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Assessment of the Correlation between Medical History, Dietary Habits, and Oocyte Yield of Ovum Donors Attending Invitro Fertilization Clinics at Abakaliki

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Abstract

Background: Many women desirous of the services of Invitro Fertilization (IVF) cannot produce viable oocytes required for their IVF cycles. They therefore depend on ovum donation from younger females for their cycles. Sometimes after spending huge amount of money screening these intending donors and probably stimulating their ovaries, the oocyte yields are not encouraging. This study is aimed at assessing the correlation between the medico-nutritional characteristics and follicular performance of ovum donors attending IVF clinics at Abakaliki. **Method:** This study was a descriptive cross-sectional study that used a census sampling technique and a structured self-administered questionnaire proforma for data collection. Questionnaires from 423 first-time female ovum donors, who properly filled their proforma questionnaires and willingly participated in donors' ovulation stimulation cycles with five (5) different stimulation drugs and were triggered with two different doses of hCG, irrespective of their follicular performances, were selected out of 444 female participants and analyzed using Statistical Package for the Social Sciences IBM, SPSS version 26 and presented in tables. p-values of <0.005 were considered statistically significant. **Result:** Majority of the ovum donors, 91 (21.5%), were 23 years of age. The mean age was 22.35 ± 3.435 (2 S.D). Majority of the ovum donors, 392 (92.7%), were nulliparous and unmarried, 390 (92.2%). Greater percentage, 87.9% (372), of the donors were undergraduate students. Majority of the oocyte donors, 319 (75.4%), had normal BMI, and 314 (74.2%) ovum donors attained menarche at age 13. Out of the 150 donors

(35.5%) who never used hormonal contraceptives, 73 (48.7%) of them produced ≥16 matured oocytes with 4% producing ≥36 matured oocytes while out of the 273 donors who had taken hormonal contraceptives, only 63 (23.1%) produced ≥16 matured oocytes with only 1.5% of them producing ≥36 matured oocytes. This was statistically significant, p-value = 0.000; chi-square = 33.616. Out of the 27 donors who admitted to have done TOP, none produced up to 16 oocytes while out of the 396 (93.6%) donors who never had TOP, 138 (32.6%) produced >16 matured oocytes. This was statistically significant, p-value = 0.003; chi-square = 20.603 (FISHER'S EXACT TEST). The number of donors whose favourites were *fufu*/*akpu* was statistically small in this study though they were associated with higher mature oocytes (≥36 oocytes). This finding was statistically significant, p-value = 0.000; chi-square = 259.508. Out of 232 donors who took only soft drinks, 107 (46.1%) produced ≥16 oocytes with 4.3% of them producing ≥36 oocytes. Of the 160 donors whose favourite drinks were alcohol, only 26 (16.3%) produced ≥16 oocytes with none of them producing up to 36 oocytes. Out of the donors whose favourite drinks were both alcohol and soft drinks, 5 (16.1%) produced ≥16 oocytes with none of them producing up to 36 oocytes. These were statistically significant, p-value = 0.000; chi-square = 57.475. The largest percentage of donors who consumed only pears produced ≥16 oocytes (42.9%), followed by donors who consumed only mangoes (40.0%) and donors who consumed only watermelon (36.5%). This was statistically significant, p-value = 0.000; chi-square = 198.441. Fifty percent (50%) of donors who took avocado regularly produced ≥16 oocytes with 25% producing ≥36 oocytes while 33% of donors who never took avocado produced ≥16 oocytes with 1.5% producing ≥36 oocytes. This was found to be statistically significant, p-value = 0.000; chi-square = 61.881. Sixty-six percent (66%) of donors who ate almond nut regularly produced ≥16 oocytes compared to donors who did not eat almond nuts where only 29.7% produced ≥16 oocytes. These findings were statistically significant, p-value = 0.000; chi-square = 50.441.
Conclusion: This study has demonstrated a correlation between follicular performance of ovum donor who consumes pears, mangoes, avocado, almond nut, watermelon, whose favourite food is *akpu*/*fufu*, abhors alcoholic drinks and who has not taken hormonal contraceptive at least six (6) months prior to ovum donation, nor has done TOP and who presented at IVF Clinics for egg donation at Abakaliki.

Keywords

Correlation, Medico-Nutritional Characteristics, Follicular Performance, Ovum Donors, Invitro Fertilization Clinics, Abakaliki

1. Introduction

The need to neutralize the socio-psychological and cultural impact of infertility on families looking for fruits of the womb, especially in our environment, has necessitated the increasing patronage to Assisted Reproductive Technology (ART),

particularly the *in-vitro* fertilization and embryo transfer (IVF-ET) [1]. Many of the women desirous of the services of Invitro Fertilization (IVF) cannot produce viable oocytes required for their IVF cycles either due to their advanced age, diseased ovaries or congenital absence of ovaries [2]. They therefore depend on ovum donation from younger females for their cycles. Sometimes these young ovum donors do not produce high-quantity and quality oocytes as expected due to many factors. On many occasions, these ovum donors are treated with *innocency*, ignoring their past medical history and nutritional characteristics.

Dietary patterns may have a great influence on follicular performance when perceived as a whole system instead of individual food constituents. This is because people generally consume the composite meals and not separated nutrients. Diets play influential roles in the reproduction of not only the females but also the males [3]. The dietary pattern of a female directly affects her ovarian micro-environment and can enhance or decrease both the Oocyte quantity and quality [3]. A diet that is balanced supports healthy follicular development and reproductive function [4].

The medical history, including drug utilization of females either in the remote or immediate past, has been reported to impact not only the immediate ovarian micro-environment but the entire hypothalmo-pituitary-ovarian axis, with consequential effect on overall follicular performances of the females.

