021 were included. Seven systematic reviews were identified. Five showed that low vitamin D levels increased the likelihood of contracting COVID-19 infections, admission into intensive care and increased mortality for severe vitamin D deficient individuals. Two reviewed the benefits of vitamin D supplementation and found an association between supplementation and a reduction in ICU admissions and mortality from COVID-19 infections. All of the systematic reviews identified a high prevalence of vitamin D deficiency in COVID-19 individuals, with a positive correlation between vitamin D deficiency and disease severity. Maintaining appropriate levels of vitamin D through oral supplementation or sunlight exposure may be beneficial to improve public resilience during this pandemic.

Keywords: COVID-19, Infection, Mortality, Vitamin D

INTRODUCTION:

The coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV 2) has had a tragic impact globally since the end of 2019 [1,2]. The pandemic is implicated in over 530 million confirmed cases, with more than 6.3 million deaths as of 8 June 2022 [3]. Medical therapies to treat COVID-19 are rapidly growing and evolving, ranging from supportive care, antivirals to administration of anti-inflammatory agents [2]. While further research is required for highly effective treatment against the virus, the best strategy to contend with COVID-19 infections is still through prevention and vaccination to reduce the risk of acquiring infections and developing complications.

Over the last few years, vitamin D deficiency and insufficiency has garnered worldwide attention as a global health issue that instigated

numerous studies related to its impact on respiratory viral infections [4, 5]. A large number of epidemiological studies have demonstrated that individuals with low levels of vitamin D have a higher risk of developing severe respiratory infections, which may lead to death [1,6-9]. Vitamin D, Cholecalciferol (vitamin D3) and Ergocalciferol (vitamin D2), is a hormone precursor that plays a vital role in regulating the metabolism of calcium and phosphate [1]. The vitamin D biosynthetic pathway begins with ultraviolet B radiation of 7-hydrocholesterol on the bare skin exposed to sunlight. This process is deemed to be the primary source for vitamin D synthesis in humans, as there are very few foods that contain vitamin D [1]. This Vitamin D then undergoes several metabolic processes in the liver and kidneys transforming it into a metabolically active form of vitamin D known as 1,25-dihydroxyvitamin D [1]. There is evidence to suggest that the local synthesis of active vitamin D is crucial for the immuno-modulatory role of vitamin D against inflammation and microbes beyond the systemic level of 25-hydroxyvitamin D and bone [1]. A systematic review and meta-analysis also identified several studies demonstrating that vitamin D hinders lymphocyte proliferation, antibody production and cytokine synthesis through monocyte and cell-mediated immune stimulation [1].

SARS-CoV 2 infections in COVID-19 patients trigger a surge of cytokine production in the pulmonary tract that prompts an uncontrolled production and infiltration of pro-inflammatory cytokines and chemokines [10]. This event subsequently activates an abnormal adaptive immune response that builds into acute respiratory distress syndrome (ARDS), identified radiologically and histologically as widespread of inflammation in the lungs [2, 10]. It is hypothesised that Vitamin D plays a role in easing this abnormal cytokine production by triggering alveolar macrophages and/or airway epithelia to express the CYP27B1 gene and vitamin D receptor (VDR), which is a natural response following a viral infection [11]. While these metabolic processes seem to occur for respiratory infections, the application of this mechanism in coronaviruses remain uncertain and requires further investigation [12]. Currently, active research is being undertaken to review the role of Vitamin D in COVID-19 infections, ranging from clinical observations to randomised controlled trials. The current hypothesis is that the risk for contracting COVID-19 infections is higher in individuals with low vitamin D status [1,2,13]. It is also hoped that vitamin D supplementation may have a potential therapeutic role in improving clinical outcomes in COVID-19 patients [1, 2].

The aim of this narrative review of systematic reviews is to provide insight into the role of vitamin D on the prognosis of COVID-19 infections and whether there is a potential benefit of vitamin D supplementation on adverse clinical outcomes in COVID-19 patients.

METHODS:

A literature search of PubMed and Google Scholar using the terms 'vitamin D' and 'COVID-19' was carried out in October 2021. For this review, only systematic reviews published in the English language between January 2020 and October 2021 were included.

