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Pattern of semen analysis in male partners of infertile couples in Western Ethiopia: Retrospective cross-sectional study

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Abstract

Objectives: This study assesses the pattern of semen analysis results in male partners of infertile couples at Gimbie Adventist Hospital, Western Ethiopia, 2021.

Methods: A retrospective cross-sectional study on 131 semen samples of male partners of infertile couples was conducted at Gimbie Adventist Hospital from 5 September 2021 to 5 October 2021. All semen samples were processed and analyzed according to methods and standards outlined by the World Health Organization laboratory manual for the examination and processing of human semen 2010. The data were coded and entered into EpiData version 3.1, and then cleaned and exported to Statistical Package for Social Sciences (SPSS for Windows version 25) for analysis. The results were presented in tables, figures, and charts.

Results: The age of study participants ranges from 20 to 65 years with a mean age of 30.2 ± 8.1 years. Sperm cell count, morphology, total motility, and vitality below the World Health Organization reference level were found in 48.9%, 27.5%, 43.5%, and 67.2% of the analyzed samples, respectively. Low power of hydrogen and high viscosity were observed in 31.3% and 16.8% of the semen samples, respectively. The majority, 84%, had one or more abnormal semen analysis parameters. Asthenozoospermia (43.5%), necrozoospermia (25.2%), oligozoospermia (24%), azoospermia (24%), and oligoasthenoteratozoospermia (25.2%) were the severe forms of abnormal semen analysis findings detected in this study. The decline in sperm cell morphology and motility were noticed after the age of 31–34 years.

Conclusion: In this study, both sperm quantity and quality were more affected when compared to similar studies. Only 16% of analyzed samples had normal semen parameters. Given this finding, identifying risk factors and introducing advanced diagnostic modalities for the workup of male infertility in the study area are highly recommended.

Keywords

Semen analysis, male infertility, Western Ethiopia

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Introduction

Infertility is a unique medical condition because it involves a couple, rather than a single individual. It has significant psychological, sociocultural, economical, demographic, and physical problems.[1,2] Infertility is clinically defined as an inability to be pregnant after 12 months or more of regular unprotected sexual intercourse.[3–5] Infertility can be primary or secondary. Primary infertility describes women who have not been conceived previously. In secondary infertility, there is at least one conception but fails to repeat.[1,3–5]

Although infertility is a global issue, the exact global prevalence is not known. It is more common in developing countries. Generally, it ranges from 5% to 30% as reported for different countries in the world.[1,6] World Health Organization also claims 60–80 million couples are facing infertility worldwide.[7,8] In Ethiopia, the burden of infertility is not yet comprehensively studied.[9]

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The etiologic causes of infertility can be of either the male or the female or both.[1,10] Female factors contribute 30%–40%, and male factor contribute 30%–40% while both factors contribute to 35%. About 5% of infertility cases are unexplained.[11–13] Male fertility can be reduced as a result of congenital or acquired urogenital abnormalities, malignancies, urogenital tract infections, increased scrotal temperature, endocrine disturbances, genetic abnormalities, sexual dysfunction, ejaculatory problem, and immunological factors.[8,10,12]

The workup of male infertility is complex and needs a stepwise approach. Semen analysis is among the major ones. It is the standard first-line investigation in evaluating male infertility[10] and continued as a useful investigation for infertile couples.[5,12,14] The semen parameters are important determinants to find out the functional capability of the spermatozoa to fertilize ova.[12] Men presenting with infertility have recognizable abnormalities on their semen analysis. They have low sperm concentration, poor sperm motility, and/or abnormal morphology. Therefore, careful evaluation of the semen parameters may point to the possible causes of male infertility.[7,10]

In Ethiopia, there is a scarcity of data about male infertility and semen analysis. Therefore, this study assesses the pattern of semen analysis results in male partners of infertile couples at Gimbie Adventist Hospital (GAH), Western Ethiopia, 2021.

Methods and materials

Study period and area

The study was conducted from 5 September 2021 to 5 October 2021, at GAH, West Wollega, Western Ethiopia. GAH is a not-for-profit institution owned by the Seventh Day Adventist Church of Ethiopia. The hospital has been serving the community of Gimbie and its surrounding since the 1940s and is located in the Oromia region, West Wollega Zone, Gimbie Town, which is 441 km from the capital city of the country, Addis Ababa. Currently, the hospital has 78 bedrooms. GAH is the only hospital with having well-organized laboratory for analyzing semen. This laboratory is led by an experienced laboratory technologist who has special training on semen and other body fluid analysis. The hospital conducts regular internal quality control on semen and other body fluid analysis.