The young female donors are typically students, who are adventurous and have diverse nutritional and dietary perceptions and biases. No study has evaluated the correlation between the medical history, dietary patterns of ovum donors and their oocyte yields in our environment. This study is therefore set to examine the correlation between the medical history as well as the dietary pattern and oocyte yields of ovum donors attending IVF Clinics at Abakaliki environment. The findings in this study will not only serve as baseline for future studies in this topic but will contribute to enriching global literature on the influence of dietary patterns on oocyte yields in particular and female fertility in general.

2. Methods

2.1. Study Area

Ebonyi State is one of the smallest states of Nigeria. In terms of land mass and population respectively, it is the 33rd largest, sitting on 6400 km^2 and the 29th most populous state in Nigeria with an estimated population of 3,490,383 (2016 estimated population by National Population Commission).

Geographically, Ebonyi State is located in the South-East geopolitical zone and shares boundaries with Benue State in the North, Cross-River State in the South East, Enugu State in the West and Abia State in the South West.

It was created out of the former Abia and Enugu States on October 1, 1996 with Abakaliki as its capital. It derives its name from the famous Ebonyi River, which traverses the greater parts of the state.

Economically, the occupation of people of Ebonyi State is mainly agriculture

(yam, cassava, rice, oil palm crops). Mining is also going on in some pockets of the state as the state is blessed with deposits of lead, zinc and is rich in limestones. The Gross Domestic Product (GDP) of Ebonyi State is estimated at $12.2 billion and $3634 per capita. Ebonyi State has the 20th highest Human Development Index (HDI 2018) in the country.

Ebonyi State has three senatorial zones of North, Central and South with 13 local government areas. Abakaliki is located in Northern Senatorial zone of the state and houses two major federal tertiary health care institutions: the Alex Ekwueme Federal University Teaching Hospital and National Obstetric Fistula Centre (NOFIC), as well as many private health care facilities, including Smile Specialist Hospital.

NOFIC Abakaliki is a federal tertiary institution that focuses its care mainly on female reproductive needs. It is situated in the State capital.

It started as Mother and Child Care Initiative (MCCI) in 2008 as a pet project of the wife of the second Governor of Ebonyi, Chief Mrs. Josephine Elechi, which cared for the women with obstetric fistula. It later transformed to South East Vesico-Vagina Fistula Centre. It was taken over and renamed National Obstetric Fistula Centre in 2011 by the Federal Government of Nigeria with six mandates, namely: Free treatment of obstetric Fistula, Research, Training, Prevention and Rehabilitation of fistula patients, as well as cancer screening/treatment with respect to cervical, breast and prostate cancers. The IVF unit of the Centre was established and became operational in 2015.

Smile Specialist Hospital is a private healthcare facility located in Abakaliki that focuses mainly on women's reproductive health needs. It was established in 2012. The IVF unit of the hospital became operational in 2014, hence, it became the first IVF Centre in the State.

The two Invitro Fertilization (IVF) clinics in Abakaliki, one private (Smile Specialist Hospital) and one Government (National Obstetric Fistula Centre), which started in 2014 and 2015 respectively were selected for the study.

The choice of Smile Specialist Hospital's IVF Centre is predicated on the premise that apart from the fact that the hospital hosts the first and oldest IVF unit in the state, its proximity to NOFIC makes data collection easy.

The choice of NOFIC IVF unit is predicated on the fact that it was the second IVF Centre in Abakaliki, as well as its proximity to Smile Specialist Hospital.

2.2. Study Population

The study population comprised of all first-time ovum donors who willingly presented to these two Centres for egg donation and willingly gave consent to participate in the study within the study period.

2.3. Study Design

This is a descriptive, cross-sectional study.

2.4. Sampling Technique/Selection Criteria

Census of all eligible first-time ovum donors within the study period who presented at the selected clinics and consented to participate in the study was used.

2.5. Sampling Size

Sample size was determined by statistical formula for descriptive studies, and was derived from the formula:

$$N = Z^2pq/d^2 \text{ [5]}$$

where:

N = minimum sample size;

Z = 1.96 (95% CI);

p = expected proportion = 0.5 (since there is no available study to pick the prevalence);

q = 1 − p;

d = desired precision (acceptable margin of error) = 0.05;

$N = (1.96)^2 \times 0.5\ (1 - 0.5)/(0.05)^2$;

$N = 3.8416 \times 0.25/0.0025 = 384.16$;

Plus 10% attrition = 38.4;

Sample size − 38.4 + 384.16 = 422.58;

Approximately 423.

2.6. Inclusion Criteria

Willing and consenting, non-recipient first-time ovum donors who willingly gave out their socio-demographic data and who willingly subjected themselves to ovarian stimulation protocols. Ovum donors who met above criteria and completed the procedure with oocyte retrieval (or did not complete the procedure because they were dropped early due to poor performances) within the study period were selected and included.

2.7. Exclusion Criteria

Excluded from the study were:

1) Ovum donors who refused to consent to the study, or refused to willingly give out their socio-demographic data.

2) Ovum donors who withdrew from the stimulation protocol before oocyte retrieval.

3) Ovum donors who have donated eggs in the past.

4) Egg-sharers, and

5) Recipient donors.

6) Donor who did TOP or used oral contraception less than six (6) months prior to presentation were excluded.

2.8. Clinical Method

All the 423 donors who participated in this study were subjected to same controlled

ovarian stimulation drugs and similar doses of trigger drug were used to trigger oocyte maturation. The oocyte retrievals were done 36 hours after the trigger drugs were administered. Three laboratory criteria were used to determine oocyte maturity viz: Cumulus-Oocyte Complex (COC), nuclear maturity and cytoplasmic maturity.

2.9. Instrument of Data Collection

The information was collected using a well-designed data collection proforma. The proforma has two sections: A and B. Section A comprised of instrument for collecting the socio-demographic characteristics of the donors. Information on the medico-nutritional characteristics of ovum donors was found in section B.

2.10. Validity of Data Collection Instrument

To ensure validity of the collection instrument, the proforma was reviewed and modified by the co-authors to ensure compliance with objectives of the study.

