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ABH SECRETOR STATUS AMONG THE UNIVERSITY OF CALABAR UNDERGRADUATES, NIGERIA

Etura Joyce,[1] Abam John,[1] Akpan Uwem,[2] Jeremiah Zaccheaus[3]

[1] University of Calabar, Faculty of Medical Laboratory Science,
Department of Haematology and Blood Transfusion, Calabar, Nigeria
[2] University of Calabar, Faculty of Medical Laboratory Science,
Department of Clinical Chemistry and Immunology, Calabar, Nigeria
[3] Rivers State University, Faculty of Medical Laboratory Science,
Department of Haematology and Blood Transfusion Science, Port Harcourt, Nigeria

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Abstract: Introduction: Secretor status is a critical component of human biology that depends on specific glycoproteins in body fluids and secretions. Its importance lies in its significant impact on health and disease, making it a compelling subject for medical research. This study aimed to determine the prevalence and understanding of secretor status among undergraduates at the University of Calabar, Nigeria. The findings could revolutionize our understanding of secretor status and open new research opportunities.

Materials and Methods: The study used a cross-sectional approach, analyzing blood samples from 100 undergraduate students using the adsorption-inhibition method. Most participants were single (94.0%), and the majority were 100-level students (51.0%). 48 students were in the 21 to 28-year range, while 6.0% were 30 or older.

Results: The findings of this study are significant, revealing that a substantial proportion of the participants were secretors, 82 (82.0%), while 18 (18.0%) were non-secretors.Interestingly, most participants (83.0%) were unaware of their secretor status, indicating a potential knowledge gap. Blood group O had the highest number of secretors, 58 (96.7%), followed by blood group A 11 (55.0%), blood group B 7 (63.6%), and the minor blood group AB 6 (66.7%). The most prevalent ethnic group was found among the Efiks (18.1%) followed by Yakurr (16.6%) and the least the Ijaws (3.8%).

Conclusion: This study underscores the importance of public education and awareness regarding secretor status and its impact on health and disease.

Keywords: Secretor status, glycoproteins, blood groups, undergraduates.

INTRODUCTION

The blood group system is controlled by genes closely linked to the same chromosome.Blood group antigens are inherited stable characteristics that have proven helpful in transfusion medicine, the prevention and management of haemolytic transfusion reactions, and resolving cases of doubtful parentage. ABO blood group antigens are present not only in red blood cells but also in bodily fluids such as saliva, tears, sperm, breast milk, and gastrointestinal fluids. Secretors secrete ABH blood group antigens in their body fluids according to their blood type, while non-secretors do not release these antigens into their bodily fluids. The secretor gene, FUT2 (fucosyl transferase 2), located on chromosome 19, plays a crucial role in determining an individual's secretor status by influencing the expression of blood group antigens in body fluids and secretions (1).

The inheritance pattern of the secretor gene (FUT2) follows an autosomal recessive pattern. This means an individual's secretor status is determined by the combination of alleles inherited from both parents: a) Homozygous dominant (SeSe): Secretor (expresses blood group antigens in body fluids); b) Heterozygous (Sese): Secretor carrier (expresses blood group antigens but can pass on the non-secretor allele); c) Homozygous recessive (sese):Non-secretor (does not express blood group antigens in body fluids) (2).

The expression of ABO blood group antigens depends on the interaction of three genes: FUT1 (H gene), responsible for the H antigen (a precursor to ABO antigens); the ABO gene, which controls A and B antigen expression on red blood cells; and the secretor gene (FUT2 or Se), governing A and B antigen expression in

bodily fluids. These genes encode enzymes (glycosyltransferases) that modify precursor substances to form new antigens (3).

The FUT2 gene controls individuals' capacity to secrete ABH antigens in bodily fluids. Meanwhile, the H (FUT1) gene encodes the H antigen found in red blood cells, while Se (FUT2) governs H antigen expression in secretions. The homozygosity of an inactive H (FUT1) and Se leads to the Bombay phenotype; individuals of the Bombay group do not have the H antigen on their red blood cells or in secretions but produce a strong anti-H antibody. Conversely, individuals who lack the H antigen in their secretions (those deficient in the Se (FUT2) gene) but possess the H antigen in their red blood cells (those who possess only the H (FUT1) gene) are referred to as non-secretors; in contrast, those with both the H antigen in their red blood cells and bodily fluids (active FUT1 and FUT2 genes) are referred to as secretors (4).