Study design

A facility-based retrospective cross-sectional study was conducted.

Study population

All male clients who attended GAH for workup of infertility and undergone semen analysis. Cases with complete documentation of all semen analysis parameters were included while cases with incomplete information in the records, men with a history of drug consumption, fever in the previous 6 months, chronic medical problems such as diabetes mellitus, hypertension, endocrine disorders, and exposure to radiotherapy and chemotherapeutic agents were excluded from the study.

Sample size determination and sampling technique

The patient's medical records and laboratory register of the hospital were reviewed to get 141 semen samples which were analyzed from 5 September 2016 to 25 October 2021. We included all cases with complete documentation. Accordingly, 131 samples were included in this study.

Semen analysis

The clients were instructed to abstain from intercourse for 3–7 days. Samples were collected by masturbation or coitus interruptus at specific sample collection room into a clean container made of plastic material. All samples were incubated at 37 °C and analyzed within 30 min to 1 h of collection. Methods and standards outlined by the World Health Organization (WHO) laboratory manual for the examination and processing of human semen 2010 were followed during the 5-year study period. Sperm count was done in the hemocytometer after appropriate dilution. Motility was observed under microscope in wet preparation. Vitality test using the Eosin-Nigrosin stain was done for membrane intact spermatozoa. Number of stained (dead) and unstained (alive) spermatozoa was counted and results were percentage. For the assessment of morphology, the semen sample was centrifuged and smears prepared and stained with Papanicoloau and hematoxylin and eosin stains. The power of hydrogen (pH) value was measured using pH paper and compared with a calibration strip. To reduce the intra-assay and inter-assay variations in the assessment of semen characteristics, all semen analyses were performed by the same three well-trained technicians using the same instrument.

Measurements

In 2010, the WHO has revised lower reference limits for semen analyses.[5] The following parameters represent the accepted 5th percentile (lower reference limits) and 95% confidence intervals (CIs): volume: 1.5 mL (95% CI = 1.4–1.7); sperm concentration: 15 million spermatozoa/mL (95% CI = 12–16); morphology: 4% normal forms (95% CI = 3–4); vitality: 58% live (95% CI = 55–63); progressive motility: 32% (95% CI = 31–34); and total motility (progressive + non-progressive motility): 40% (95% CI = 38–42).[5]

Semen analysis terminologies

The following are common terminologies with their definition the authors used in this study: normozoospermia: all semen parameters are normal; severe oligozoospermia: sperm cell count per mL less than 5 million; asthenozoospermia: reduced sperm cell motility; azoospermia: no sperm cells in semen; necrozoospermia: all sperm cells are nonviable; and teratozoospermia: increased abnormal forms of sperm.

Data collection procedures

Two laboratory technologists were recruited and trained to collect data. A logbook review was done to collect the data. All checklists were checked for completeness by the principal investigator.

Statistical analysis

The data were coded and entered into EpiData version 3.1, and then cleaned and exported to Statistical Package for Social Sciences (SPSS for Windows version 25) for data analysis. Descriptive statistics like frequency, percentage, and average were computed for data presentation. Finally, results were presented in tables, figures, and charts.

Results

Results of 131 semen samples which were analyzed at GAH from 5 September 2016 to 25 October 2021 based on WHO Guidelines 2010 for semen analysis were retrieved from the laboratory register. The age of study participants ranges from 20 to 65 years with a mean age of 30.2 ± 8.1 years. The majority were between the age group of 25–30 years accounting for 45.8% (Figure 1).

Table 1 shows semen analysis parameters including semen volume per ejaculate, sperm cell count per milliliter (mL) of semen, sperm cell motility, sperm cell morphology, the vitality of sperm cells, and pH and viscosity of semen. Semen volume less than 1.5 mL was observed in 8.4% of the samples. Sperm count below the reference level was found in 48.9% of cases; whereas 57.1% of cases had sperm cell count within the normal range. Total sperm cell motility of less than 40% was observed in 43.5% of the samples. Normal sperm cell morphology was observed in 72.5% of the samples. Normal vitality of sperm cells was seen in 32.8% of the samples. Regarding semen pH, 16.8% of the samples had less than 7.2 (Table 1).

According to 2010 WHO normal reference values for semen analysis, this study identified severe forms of semen analysis parameters. Only, 21 (16%) of analyzed samples were normozoospermic in which case all semen parameters were normal. The majority, 110 (84%) had one or more abnormal semen analysis parameters. Asthenozoospermia (43.5%), necrozoospermia (25.2%), severe oligozoospermia (24%), and azoospermia (24%) were the severe forms of abnormal semen analysis findings detected in this study. In addition to this, 23 (16.8%) of semen samples had low pH (Table 2).