2.11. Reliability of the Instrument

To ensure reliability of the proforma instrument, it was pre-tested on 10 selected ovum donors. This exercise helped to identify some ambiguities with the proforma, which were corrected before proceeding with data collection.

2.12. Data Collection

Six (6) research assistants (2 doctors and 4 nurses) who understood the three major languages of Nigeria-Hausa, Igbo and Yoruba, and the major dialects in Ebonyi State—Izzi, Ezza, Ohaozara and Afikpo, as well as the IVF terminologies and also worked routinely in IVF clinics, received further training for a day and were equipped with the contents of the proforma.

The research assistants counseled each donor and collected information on their socio-demographic and anthropometric characteristics.

2.13. Data Analysis

Data was analyzed using Statistical Package for the Social Sciences IBM, SPSS version 26. The assistance of a Statistician conversant with this was sorted to help in the analysis.

Frequencies, percentages, mean and standard deviation were used to present the results.

3. Ethical Considerations

Ethical clearance was obtained from Research and Ethics Committee of Ebonyi State University, Abakaliki (EBSU REC). Formal administrative permission was secured from the heads of the IVF Clinics used.

Confidentiality was observed and data was extracted and analyzed anonymously. All donor's information that would expose her identity was not entered into the

proforma and were excluded from the data set.

All participating ovum donors gave consent in writing and were made to know that they could withdraw at any stage of the research without untoward effects.

4. Results

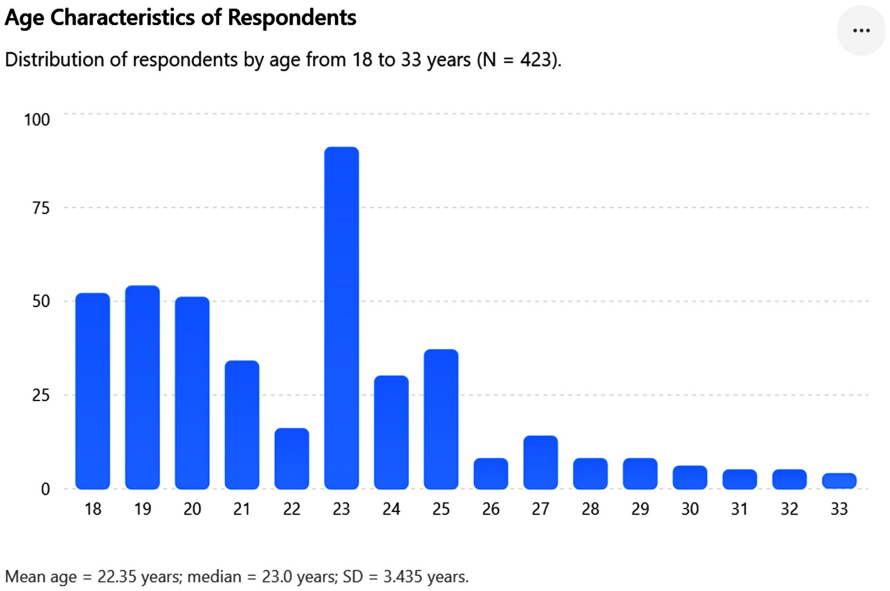


Figure 1. Age characteristics of respondents.

Figure 1 shows that majority of the donors were 23 years old (21.5%) while age 33 formed the least (0.9%). The mean age was 22.35 years ± 3.435 (2 SD).

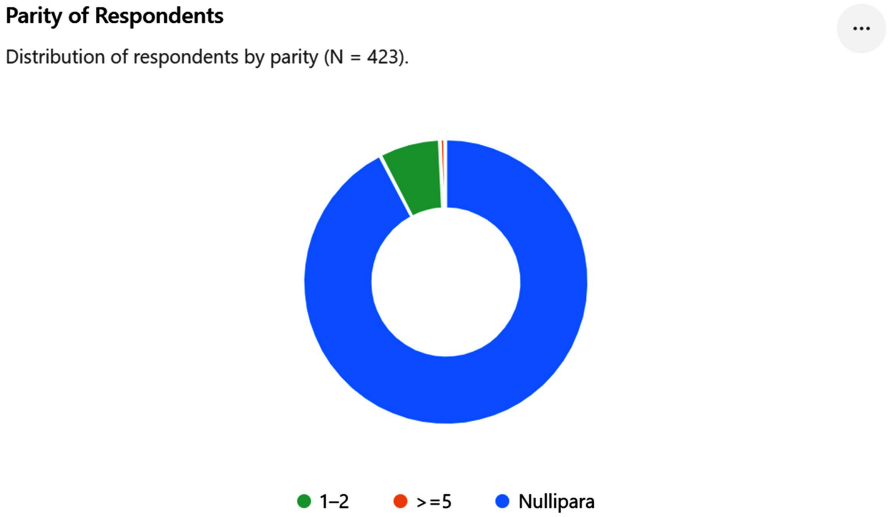


Figure 2. Parity of respondents.

Figure 2 showed that majority of the donors were nulliparous, 392 (92.7%). This is statistically significant, chi-square = 51.541, p-value = 0.000.