The H antigen plays a crucial role in forming ABO blood group antigens, while the Se gene controls the production of H antigens in bodily secretions by encoding the enzyme 2-L- fucosyltransferase. This enzyme converts precursor substances in body fluids into the H antigen in individuals with the secretor genotype.Subsequently, glycosyltransferases encoded by the ABO blood type modify this antigen. Non-secretors cannot express soluble ABO antigens due to their inability to generate the H antigen in bodily fluids (5).

According to Rydell et al. (6), approximately 80% of Caucasian individuals (with genotypes SeSe or Sese) are secretors, while 20% are non-secretors (genotype sese). Non-secretors are more exposed to endogenous and exogenous infections than secretors due to the lack of ABO blood group antigens in their bodily fluids. IgA levels in serum and saliva have been reported to be low in non-secretors; as a result, non-secretor individuals may have a diminished immune response at mucosal surfaces compared to secretors. Additionally, their IgG levels are reduced, which may explain why non-secretor individuals are more susceptible to autoimmune disorders (7).

MATERIALS AND METHODS

StudyArea

The study was conducted at the University of Calabar, Nigeria, a federal university located in Cross River State, South-South Nigeria. Established in 1975, it comprises one postgraduate school, one medical college, twenty faculties, three academic centers, three institutes, and one hundred and sixteen departments.

Study Population

Undergraduates from various departments at the University of Calabar participated in the study. Ten faculty members were selected via balloting using a multistage sampling technique. Two departments were chosen from each faculty through a simple random balloting method. The selected departments covered various disciplines, including English, Biochemistry, Haematology, Sociology, and more. The final sample size consisted of 100 students, with 15 from each department.

Study Design

A cross-sectional survey was adopted for this research.

Eligibility Criteria

Inclusion Criteria: Students of either gender who are undergraduates of the University of Calabar and provide informed consent were recruited as inclusion criteria. **Exclusion Criteria:** Non-consenting undergraduates of the University of Calabar were excluded.

Ethical Considerations

We obtained ethical clearance from the Research and Ethical Committee of the Ministry of Health, Cross River State. Participants received a comprehensive explanation of the study's purpose, objectives, risks, benefits, and confidentiality. Verbal consent was obtained, and participants were assured of their right to refuse or withdraw from the study at any time.

Collection of Samples

A sterile syringe and needle were used to obtain 2 ml of blood from each subject, ensuring that all aseptic techniques were observed. The samples were dispensed into clean sample bottles labeled with laboratory numbers. Samples were stored in a flask containing ice blocks and later transported to a refrigerator. Additionally, 5 ml of whole unstimulated saliva was collected into a clean, wide-mouthed, labeled container from each subject by having them bend their heads for two minutes and directly collecting the saliva into the container. Blood grouping was performed for the collected blood using the ABO standard tube method, and the estimation of salivary blood group antigens was conducted using the standard absorption inhibition method.

Determination of ABH Secretor Status by Absorption Inhibition Method Procedures

Saliva-filled test tubes were cooled in a boiling water bath for 10 minutes. Subsequently, the cooled tubes underwent centrifugation at 3000 rpm for 10

minutes. After discarding the supernatant, clear saliva was collected using a pipette. One drop of saline was added to each control test tube.

Four test tubes were prepared, two labeled as TEST and two as CONTROL. The controltubes serve as a crucial reference point in the procedure, ensuring that the antisera is not excessively diluted for agglutination. The stock agglutinating reagent was meticulously adjusted to a 1:8 titer, and one drop of diluted antisera was added to each tube. Clear saliva was also added to each test tube, while the control tube received one drop of saline. After mixing, both tubes were incubated at room temperature for a minimum of 10 minutes. Next, one drop of the appropriate indicator erythrocytes was added to each tube, followed by another 10-minute incubation. For the saline reaction in the control, the tubes underwent centrifugation for 10 minutes. Agglutination reactions were recorded, and negative results were re-evaluated using the same procedure.