RESULTS:

Seven systematic reviews were identified that evaluated the association of vitamin D status and COVID-19 infections, of which two investigated the benefits of vitamin D supplementation on COVID-19 outcomes.

A systematic review by Yisak et al evaluated nine studies (1,005,042 participants) on the effects of vitamin D levels on the prognosis of COVID-19 infections [14]. The authors found that vitamin D deficiency was associated with hospitalisation of COVID-19 patients. Individuals with low levels of vitamin D had increased odds of contracting COVID-19 infections (OR 1.77, 95% CI 1.07-2.93). The likelihood for Intensive Care Unit (ICU) admission following COVID-19 infections were also greater in vitamin D deficient individuals (OR 2.55, 95% CI 1.28-5.08), with a higher mortality risk observed in severely vitamin D deficient patients (OR 5,681, 95% CI 1,114–28,974; P=0.037) [14]. The authors acknowledged that two of the nine studies failed to demonstrate an association between vitamin D status and COVID-19 infection. However, it was important to note that the vitamin D levels measured in these two studies were acquired long before patients were infected with COVID-19, thus may not reflect the level of vitamin D during the COVID-19 infection [14]. The authors concluded that based on their findings, the likelihood of contracting COVID-19 including severity and mortality rate were strongly associated with vitamin D status. These findings were consistent with the systematic reviews conducted by Teshome et al [4], Ghasemia et al [5], Liu et al [1], and Periera et al [15]. Teshome et al examined 14 studies (91,120 participants) to review the impact of vitamin D levels on COVID-19 infections, which found that individuals deficient in vitamin D had an 80% higher risk of acquiring COVID-19 infections [4]. This review initiated the consideration of vitamin D supplementation to reduce the risk of contracting COVID-19, including severe infections and mortality rate [4]. In Ghasemia et al, 23 studies (11,901 participants) were evaluated to identify the link between vitamin D status and COVID-19 infections [5]. It was found that 41% and 42% of the COVID-19 patients had deficiency and insufficiency in vitamin D respectively, with vitamin D deficiency individuals having five times higher probability to develop severe COVID-19 [5]. The odds of getting infected with COVID-19 were 3.3 times higher in individuals with vitamin D deficiency [5], supporting the importance of having optimal levels of vitamin D. However, in contrast with the review findings of Yisak et al [14] and Teshome et al [4], Ghasemia

et al [5] did not find a significant association between vitamin D deficiency and mortality rates in COVID-19 patients.

The systematic review and meta-analysis by Liu et al consisting of 10 articles covering 361,934 participants also had similar outcomes [1]. In this review, although generally low levels of vitamin D were associated with a higher risk of COVID-19 infections, one of the studies did not demonstrate this link. However, the data on vitamin D levels for this study was collected between 2006 and 2010. When the authors conducted a sensitivity analysis to distinguish the overall effect estimate by removing this study from the meta-analysis, there were no significant changes in the results. The overall findings still supported the association that individuals infected with COVID-19 had lower vitamin D levels compared to COVID-19 negative counterparts. The authors suggested the need for future research to evaluate the benefits of vitamin D supplementations in improving clinical severity and prognosis of COVID-19 patients [1]. The systematic review and meta-analysis by Pereira et al (27 articles, 8,176 participants) observed similar findings [15]. While this review did not find an association between vitamin D deficiency and increased risk of COVID-19 infections, it identified that a higher prevalence of vitamin D deficiency was seen in COVID-19 positive patients. An association was also observed between vitamin D deficiency and COVID-19 severity, especially in the elderly [15]. The authors proposed, from these findings, that the assessment of vitamin D levels should be considered as routine clinical practice by healthcare professionals in the management of COVID-19 infections, including vitamin D supplementation in those with vitamin D deficiency and insufficiency [15].