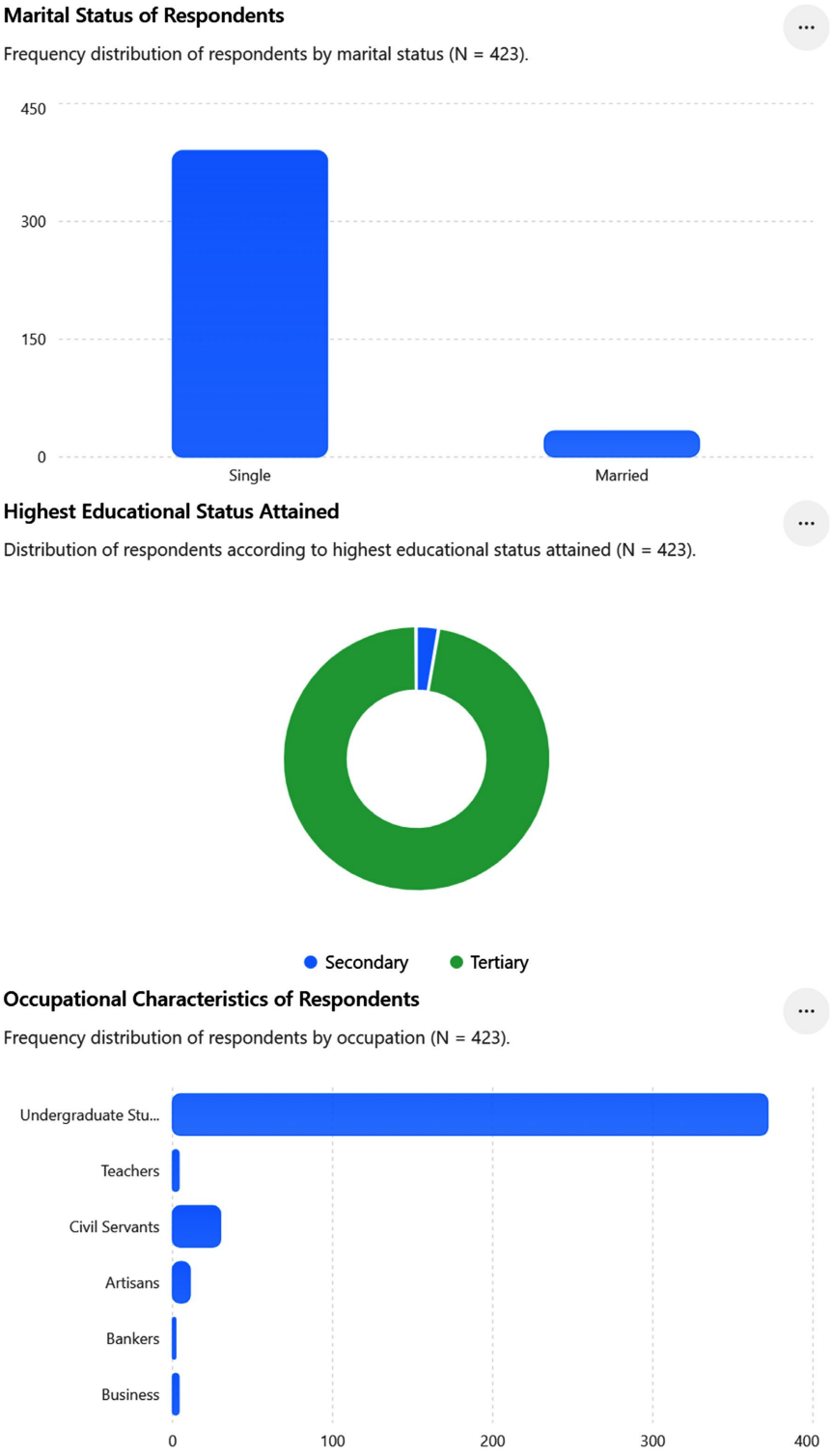
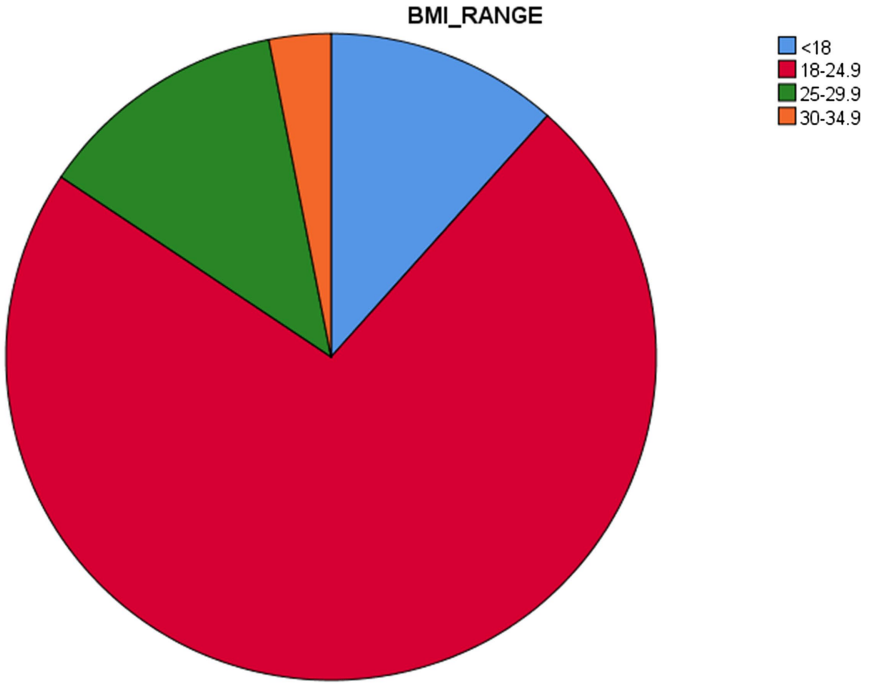


Figure 3. Marital/educational/occupational status of respondents.

Figure 3 showed that majority of the donors, 390 (92.2%), were single. Donors with tertiary education as their highest educational attainment were 412 (97.4%) while 372 (87.9%) were students.



p-value = 0.000; chi-square = 4493.329.

Figure 4. The Body Mass Index (BMI) characteristics of respondents.

Figure 4 shows that majority of the donors, 319 (75.4%), had normal BMI of 18 to 25.5 kg/m^2. Forty-nine (49) donors (11.6%) had BMI of less than 18 kg/m^2 while 55 (13.0%) Donors had BMI > 25.5 kg/m^2. This was statistically significant, p-value = 0.000; chi-square = 4493.329.