Interpreting test results is crucial. In the control samples, clumping occurred, signifying no antigen presence. In the test group, a lack of agglutination indicated an antigen-antibody reaction between saliva and antisera, suggesting the presence of the blood group. The same principle applied to negative test samples, where the absence of agglutination indicated antigen presence.

ABO Blood Grouping Procedures

In forward grouping, blood cells were mixed with saline in two test tubes. Next, one drop of anti-A and one drop of anti-B were separately added to these samples. After centrifugation, the resulting mixture was gently shaken to observe agglutination.

Statistical Analysis

The data collected during the study were recorded, checked, and entered into Microsoft Excel, then exported to the Statistical Package for the Social Sciences (SPSS) (version 22.0) software for statistical analysis. A chi-square analysis was conducted and expresse data 95% confidence interval. P-values were considered significant at $p < 0.05$, and the results were presented using tables and figures.

RESULTS

This study investigated the prevalence of secretor and non-secretor status among undergraduate students at the University of Calabar in Cross River State. The parameter analyzed included ABO blood group and secretor status. The research involved 100 undergraduates, comprising 52 females and 48 males.

Table 1. *Sociodemographic characteristics of respondents*

VARIABLE	NUMBER ENROLLED (N = 100)	PERCENT AGE ENROLLED (%)
Gender		
Male	48	48.0
Female	52	52.0
Age group (Years)		
15-20	25	25.0
21-25	48	48.0
26-30	21	21.0
> 30	6	6.0
Marital status		
Married	6	6.0
Single	94	94.0
Divorced	0	0
Widowed	0	0
Level		
100	51	15.0
200	25	25.0
300	30	30.0
400	20	20.0
500	6	6.0
600	4	4.0

Table 1 presents the demographic characteristics of the undergraduates. The most common age group was 21-25 years, with a frequency of 48.0%. The majority of participants were single (94.0%), with married individuals making up 6.0%. Most participants were first-year students (100-level class), representing 51.0% of the sample, followed by 300-level students (30.0%), 200-level students (25.0%), 400-level students (20.0%), 500-level students (6.0%), and 600-level students (4.0%).

Table 2 summarizes respondents' knowledge of secretor status. Participants displayed limited awareness of their secretor status; none of the 100% of respondents tested knew their secretor status.

Table 3 presents the respondents' knowledge levels. The total knowledge score was 8, with scores categorized as poor (0-2), fair (3-5), and good (6-8). The mean knowledge score was 1.89 ± 1.23, indicating that participants generally had poor knowledge. Among the 100 respondents, 83.0% had inadequate knowledge, 14.0% had fair knowledge, and 3.0% had good knowledge.

Table 4 shows the influence of various demographics on respondents' levels of knowledge of secre-

Table 2. *Respondents' knowledge about secretor and non-secretor status*

VARIABLES	Yes	No	Idon't know
Have you heard of secretor and non-secretor status?	5 (5.0%)	58 (58.0%)	37 (37.0%)
Do you know your secretor status?	0 (0.0%)	89 (89%)	11 (11.0%)
Are secretors individuals whose blood group can also be detected in bodily fluids other than blood?	17 (17.0%)	21 (21.0%)	62 (62.0%)
Are non-secretors individuals whose blood group can only be detected in their blood, not body fluids?	14 (14.0%)	10 (10.0%)	76 (76.0%)
Are non-secretor individuals prone to reoccurring episodes of infections?	19 (19.0%)	35 (35.0%)	46 (46.0%)
ABH blood group antigen present in an individual's blood tells the individual's blood type.	41 (41.0%)	25 (25.0%)	34 (34.0%)
An individual might possess the ABH antigens in their blood but lack the antigens in their secretion.	23 (23.0%)	28 (28.0%)	49 (49.0%)
Is the secretor gene more common with males than females?	34 (34.0%)	15 (15.0%)	51 (52.0%)

Table 3. *Respondents' level of knowledge*

VARIABLE	FREQUENCY
Level of knowledge	
0-2 (Poor)	83 (83.0%)
3-5 (Fair)	14 (14.0%)
6-8 (Good)	3 (3.0%)
Mean knowledge score	1.89 ± 1.23