Hariyanto et al [2] and Pal et al [13] both specifically investigated the impact of vitamin D supplementation on the clinical outcomes of COVID-19 infections. Hariyanto et al conducted a systematic review and meta-analysis of 11 studies (2,265 participants), in which vitamin D supplementation was found to be associated with a reduction in ICU admissions and mortality from COVID-19 infections [2]. These findings are similar to the systematic review and meta-analysis done by Pal et al (13 studies with 2,933 participants) [13]. Pal et al further discovered a reduction in the risk of adverse outcomes following vitamin D supplementation, with improved clinical outcomes in patients receiving the vitamin after diagnosis of COVID-19 [13]. However, most of the studies reviewed did not specify consistent or any baseline levels of vitamin D in their patients prior to supplementation. Therefore, it was difficult to propose whether the response obtained would be different in those with optimal versus deficient vitamin D levels. However, the positive outcomes still supported the use of vitamin D supplementation for the management of patients with COVID-19. The authors also suggested a need for further research directed towards identifying the appropriate dose of vitamin D

supplementation, including the duration and mode of administration [13].

DISCUSSION:

The above mentioned systematic reviews and meta-analyses indicated the importance of understanding the roles of vitamin D in managing COVID-19. The risk of acquiring COVID-19 infections was higher in individuals with low levels of serum vitamin D [1, 4, 5, 14], suggesting a vital role vitamin D has in potentially preventing COVID-19 infections. Following COVID-19 infections, the likelihood for ICU admissions was observed to be higher in patients who were vitamin D deficient [14]. The disease severity was especially linked to lower levels of serum vitamin D in older people [15]. Mortality rate was also higher in COVID-19 patients who have vitamin D deficiency [4, 14]. All these indicated that it was imperative to maintain optimal levels of vitamin D, including after contracting COVID-19 infections, as it is associated with overall clinical COVID-19 disease outcomes. Vitamin D supplementation was also potentially beneficial in treating COVID-19, as it lowered the risk of adverse outcomes in terms of ICU admission and mortality [2, 13].

Overall, these findings lend support towards the clinical practice of incorporating assessment of vitamin D levels and supplementation in the treatment of COVID-19 cases.

There are several limitations of this narrative review of identified systematic reviews and meta-analyses.

Firstly, the studies included were retrospective in nature, therefore unknown or unaccounted confounding factors may influence the results. A correlation does not confirm causation and only prospective studies controlling for potential biases can establish a true causal relationship [16].

Secondly, the different studies used different testing strategies for COVID-19 infections. The definitions for vitamin D deficiency and insufficiency were also not clearly stated or reported. For instance, among seven of the systematic reviews included, only Liu et al [1] and Ghasemian et al [5] reported their definition for vitamin deficiency and insufficiency being serum levels of 25-hydroxyvitamin D ([25(OH)D]) below 20 ng/mL and 21-29 ng/mL respectively. Thus, it is difficult to comment on the reliability and comparability of the data from the studies. Thirdly, COVID-19 severity may also be affected by other variables such as age, sex, existing comorbidities [15], and other immunomodulatory factors (e.g., vitamin C, zinc, selenium etc) [5], all of which were not explicitly discussed or included in the literature. Finally, it is possible that there is publication bias, as studies with negative associations are less likely to be published [1]. Thus, while there is a demonstrated association between vitamin D status and acquiring COVID-19 infection, disease severity and mortality, caution should

be exercised when interpreting these results. Larger prospective clinical trials that consider different age groups and climate conditions, following similar COVID-19 diagnostic criteria and vitamin D classifications should be developed in future studies to evaluate causality of vitamin D status and COVID-19 outcomes.

CONCLUSION:

The present literature confirms a high prevalence of vitamin D deficiency in COVID-19 positive individuals, with a positive association between vitamin D deficiency and disease severity. Maintaining appropriate levels of vitamin D, either via oral supplementation or sunlight exposure may be beneficial to improve public resilience during this pandemic. The use of vitamin D supplementation may be beneficial in COVID-19 patients with vitamin D deficiency and insufficiency. Large prospective trials are still needed to confirm these findings.