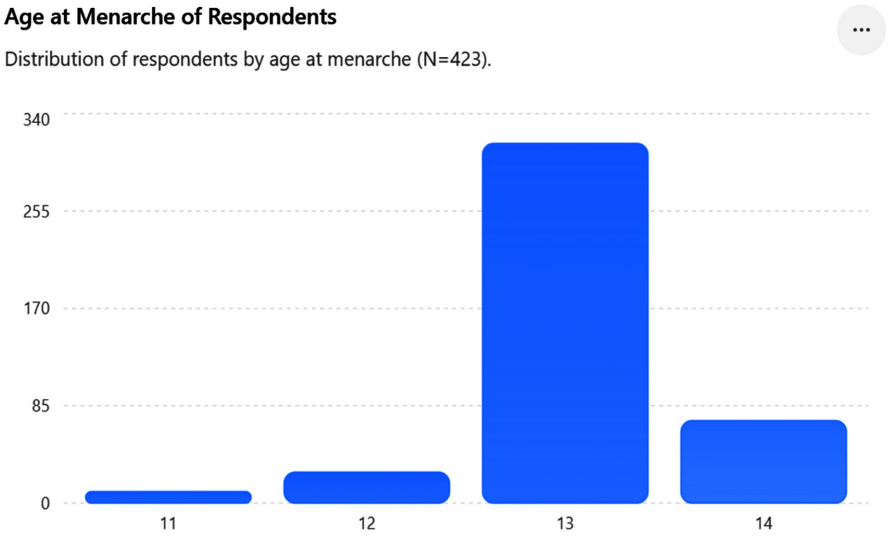


Figure 5. Age of menarche of respondents.

Figure 5 above showed that majority of the donors, 314 (74.2%), attained menarche at age 13, followed by age 14.

Table 1. Medico-nutritional history of ovum donors.

Hormonal Contraceptive Usage	Frequency	Percentage (%)
Postinor-2	261	61.7
(0.75 mg levonorgestrel)		
COCP	12	2.8
None	150	35.5
Termination of Pregnancy (TOP)		
YES	27	6.4
NO	396	93.6
Nutrition		
Complex Carbohydrates (yam, rice, ebba/garri, akpu)	180	42.6
Plastic food (indomie, meatpie, spaghetti)	217	51.3
Beans/fiofio, ukwa	11	2.6
Tea/bread + egg + milk	15	3.5
Drinks		
Soft drinks only	232	54.8
Alcohol only	160	37.8
Both	31	7.3
Favourite Fruits		
Banana + mango + avocado + almond nut	6	1.4
Watermelon	197	46.6
Banana + avocado	13	3.1
Cashew + avocado + almond nut	14	3.3
Local pear + almond nut	28	6.6
Apple + avocado + almond nut	23	5.4
Mango and avocado	85	20.1
Orange + almond nut	12	2.8
Pawpaw and banana = almond nut	2	0.5
Udara + avocado	15	3.5
Pineapple	4	0.9
All fruits	2	0.5
None	22	5.2
Total	423	100.0

Table 1 showed that majority of the donors had taken some form of hormonal contraception, 273 (64.5%), with the commonest being Postinor-2, while 35.5% had never taken.

Majority of the donors never had TOP, 396 (93.6%). Among the 27 (6.4%) who had, dilatation and curettage was the major mode of TOP, accounting for about 58% while the use of misoprostol accounted for about 42%.

Majority of the donors consumed plastic food, 217 (51.3%), and soft drinks only, 232 (54.8%), followed by donors who consumed heavy carbohydrates (42.6%) and

alcoholic drinks only (37.8%).

Donors who consumed watermelon as their favourite fruits constituted majority, 197 (46.6%), while 5.2% of donors never had any favourite fruits.

Table 2. Hormonal contraceptive usage and total number of matured oocytes retrieved.

Hormonal Contraceptive Usage	0 (%)	1 - 5 (%)	6 - 10 (%)	11 - 15 (%)	16 - 20 (%)	21 - 25 (%)	26 - 30 (%)	31 - 35 (%)	36 - 40 (%)	Total (%)
Yes	34 (12.5)	68 (24.9)	67 (24.5)	41 (15.0)	10 (3.7)	25 (9.2)	12 (4.4)	12 (4.4)	4 (1.5)	273 (64.5)
N0	7 (4.7)	27 (18.0)	29 (19.3)	14 (9.3)	14 (9.3)	21 (14.0)	18 (12.0)	14 (9.3)	6 (4.0)	150 (35.5)
Total	**41 (9.7)**	**95 (22.5)**	**96 (22.7)**	**55 (13.0)**	**24 (5.7)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100.0)**

Chi-square = 33.61; p = 0.000.

Table 2 showed that majority of the donors, 273 (64.5%), had taken some form of hormonal contraception. Out of the 150 donors (35.5%) who never used hormonal contraceptives, 73 (48.7%) of them produced ≥16 matured oocytes with 4% producing ≥36 matured oocytes. Out of the 273 donors who had taken hormonal contraceptives, only 63 (23.1%) produced ≥16 matured oocytes with only 1.5% of them producing ≥36 matured oocytes. This was statistically significant, p-value = 0.000; chi-square = 33.616.

Table 3. TOP and total number of matured oocytes retrieved.

TOP Done	0	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	25 - 30	31 - 35	36 - 40	Total
Yes	9 (33.3)	8 (29.6)	5 (18.5)	5 (18.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	27 (6.4)
No	32 (8.1)	87 (21.9)	89 (22.5)	50 (12.6)	26 (6.6)	46 (11.6)	30 (7.6)	26 (6.6)	10 (2.5)	396 (93.6)
Total	**41 (9.7)**	**95 (22.5)**	**94 (22.2)**	**55 (13.0)**	**26 (6.1)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100)**

Chi-square = 20.603 (FISHER'S EXACT TEST); p = 0.003.