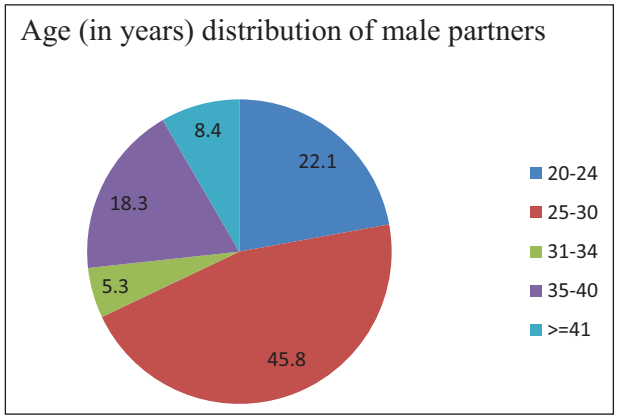

Figure 1. Age (in years) distribution of study participants at Gimbie Adventist Hospital, West Wollega, Western Ethiopia, 2021.

This study also assessed a combination of abnormal semen analysis parameters. Accordingly, oligoasthenozoospermia (29%), teratozoospermia (27.5%), oligoteratozoospermia (26%), asthenoteratozoospermia (26%), and oligoasthenoteratozoospermia (25.2%) were identified (Figure 2).

Figure 3 shows an age-specific comparative analysis of the mean sperm cell motility and morphology. They are indicators of sperm cell quality. These parameters were better from age 31–34 years and sharp decline after this age range. This study also indicates decline in sperm concentration as age increases (Figure 4).

Discussion

This study described semen analysis parameters in the Western part of Ethiopia. The age of study participants ranges from 20 to 65 years with a mean age of 30.2 ± 8.1 years. In this study, the majority (84%) of the analyzed samples had one or more abnormal semen analysis parameters. The most significant of these are no or low sperm cells in semen, no or poor sperm cell motility, abnormal sperm cell morphology, and/or a combination of these. This is higher than other studies.[7,10,11,15,16] This finding is similar to a study finding from Delhi (84%).[17] The decline in semen quality in this study may be due to environmental, nutritional, socioeconomic, hormonal, genetic, and/or other factors.

Sperm concentration is often proposed to be a predictor of fertility potential.[5] Oligozoospermia is the most common cause of male infertility.[2] In this study, 48.9% of the analyzed samples had sperm count below the reference level set by WHO. Severe oligozoospermia was observed in 24.4% of the analyzed samples. This is higher than similar studies in

Table 1. Distribution of different parameters of semen analysis among study participants at Gimbie Adventist Hospital, West Wollega, Western Ethiopia, 2021.

Number	Sperm parameters	Category	Frequency	%
1	Semen volume in mL per ejaculate	<1.5	11	8.4
		⩾1.5	120	91.6
2	Viscosity	High	41	31.3
		Normal	90	68.7
3	Sperm count per mL of semen (in millions)	<15	64	48.9
		⩾15	67	51.1
4	Total sperm cell motility	<40%	57	43.5
		⩾40%	74	56.5
5	Sperm cell morphology	<4%	36	27.5
		⩾4%	95	72.5
6	Sperm cell vitality	<58%	88	67.2
		⩾58%	43	32.8
7	pH of semen	<7.2	22	16.8
		⩾7.2	109	83.2

Table 2. Severe forms of semen analysis finding among study participants at Gimbie Adventist Hospital, West Wollega, Western Ethiopia, 2021.

Number	Categories	Frequency	%
1	Azoospermia	32	24.4
2	Teratozoospermia	36	27.5
3	Severe oligozoospermia	32	24.4
4	Necrozoospermia	33	25.2
5	Asthenozoospermia	57	43.5
6	Low pH	22	16.8

Ebonyi State, Nigeria (38.6%), Delhi (17%), India (30%), and Indonesia (39.7%) (Table 3).[7,15–17]

Azoospermia (24.4%) is one of the common findings in this study. It is comparable to a study conducted in Indonesia (24.4%)[15] and lower than a study conducted in Nepal (28.8%).[8] This finding is higher than studies in Ebonyi State, Nigeria (11.7%), Senegal (14.5%), Delhi (9%), and India (10%) (Table 3).[7,16–18] The difference could be explained by the difference in the study population. This abnormal parameter may be related to hypothalamic–pituitary–testicular axis failure, obstruction of the male reproductive tract, or defective production of sperm cells.[8,13,15] Therefore, the authors recommend a testicular biopsy, hormonal analysis, and chromosomal study in these male partners of infertile couples.[13,19]