Table 4. *Relationship between secretor status knowledge & some demographic characteristics*

VARIABLE	FREQUENCY n = (100%)	PROPORTION (%)	LEVEL OF KNOWLEDGE			P-VALUE
			POOR	FAIR	GOOD	
Age group (Years)						
15-20	25	25.0	21 (84.0%)	3 (12.0%)	1 (4.0%)	0.061
21-25	48	48.0	41 (85.4%)	6 (12.5%)	1 (2.1%)	
26-30	21	21.0	16 (76.2%)	5 (23.8%)	0 (0.0%)	
> 30	6	6.0	5 (83.3%)	0 (0.0%)	1 (16.7%)	
Gender						
Male	48	48.0	41 (85.4)	5 (10.4)	2 (4.2)	0.567
Female	52	52.0	42 (80.8)	9 (7.3%)	1 (1.9)	
Marital status						
Married	6	5 (83.3)	0 (0.0)	1 (16.7)	0 (0.09)	0.209
Single	94	78 (83.0)	14 (14.9)	2 (2.1)	2 (2.2)	
Divorced	0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Widowed	0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Level						
100	51	15.0	15 (100.0)	0 (0.0)	0 (0.0)	0.388
200	25	25.0	20 (80.0)	5 (20.0)	0 (0.0)	
300	30	30.0	23 (76.7)	4 (13.3)	3 (10.0)	
400	20	20.0	16 (80.0)	4 (20.0)	0 (0.0)	
500	6	6.0	6 (100.0)	0 (0.0)	0 (0.0)	
600	4	4.0	3 (75.0)	1 (25.0)	0 (0.0)	

Table 5. *Distrinution of secretor status*

STATUS	FREQUENCY	PERCENTAGE (%)
Secretors	82	82.0
Non-secretors	18	18.0
Total (n = 100)	100	100.0

Table 6. *Relationship between ABO blood group and secretor status*

BLOOD GROUP	FREQUENCY	SECRETOR STATUS		PVALUE
		Se POSITIVE	Se NEGATIVE	
A	20	11 (55.0%)	9 (45.0%)	0.001
B	11	7 (63.6)	4 (36.4)	
AB	9	6 (66.7%)	3 (33.3)	
O	60	58 (96.7)	2 (3.3)	
Total	100	82	18	

Table 7. *Comparison of secretor status in the studied population with published data from previous studies*

SECRETOR STATUS	PRESENT STUDY (2022)	Emeribe *et al.* (8)	Jaff (9)	Tejasiv *et al.* (10)	p-value	χ^2value
Se positive	82.0%	86.9%	76.1%	86.6%	0.157	2.000
Se negative	18.0%	13.1%	23.9%	13.4%		

tor status, grouped into poor, fair, and good knowledge categories. Among those aged 15-21, knowledge levels were 84.0%, 12.0%, and 4.0%, respectively. For those aged 21-25, the distribution was 85.4%, 12.5%, and 2.1%. Those aged 26-30 showed frequencies of 76.2%, 23.8%, and 0.0%, while individuals above 30 years had levels of 16.7%, 0.0%, and 83.3%, respectively. Regarding gender, males exhibited poor, fair, and good knowledge of secretor status at rates of 85.4%, 10.4%, and 4.0%, respectively, while females had 80.8%, 7.3%, and 1.9%. Concerning marital status, singles recorded knowledge levels of 0.0%, 16.7%, and 0.9%, while married individuals had 14.9%, 2.1%, and 2.2%. In terms of education level, knowledge scores were as follows:100-level students (100.0%, 0.0%, 0.0%), 200-level students (80.0%, 20.0%, 0.0%), 300-level students (76.7%, 13.3%, 0.0%), 400-level students (80.0%, 20.0%, 0.0%), 500-level students (100.0%, 0.0%, 0.0%), and 600-level students (75.0%, 25.0%, 0.0%) for poor, fair, and good knowledge, respectively. No statistical differences existed between the knowledge levels of the groups examined ($p > 0.05$).