Table 3 showed that out of the 27 donors who admitted to have done TOP, none produced up to 16 oocytes. 33.3% (9) of them produced no oocytes while the highest oocyte range of 11 - 15 was produced by 18.5% (5) of them. While out of the 396 (93.6%) donors never had TOP, 138 (32.6%) produced >16 matured Oocytes, 2.5% (10) produced up to 40 oocytes with only 8.1% (41) of them not producing oocytes at all. This was statistically significant, p-value = 0.003; chi-square = 20.603 (FISHER'S EXACT TEST).

Table 4. Correlation between nutritional pattern/choices and total mature oocytes retrieved.

Nutritional Favourites/ Pattern	0 (%)	1 - 5 (%)	6 - 10 (%)	11 - 15 (%)	16 - 20 (%)	21 - 25 (%)	26 - 30 (%)	31 - 35 (%)	36 - 40 (%)	Total (%)
Garri/*eba* and egusi soup	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)
Rice	8 (7.5)	12 (11.3)	26 (24.5)	8 (7.5)	6 (5.7)	18 (17.0)	14 (13.2)	8 (7.5)	6 (5.7)	106 (25.1)

Continued

Yam	6 (9.2)	9 (13.8)	13 (20.0)	6 (9.2)	6 (9.2)	7 (10.8)	8 (12.3)	8 (12.3)	2 (3.1)	65 (15.4)
Indomie	18 (13.5)	41 (30.8)	39 (29.3)	17 (12.8)	6 (4.5)	4 (3.0)	4 (3.0)	4 (3.0)	0 (0.0)	133 (31.4)
Spaghetti	4 (5.3)	20 (26.3)	12 (15.8)	20 (26.3)	6 (7.9)	8 (10.5)	2 (2.6)	4 (5.3)	0 (0.0)	76 (18.0)
Rice and beans	0 (0.0)	3 (27.3)	4 (36.4)	0 (0.0)	0 (0.0)	2 (18.2)	0 (0.0)	2 (18.2)	0 (0.0)	11 (2.6)
Meatpie	2 (25.0)	6 (75.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	8 (1.9)
Rice and yam	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)
Tea and bread	0 (0.0)	0 (0.0)	0 (0.0)	4 (26.7)	2 (13.3)	7 (46.7)	2 (13.3)	0 (0.0)	0 (0.0)	15 (3.5)
Fufu/akpu	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	2 (0.5)
Afang soup + any swallow	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.7)
Total	**41 (9.7)**	**95 (22.5)**	**94 (22.2)**	**55 (13.0)**	**26 (6.1)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100)**

Chi-square = 259.50; p = 0.000.

Table 4 showed that Donors whose favourite foods were yam only (3.1%) and rice only (5.7%), as well as 100% of donors whose favourites were *fufu/akpu* produced ≥36 oocytes each. No other donors with other nutritional choice/favourite produced such number of oocytes. This finding was statistically significant, p-value = 0.000; chi-square = 259.508.

Table 5. Favourite drinks and total number of mature oocytes retrieved.

Favourite drinks	0 (%)	1 - 5 (%)	6 - 10 (%)	11 - 15 (%)	16 - 20 (%)	21 - 25 (%)	26 - 30 (%)	31 - 35 (%)	36 - 40 (%)	Total (%)
Soft drinks	12 (5.2)	43 (18.5)	45 (19.4)	25 (10.8)	16 (6.9)	35 (15.1)	24 (10.3)	22 (9.5)	10 (4.3)	232 (54.8)
Alcohol	23 (14.4)	45 (28.1)	40 (25.0)	26 (16.3)	10 (6.3)	8 (5.0)	6 (3.8)	2 (1.3)	0 (0.0)	160 (37.8)
Both	6 (19.4)	7 (22.6)	9 (29.0)	4 (12.9)	0 (0.0)	3 (9.7)	0 (0.0)	2 (6.5)	0 (0.0)	31 (7.3)
Total	**41 (9.7)**	**95 (22.5)**	**94 (22.2)**	**55 (13.0)**	**26 (6.1)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100)**

Chi-square = 57.47; p = 0.000.

Table 5 above showed that majority of the donors, 232 (54.8%) took soft drinks only. 160 (37.8%) took alcohol only while 31 (7.3%) took both alcohol and soft drinks. Out of 232 donors who took only soft drinks, 107 (46.1%) produced ≥16 oocytes with 4.3% of them producing ≥36 oocytes. Of the 160 donors whose favourite drinks were alcohol, only 26 (16.3%) produced ≥16 oocytes with none of them producing up to 36 oocytes. Out of the donors whose favourite drinks were both alcohol and soft drinks, 5 (16.1%) produced ≥16 oocytes with none of them producing up to 36 oocytes. These were statistically significant, p-value = 0.000; chi-square = 57.475.

Table 6. Favorite fruit consumption pattern and total number of mature oocytes retrieved.

Favourite Fruit Consumption Pattern	0	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	31 - 35	36 - 40	Total
Banana & Mango	0 (0.0)	4 (66.7)	0 (0.0)	2 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (1.4)