Assessing sperm cell motility is essential as the spermatozoa have to interact with cervical mucus and travel in the female genital tract to fertilize the oocyte in the uterine tube.[5,20] Motility is also an indicator of how sperm cells penetrate the corona radiate and zona pellucida before oocyte fertilization.[5,17] In this study, 43.5% of the samples had total sperm cell motility below the reference level set by WHO. This is higher than study conducted in Indonesia (5.9%), Ebonyi State, Nigeria (23.4%), Delhi (22.1%), Gujarat (31.4%), and India (27.5%) (Table 3).[7,15–17,21]

Sperm cell morphology is also an important contributing factor in male fertility. The total number of morphologically normal spermatozoa in the ejaculate is of biological significance. Cells with abnormal morphology have a deleterious effect on the rate of fertilization.[5,22] In this study, 72.5% of analyzed samples had normal morphology. This is lower than the study conducted in Gujarat, India (91.4%) and Ebonyi State, Nigeria (64%). It is comparable to other study conducted in Nigeria (73.1%) (Table 3).[12,16,21]

In this study, one-fourth of the analyzed samples had triads of abnormalities in sperm concentration, motility, and morphology. This is termed oligoasthenoteratozoospermia. This finding is higher than other studies in Indonesia (5.7%)[15] and Ebonyi State, Nigeria (4.3%).[16] This abnormality indicates both the quantity and quality of semen analysis parameters were affected.

Age-related changes on the seminal parameters were also evaluated in this study, it was noted that average total motility, morphology, and vitality revealed an increase in the average values of these parameters up to 31–34 years and then a sharp decline with age. This finding is supported by the other two studies.[11,22] Increasing seminal reactive oxygen species (ROS) levels and changes in epididymal and accessory sex gland function may be possible causative factors for the decline in motility with aging.[10,22]

Limitations of this study

This study was a cross-sectional study and may not show the cause and effect relationship. The sample size was not calculated. The other limitation could be a small sample that might lead to statistical imprecision.

Conclusion

In this study, both sperm quantity and quality were more affected when compared to similar studies. Only 16% of analyzed samples had normal semen parameters. Given this finding, identifying risk factors and introducing advanced

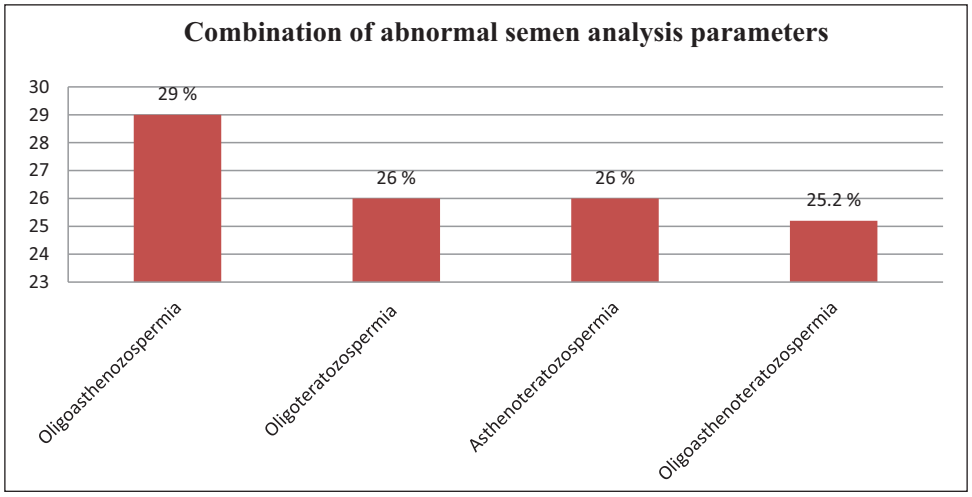

Figure 2. Combination of abnormal semen analysis finding among study participants at Gimbie Adventist Hospital, West Wollega, Western Ethiopia, 2021.