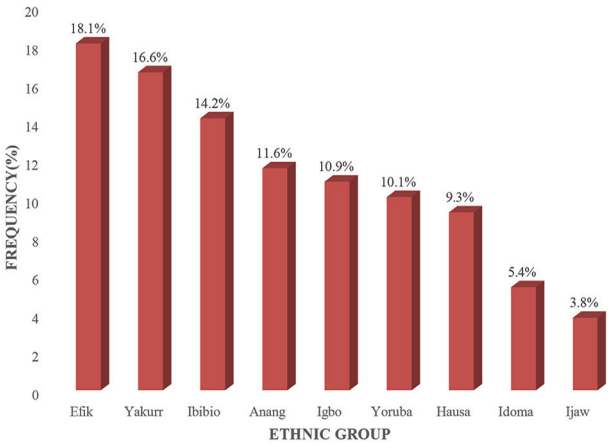

Figure 1. *Bar-chart representation of ethnicity of respondents*

Table 5 shows the prevalence of secretor status among undergraduates at the University of Calabar. Of the 100 participants in this study, 82.0% were secretor-positive (Se), while 18.0% were secretor-negative (se).

Table 6 presents the influence of blood group on the secretor status of undergraduates. Blood group

O had the highest prevalence at 60.0%, followed by group A (20.0%), group B (11.0%), and group AB (9.0%). For secretor status, blood group O had 58 (98.7%) secretors and 2 (3.3%) non-secretors; blood group A had 18 (55.7%) secretors and 9 (45.0%) non-secretors; blood group B had 7 (66.6%) secretors and 4 (36.4%) non-secretors; and blood group AB had 6 (66.7%) secretors and 3 (33.3%) non-secretors.

Table 7 compares secretor status in the studied population with published data from earlier studies. Previous studies reported secretor and non-secretor status of 86.9% and 13.1% (8), 76.1% and 23.9% (9, 10), and 86.6% and 13.4%, respectively.

Figure 1 is a bar chart representing participants based on their ethnicity. The most prevalent ethnic group was found among the Efiks, with a frequency of 18.1%, followed by Yakurr (16.6%), Ibibio (14.2%), Anang (11.6%), Igbo (10.9%), Yoruba (10.1%), Hausa (9.4%), Idoma (5.4%), and the least represented group was Ijaw (3.8%).

DISCUSSION

This study aimed to provide insights into the prevalence of secretor status among undergraduate students at the University of Calabar. Most participants fell within the age range of 21-25 years (48.0%), while only 6.0% were above 30 years. Among the students, those in the 100-level constituted the highest proportion (51.0%), followed by the 300-level (30.0%), with the 600-level showing the least representation (4.0%).

The relationship between ABO blood groups and secretor status in this study indicated that the majority of secretor-positive individuals were of blood group O, with a prevalence of 58.0%. In contrast, blood group O had only 2.0% secretor-negative participants. Blood group A showed a prevalence of 11.0% for secretor-positive and 9.0% for secretor-negative, while blood group B had 7.0% secretor-positive and 4.0% secretor-negative. Blood group AB recorded 6.0% secretor-positive and 3.0% secretor-negative individuals. This indicates that individuals with blood group O have a significantly higher frequency of secretor status compared to other groups, a finding consistent with Emeribe et al (8) and Jaff (9) who also reported that most secretor-positive individuals belonged to blood group O. This higher prevalence of secretor status in blood group O individuals may help explain the lower incidence of certain diseases in this group compared to others. Regarding ethnicity, the majority of participants were Efiks (18.1%), followed byYakurr (16.6%), with the least represented being the Ijaw (3.0%).

Out of the 100 enrolled students, 82 (82.0%) tested secretor-positive (Se), and 18 (18.0%) tested secretor-negative (se). This prevalence aligns with findings from Tejasiv et al. (10) and Akhter et al. (11), which reported secretor-positive rates of 76.1%, 60.0%, and 86.6%, respectively. The research included 100 undergraduates, comprising 52 females and 48 males. consistent with findings by Sherwani et al. (12), who reported a higher female representation.

The secretor status, determined by the FUT2 gene, influences the expression of ABH antigens in body fluids beyond blood cells. However, its direct impact on haemoglobin levels remains less understood. While secretor status is associated with protection against certain infections (such as *Helicobacter pylori*, noro virus, and cholera), its specific effect on hemoglobin levels warrants further investigation (13, 14, 15).