Continued

Watermelon	30 (15.2)	44 (22.3)	31 (15.7)	20 (10.2)	12 (6.1)	26 (13.2)	16 (8.1)	14 (7.1)	4 (2.0)	197 (46.6)
Banana only	0 (0.0)	3 (23.1)	0 (0.0)	8 (61.5)	0 (0.0)	0 (0.0)	2 (15.4)	0 (0.0)	0 (0.0)	13 (3.1)
Cashew	2 (14.3)	4 (28.6)	0 (0.0)	4 (28.6)	2 (14.3)	0 (0.0)	0 (0.0)	2 (14.3)	0 (0.0)	14 (3.3)
Pear	0 (0.0)	8 (28.6)	6 (21.4)	2 (7.1)	0 (0.0)	10 (35.7)	0 (0.0)	2 (7.1)	0 (0.0)	28 (6.6)
None	2 (9.1)	2 (9.1)	6 (27.3)	4 (18.2)	4 (18.2)	2 (9.1)	2 (9.1)	0 (0.0)	0 (0.0)	22 (5.2)
Apple	0 (0.0)	0 (0.0)	12 (52.2)	7 (30.4)	0 (0.0)	0 (0.0)	2 (8.7)	2 (8.7)	0 (0.0)	23 (5.4)
Mango only	5 (5.9)	15 (17.6)	29 (34.1)	2 (2.4)	6 (7.1)	8 (9.4)	8 (9.4)	6 (7.1)	6 (7.1)	85 (20.1)
Orange	2 (16.7)	4 (33.3)	4 (33.3)	0 (0.0)	2 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	12 (2.8)
Pawpaw & Banana	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)
Udara	0 (0.0)	4 (26.7)	5 (33.3)	6 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	15 (3.5)
Pineaple	0 (0.0)	3 (75.0)	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.9)
All fruits	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)
Total	**41 (9.7)**	**95 (22.5)**	**94 (22.2)**	**55 (13.0)**	**26 (6.1)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100)**

Chi-square = 198.441; p = 0.000 (<0.001).

Table 6 showed that the largest percentage of donors who consumed only pears produced ≥16 oocytes (42.9%), followed by donors who consumed only mangoes (40.0%) and donors who consumed only watermelon (36.5%). This was statistically significant, p-value = 0.000; chi-square = 198.441.

Table 7. Frequency of avocado consumption and total number of mature oocytes retrieved.

Frequency of Avocado Consumption	0	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	31 - 35	36 - 40	Total
3X a week	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)
None	25 (9.4)	70 (26.4)	61 (23.0)	21 (7.9)	16 (6.0)	24 (9.1)	20 (7.5)	24 (5.7)	4 (1.5)	265 (62.6)
Sparingly	16 (10.8)	23 (15.5)	31 (20.9)	32 (21.6)	10 (6.8)	20 (13.5)	10 (6.8)	2 (1.4)	4 (2.7)	148 (35.0)
Always	0 (0.0)	0 (0.0)	2 (25.0)	2 (25.0)	0 (0.0)	2 (25.0)	0 (0.0)	0 (0.0)	2 (25.0)	8 (1.9)
Total	**41 (9.7)**	**95 (22.5)**	**94 (22.2)**	**55 (13.0)**	**26 (6.1)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100)**

Chi-square = 61.881; p = 0.000.

Table 7 showed that majority of the donors, 265 (62.6%), were not taking Avocado. Among donors who do take avocado, 50% of those who took it always produced ≥16 oocytes with 25% producing ≥36 oocytes. 33% of donors who never took avocado produced ≥16 oocytes with 1.5% producing ≥36 oocytes. This was found to be statistically significant, p-value = 0.000; chi-square = 61.881.

Table 8 showed that majority of the donors did not take almond nut, 335 (79.2%), and constituted the least (29.7%) of those who produced ≥16 oocytes, while those who always took almond nuts constituted the highest percentage (66.6%) of donors who produced ≥16 oocytes. These findings were statistically significant, p-value = 0.000; chi-square = 50.441.

Table 8. Frequency of almond nut consumption and total number of mature oocytes retrieved.

Frequency of Almond Nut Consumption	0	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	31 - 35	36 - 40	Total
Sparingly	8 (10.1)	13 (16.5)	11 (13.9)	14 (17.7)	4 (5.1)	15 (19.0)	8 (10.1)	2 (2.5)	4 (5.1)	79 (18.7)
None	33 (9.9)	82 (24.5)	83 (24.8)	38 (11.3)	20 (6.0)	29 (8.7)	22 (6.6)	24 (7.2)	4 (1.2)	335 (79.2)
Always	0 (0.0)	0 (0.0)	0 (0.0)	3 (33.3)	2 (22.2)	2 (22.2)	0 (0.0)	0 (0.0)	2 (22.2)	9 (2.1)
Total	**41 (9.7)**	**95 (22.5)**	**94 (22.2)**	**55 (13.0)**	**26 (6.1)**	**46 (10.9)**	**30 (7.1)**	**26 (6.1)**	**10 (2.4)**	**423 (100)**

Chi-square = 50.441; p = 0.000.

Note:

1) "Favourite" food, fruits and drinks refer to the food, fruits and drinks the donors prefer consuming and consumed above others.

2) "Sparingly" means what the donors consumed infrequently or rarely.

3) "Always" means what the donors consumed frequently.

5. Discussion

Majority of the ovum donors in this study had used hormonal Oral contraceptives prior to embarking in ovum donation more than six (6) months prior to ovum donation. This finding is not unexpected since majority of the donors are students who are unmarried, sexually active at the peak of their sexual exuberances and experimentations. Hormonal Oral Contraceptives suppress ovulation by inhibiting follicular growth. This is achieved by inhibiting the secretion of Luteinizing Hormone (LH) and Follicle Stimulation Hormone (FSH), which are crucial for follicular development [4] [6].

Our study showed that higher number of donors who admitted to have used hormonal contraceptives in the past significantly yielded lower quantity and quality of matured oocytes. It's possible that these donors frequently used Postinor-2 as means of preventing unwanted pregnancy (or recently used them less than six months before their selection but denied revealing that for fear of exclusion because of financial gratification). This agrees with study by Ahmed *et al.* (2019) [6], which reported that usage of hormonal contraception prior to ovum donation may be associated with poor follicular performance.

The number of ovum donors who had terminated pregnancy (TOP) prior to ovum donation in this study is low. This agrees with the high percentage of contraceptive use among these donors. Though misoprostol usage as a mode of termination of pregnancy among these donors was high, majority of the donors who did TOP used Dilatation and Curettage (D&C). Though the main usage of misoprostol, a synthetic analogue of prostaglandin E1 (PGE1), in Obstetrics and Gynecology is for uterine contractions and ripening of the cervix, prostaglandin plays physiological role in ovarian follicular development, maturation and rupture. Misoprostol activates prostaglandin EP receptors (EP2, EP3 and EP4) in human granulosa cells [7] [8].