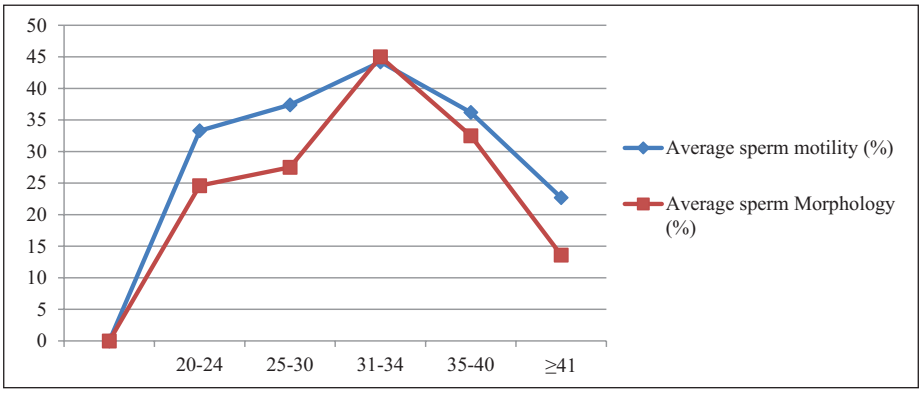

Figure 3. Age-wise trends of average sperm motility and morphology among study participants at Gimbie Adventist Hospital, West Wollega, Western Ethiopia, 2021.

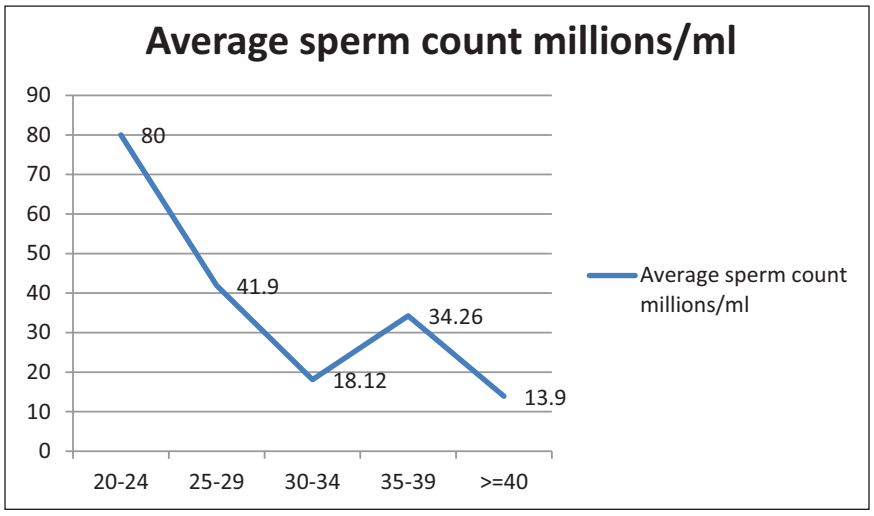

Figure 4. Age-wise trends of average sperm count among study participants at Gimbie Adventist Hospital, West Wollega, Western Ethiopia, 2021.

Table 3. Semen analysis parameters of this study compared to other studies.

Parameter	Current study, 2021 (n = 131)	Onyebuchi et al.[16] (n = 376)	Aulia et al.[15] (n = 1186)	Jairajpuri et al.[17] (n = 139)	Kurdukar et al.[7] (n = 40)	Koju et al.[8] (n = 520)	Diallo et al.[18] (n = 262)
Normozoospermia	16%	50.3%	33%	16%	55%	56%	19.1%
Oligozoospermia	48.9%	38.6%	39.5%	17%	30%	8.7%	27.7%
Azoospermia	24.4%	11.7%	24.4%	9%	10%	28.8%	14.1%
Asthenozoospermia	43.5%	23.4%	5.9%	22.1%	27.5%	39.3%	10.3%
Teratozoospermia	27.5%	36%	2.6%	33.5%	0%	1.8%	80.9%

diagnostic modalities for the workup of male infertility in the study area are highly recommended.

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Author contributions

T.T., R.O., and A.G. were involved in all components of this research, including conception, design, and supervision of data collection, data analysis, and write up of the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

The data sets are available from the corresponding author on a reasonable request.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

Ethical clearance was obtained from the Research Ethics Review Committee of Wollega University (approval number/ID = WU/RD/370/2013). The letter was written to Gimbie Adventist Hospital. The hospital was informed of the objectives of the study and permission to get access to patient documents and laboratory register was obtained. All methods were performed in accordance with the relevant guidelines and regulations.

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Informed consent

Written informed consent was obtained from legally authorized representatives of the hospital and laboratory head before the study. This is approved by IRB number of WU/RD/370/2013. They were informed about the purpose of the study. This informed consent was needed to access patient medical records and laboratory registrations. It was not taken from patients because the data were from document review.

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