The participants' knowledge about secretor and non-secretor status was notably low, with none being aware of their secretor status before testing. This finding highlights the need for increased public education and awareness regarding secretor status, as no published evidence supports this level of ignorance.

CONCLUSION

In conclusion, this study found that 82.0% of undergraduate students at the University of Calabar were secretors, with blood group O individuals exhibiting the highest secretor frequency (96.7%) and blood group AB the lowest (66.7%). Notably, the ability to secrete ABH substances appears to be independent of ABO blood group antigens.

Acknowledgments

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Abbreviations

FUT1 - Fucosyltransferase1
FUT2 - Fucosyltransferase2

Conflict of Interest: All authors declare that they have no conflicts of interest.

Source of Funding: The authors received no external funding for this study.

Note: AI was not used as a tool in this study.

Sažetak

ABH STATUS SEKRETORA MEĐU STUDENTIMA UNIVERZITETA U KALABARU, NIGERIJA

Etura Joyce,[1]Abam John,[1] Akpan Uwem,[2] Jeremiah Zaccheaus[3]

[1] Univerzitet Calabar, Fakultet medicinskih laboratorijskih nauka,
Departman za hematologiju i transfuziju, Calabar, Nigerija
[2] Univerzitet Calabar, Fakultet medicinskih laboratorijskih nauka,
Departman za kliničku hemiju i imunologiju, Calabar, Nigerija
[3] Rivers State univerzitet, Fakultet medicinskih laboratorijskih nauka,
Departman za hematologiju i transfuziju, Port Harcourt, Nigerija

Uvod: Sekretorski status je ključna komponenta ljudske biologije koja zavisi od specifičnih glikoproteina u telesnim tečnostima i sekretima. Njegov značaj leži u značajnom uticaju na zdravlje i bolest, čineći ga privlačnom temom za medicinska istraživanja. Ova studija imala je za cilj da odredi učestalost i razumevanje sekretorskog statusa među studentimana Univerzitetu u Kalabaru, Nigerija. Nalazi bi mogli transformisati naše razumevanje sekretorskog statusa i otvoriti nove mogućnosti za istraživanje.

Materijali i metode: U ovoj studiji preseka, analizirani su uzorci krvi 100 studenata koristeći metodu adsorpcije-inhibicije. Najveći broj učesnika su bili samci (94,0%), a većinu su činili student prve godine (51,0%). 48 studenata bilo je u uzrastu od 21 do 28 godina, dok je 6,0% imalo 30 ili više godina.

Rezultati: Rezultati ove studije su značajni, pokazujući da je značajan deo učesnika bio sekretor, 82 (82,0%), dok je 18 (18,0%) njih označeno kao nesekretori. Zanimljivo je da je većina učesnika (83,0%) bila nesvesna svog sekretorskog statusa, što ukazuje na potencijalnu prazninu u znanju. Krvna grupa O imala je najveći broj sekretora, 58 (96,7%), dok je u krvnoj grupi A taj broj 11 (55,0%), u krvnoj grupi B 7 (63,6%), a u krvnoj grupi AB 6 (66,7%).

Najrasprostranjenija etnička grupa među ispitanicima je bila Efik (18,1%), zatim Yakurri (16,6%), a najmanji broj je među Ijawima (3,8%).

Zaključak: Ova studija naglašava važnost javnog obrazovanja i svesti o sekretorskom statusu i njegovom uticajuna zdravlje i bolest.

Ključne reči: Sekretorski status, glikoproteini, krvne grupe, studenti.

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Correspondence to/Autor za korespondenciju
Prof dr Zaccheaus Awortu Jeremiah
Department of Haematology and Blood Transfusion Science Faculty of Medical Laboratory Science
Rivers State University Port Harcourt, Nigeria Pnone:+2348034045636
ORCID:0000-0003-4994-9826
ORCID:
Etura Joyce = 0000-0003-3207-9487;
Abam John = 0009-0003-9771-5570
Akpan Uwem = 0000-0002-4685-6619

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