Our study showed that donors who have had TOP in the past produced less matured oocytes than those who never had TOP. This finding differs from various studies which reported that TOP of any method does not influence follicular performance [8] [9]. The difference in this finding in our study may be due to differences in study settings.

Though the TOP methods have no direct effect on follicular performance of ovum donors, it is essential that the principle of allowing at least two normal and spontaneous menstrual cycles be observed after TOP to ensure that the pregnancy-induced human chorionic gonadotropin is cleared and normal hormonal environment is restored before commencing ovulation donation cycle [9]. The observation of poor follicular performance among donors who have had TOP in this study may be attributed to non-observance of this principle.

Dietary patterns have been shown to play significant roles in ovarian microenvironments, folliculogenesis, and overall oocyte yield during Controlled Ovarian Stimulation (COS) [10]-[12].

It was observed in this study that donors who regularly consumed pears, mangoes, watermelons, avocado and almond nuts produced more mature oocytes than their counterparts who did not consume these nuts and fruits regularly. This finding agrees with various studies. It has been reported that donors who regularly consumed pears, mangoes, almonds and Monounsaturated Fatty Acids (MUFAs, such as avocado) have better follicular performance. They act as anti-oxidants, reducing lipid peroxidation within the follicular environment. Mangoes and Pears have high content of copper and manganese, which are known critical micronutrients that neutralize hydroxyl radicals in the granulosa cells [11]-[14].

Tree nuts are rich sources of MUFAs, antioxidants (e.g., α-tocopherol), magnesium, and essential trace elements like zinc, which have been shown to play significant roles in follicular growth, chromatin remodeling, and oocyte meiotic competence. It has also been reported that micronutrients and antioxidants in tree nuts mitigate intra-follicular oxidative stress, thereby preserving granulosa cell function and maximizing gonadotropin responsiveness [12]-[15].

Avocados are rich in oleic acid (a key MUFA), folate, and fat-soluble vitamins. High dietary intake of MUFAs is strongly associated with increased yields of matured oocytes. MUFAs act as anti-inflammatory agents within the follicular fluid, enhancing lipid metabolism during the pre-ovulatory surge without inducing lipotoxicity [16].

Watermelon is high in L-Citrulline and L-Arginine, a precursor to Nitric Oxide (NO), which promotes microvascular blood flow to the ovarian stroma, maximizing the effects of stimulation drugs to developing antral follicles. Watermelon is also rich in lycopenes and micronutrients. These are potent carotenoid antioxidants that scavenge Reactive Oxygen Species (ROS) in follicular fluid, thereby shielding the lipid bilayers of maturing oocytes from oxidative degradation [15] [16]. It is therefore not surprising in the observation that donors who consumed more watermelon in this study as fruits of choice were associated with more ma-

tured oocytes.

It was observed in this study that ovum donors whose dietary favourites were more of the traditional complex carbohydrates like *akpu* (fermented cassava fufu), yam, and rice were associated with higher yields of mature oocytes. This agrees with other studies [12]-[17]. This is not unexpected, as it has been reported that complex carbohydrates such as *akpu*, rice, etc., offer a lower glycemic index and sustained glucose release compared to simple sugars [12] [17]. Granulosa cells are said to rely on steady glycolytic intermediates to supply pyruvate and lactate to the transcriptionally silent oocyte. Also, complex carbohydrates help to balance insulin sensitivity and avoid hyperinsulinemia-induced follicular arrest, thereby facilitating synchronized follicle recruitment [12] [14] [15] [17].

It is not surprising that majority of these donors (N = 217) frequently consumed processed foods such as instant noodles (indomie). This may be due to the fact that these foods are easy to prepare. They are also cheaper and readily available. Ignorance of the harm they can cause to the female reproductive health may also contribute to the high-level consumption rate by these young female donors. While plastic, processed foods are linked to metabolic dysfunction, and poor oocyte yields, a moderately good oocyte yields in his study by some of these donors who consumed more of plastic, processed foods may likely reflect age-related ovarian reserve resilience in these young donors.

In this study, it was observed that majority of donors (N = 232) consumed soft drinks, and yielded more matured oocytes than those who consumed alcohol. This agrees with other studies. This is expected because it has been reported that ethanol and its metabolite, acetaldehyde, exert direct cytotoxic effects on ovarian granulosa cells, induce mitochondrial dysfunction, elevate ROS levels, and impair steroidogenesis [16].

It is true that soft drinks contain simple refined sugars, which are not healthy for metabolism, they do not however, exert the direct gonadotoxic and anti-ovulatory properties of alcohol [16]. This may have explained the higher matured oocyte yields observed in this study among soft-drink consumers compared to alcohol consumers.

6. Conclusion

This study has demonstrated a correlation between follicular performance of ovum donor who consumes pears, mangoes, avocado, almond nut, watermelon, whose favourite food is *akpu*/*fufu*, abhors alcoholic drinks and who have not taken hormonal contraceptives at least six (6) months prior to ovum donation, nor have done TOP and who presented at IVF Clinics for egg donation at Abakaliki.

7. Limitation of the Study

Though these exploratory associations between dietary intake and follicular performance of ovum donors have been observed in this study, it is necessary to state that dietary intake alone may not be the determining factor of these observations.

The observed results may therefore be an interplay between the medico-nutritional and biochemical characteristics of ovum donors as well as external factors such as the stimulation protocols and clinical handling of each donor.

Author Contributions

1) Both authors contextualized the title of the research; 2) Johnson Akuma Obuna carried out the actual research with the help of research assistants; 3) Henry Uro-Chukwu did most of the critical analysis, supervision and correction of the write-up.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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