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LETTER TO THE EDITOR:

ADAPTING HIV SERVICE PROVISION DURING PUBLIC HEALTH EMERGENCIES: A LOOK AT ESWATINI'S RESPONSE TO THE COVID-19 PANDEMIC

Running Title: *Eswatini HIV services in COVID-19 pandemic*

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BACKGROUND:

The human immunodeficiency virus (HIV) is an epidemic disease for countries in sub-Saharan Africa (SSA). This problematic situation coupled with the SARS-CoV-2 virus global pandemic has led to additional strain to developing health systems in the region.

There are 37.7 million people living with HIV (PLHIV) globally, of which SSA bears 67% of this disease burden [1]. In Eswatini, the HIV among people aged 15 years and older is 27%; more than 200,000 of them are on lifelong antiretroviral therapy (ART) [2]. A systematic review and meta-analyses of PLHIV co-infected with SARS-CoV-2 virus found that PLHIV had a greater risk of coronavirus disease 2019 (COVID-19) infections (risk ratio of 1.24) [3] and mortality (between 78% to 95%) [4]. Population-based studies conducted in South Africa and the United Kingdom also found that during the first COVID-19 waves in 2020, PLHIV were at least twice as likely to die from COVID-19 compared to the HIV-negative population [5]. A study from the University of California found that unvaccinated PLHIV were four times more likely to experience COVID symptoms for an extended period with higher levels of inflammatory markers than HIV-negative people [6]. A larger UK study found that 5% of PLHIV experienced symptoms as long as three to four months post-acute COVID infections [7].

PROBLEM:

In an effort to contain the spread of SARS-CoV-2 infections, many countries instituted measures to restrict non-essential movement of people. However, the public health measure of movement restrictions had unintended consequences. For PLHIV, this limited their access to medications and services, leading to treatment interruptions [8]. When the Omicron SARS-CoV-2 strain emerged in November 2021, the importance of ensuring PLHIV take life-saving ARTs correctly and consistently was highlighted, as PLHIV with unsuppressed viral loads may be sources of "viral evolution" [9]. A mathematical model predicted that HIV treatment interruptions may lead to up to 1.63

times more HIV-related deaths annually [10]. The HIV viral load suppression is also associated with better treatment outcomes for patients with COVID-19. A systematic review conclusively demonstrated that viral suppressed PLHIV have better treatment outcomes than unsuppressed individuals, who are at high risk of developing super-infections for COVID-19 infected PLHIV [11].

Interventions:

Since March 2020, US President's Emergency Plan For AIDS Relief (PEPFAR), Eswatini have been supporting the National AIDS Program to rapidly develop and scale-up program adaptations to ensure uninterrupted treatment and services for PLHIV [12]. These adaptations include:

i) Moving from the national standard of 3 Multi-Month Dispensing (MMD) for all stable clients to 6MMD. This has resulted in more than 60% of clients on Antiretroviral Therapy (ART) receiving 6MMD in March 2021 compared to less than 1% in March 2020. It should be noted that the 6MMD implementation had to be balanced with supply chain security threats due to global disruptions and extended lead times for antiretrovirals.
ii) 3MMD was expanded to include all stable children older than two years, which is an expansion of the eligibility criteria [12].
iii) Establishment and implementation of a national Community Commodity Distribution (CCD) system. CCD was a hybrid of differentiated service delivery models that were already implemented across 121 (out of 196) ART facilities [13]. By the end of October 2020, 962 CCD points were established and actively provides medication refills to 25% of all clients on ART. Community refills have also demonstrated consistently lower missed appointments at 1% as opposed to 7% missed appointments at facilities.
iv) Integrating non-communicable disease (NCD) commodities, family planning, TB screening, tuberculosis-preventative therapy and HIV prevention services and commodities into the CCD system.

While there was a drop in health facility attendance, a reduction in HIV tests conducted and fewer ART initiations, these interventions helped to maintain treatment numbers and reduce preventable interruptions to life-saving treatment for over 200,000 PLHIV.

CONCLUSION:

PLHIV are a vulnerable group for COVID-19 infections. HIV viral load suppression from life-saving ARVs is associated with improved outcomes from COVID-19 infections and may theoretically limit the possibility of SARS-CoV-2 evolution. Thus, policy makers and healthcare workers should continuously innovate and

evolve health service provision to ensure the needs of PLHIV are met during this global pandemic.

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Book:

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