Kurdish Studies
August 2024
Volume: 12, No: 4, pp 1831 - 1837
ISSN: 2051-4883 (Print) | ISSN 2051-4891 (Online)
www.KurdishStudies.net

DOI: 10.53555/ks.v12i4.3680

The Effect of Obesity on Reproductive Hormones and Fertility

Sabahat[1*], Dr. Anees Ahmed[2], Dr. Kiran[3]

[1]Department of zoology, University of Sindh Jamshoro
[2]Department of Physiology, Liaquat Institute of Medical Health Sciences LUMHS Thatta, Pakistan
[3]Department of Gynecology and Obstetrics, Liaquat University Hospital Hyderabad, Pakistan

***Corresponding Author:** Sabahat
*Email: Shabahat113@gmail.com

Abstract
The present paper focuses on the effects of obesity on reproductive hormones and fertility with reference to secondary data along with qualitative research method. The study shows that obesity distorts female and male endocrine systems and compromises physiological processes of reproduction. In women obesity leads to hyperestrogenism, anovulation and conditions such as PCOS that lower the fertility capability. Obesity has negative effects on spermatogenesis and sperm qualities, and in men it causes hypogonadism and so conception becomes even harder. The study also looks at obesity as a factor of poor success outcomes of infertility treatment; ART like IVF where obese candidates have been proved to have a lower implantation success rate and higher chances of a miscarriage. Besides the physiological impact, psycho-social stresses show up more robust culprits as stress and negative body image alter the hormonal balance and affects fertility. These outcomes highlight the requirement for multimodal methods in the reproductive health area by implementing weight reduction methods, psychological health boosting, and informative programmes. The lack of longitudinal studies and targeted interventions for obesity requiring additional research should be utilized to better prevent and study how obesity affects fertility. Such an assessment can enhance reproductive success and general health for groups of people experiencing obesity.

Keywords: Obesity, Reproductive Hormones, Fertility, Assisted Reproductive Technologies (ART)

Introduction

Overweight has assume a new dimension as one of the most important health challenges in the global societies today whose population increase rate has been accelerated (Mohajan and Mohajan, 2023). As a condition that has been described as an abnormal increase of body fat deposits, obesity can be measured using Body Mass Index (BMI) that assigns those who have a BMI greater than 30 as obese. This condition also affects health in many ways such as cardiovascular, diabetes, metabolic syndrome health among others (Kumanyika and Dietz, 2020). However, there are other subtle effects of obesity that are not very well articulated and these have to do with fertility. Mączka et al. (2024) focused on fertility, which is in the list of vital and sensitivity health indicators, and has strong connection with hormonal and physiological functions that can be affected by obesity. Oestrogen, progesterone, testosterone, LH, and FSH are the hormones that are well known to play a pivotal role in regulating fertility in both men and women (Al-Suhaimi, Khan and Homeida, 2022). Given its ability to effect metabolic and inflammatory changes in the body, obesity can then disrupt these hormones and, in turn, affect reproductive success. The purpose of this article in this series is to unravel complex interaction between obesity and reproductive hormones, with reference to body weight's impact on hormones levels and fertility opportunities in both men and women.

Literature Review

This section includes the backdrop of existing literature on obesity and fertility emphasizing the relationship between metabolic health and hormonal dynamics regulating fertility. Increased adiposity particularly through obesity has widespread impacts on hormone balance in both sexes (Pan and Chen, 2021). Research on this disruption has been more precisely conducted in the field of fertility with far reaching consequences for both spontaneous conception.

In women, obesity has been associated with interference of the hypothalamic-pituitary-ovarian (HPO) axis (Lonardo et al., 2024). Higher levels of adipose tissue has enhanced aromatase activity thus promoting conversion of androgens to oestrogens. This hyperestrogenic state interferes with the classical negative feedback regulation of the HPO axis and will not allow follicular maturation and ovulation. It is established by Baraskar et al. (2021) and Marinelli et al., (2022) that obesity leads to anovulation, irregular menstrual cycle, and poor quality of oocyte. Overweight and obesity are also associated with polycystic ovary syndrome (PCOS) which has hormonal imbalance, high level of androgens, insulin resistance, and irregular menstruation which all affect fertility (Khmil, Khmil and Marushchak, 2020).

In men only, obesity influences the hypothalamic-pituitary-testicular (HPT) axis and in consequence results in a low testosterone level and high estradiol level because of the aromatization of androgens in adipose tissue (Kurniawan, 2021). These experiments by Wittert and Grossmann (2022) and Rabijewski (2023) show that this hormonal changes leads to decreased spermatogenesis, low motility, and sperm concentration. These results are further confirmed by meta-analysis for

BMI which show negative association between BMI and semen characteristics reinforcing negative effects of obesity on male infertility (Jahangir et al., 2024).

Obesity has also impact on fertility through the metabolic and inflammatory mediators. Hyperinsulinemia due to obesity fuels insulin resistance that rises insulin levels and alters the hormonal equilibrium in the body that is required for proper sexual activity (Athar, Karmani and Templeman, 2024). Several molecules including Ovalbumin and Interleukin-Six (IL-6) are released in obesity and are known to affect the gonadal health in both sexes (Ekpruke and Silveyra, 2022). These metabolic and inflammatory effects enlist towards a composite phenomenon of reduced fertilization competence.

Several research have been conducted to describe the influence of obesity on artificial reproductive technologies (ART). Ladies who are affected by obesity and going through ART like IVF have issues which include, lower implantation, high chances of pregnancy loss and least response to ovarian stimulation (Ribeiro et al., 2022). According to Li et al. (2024) and other writers, obesity is a significant predictor of low ART outcomes, where women require greater quantities of gonadotropins and longer treatment periods. Likewise, in obese men, the overall quality of sperm utilized in different ART processes may have an unfavourable impact on the prognosis, underlying the importance of weight control earlier to conception (Service et al., 2023).

Psychological and social factors add on to the part played by obesity in reproductive health among women (Ahmed and Konje, 2023). There is significant correlation between obesity and body image dissatisfaction, poor self-esteem, and increased levels stress all of which affect reproductive function through disruption of HPA axis (Barbagallo et al., 2024). Research has revealed that the hormonal changes that are brought about by stress actually worsen other fertility problems to make it a vicious cycle of infertility (Öztürk et al., 2021). However, there are still deficiencies in the scientific literature regarding the mechanisms by which obesity affects reproductive dysfunction. The current research has revealed coherent correlations, however, prospective pathways between the variables need to be investigated. A call for long-term prospective investigations and meta-analyses of randomised clinical trials is thus made to ascertain the cause-and-effect relationship and assess efficacy of the practical efforts aimed at weight loss and enhancements on the metabolic factor in fertility retrieval (Assaysh-Öberg, Borneskog and Ternström, 2023). Lastly, cultural and socio-economic determinants of obesity and reproductive health have not attracted the desired research exploration; thereby creating room for more culturally sensitive research.

In all, the available literature supports the notion that obesity has enormous influence on the levels of reproductive hormones, and fertility, in both sexes. All of these effects occur with hormonal imbalances, metabolic disorders, inflammation, and psychological influences. This study revealed that obesity could act as modifiable risk factor that affects infertility among women but further research and interventional studies are required among women with such factors.

Methodology

The present research utilizes a qualitative research approach and utilizes secondary data analysis to establish impacts of obesity on reproductive hormones and fertility. The rationale of using the qualitative approach is to ensure that the researcher examines related literature in a way that captures complexity of the relations that are of interest decomposing them into themes and subthemes (Qaissi, 2024). Quantitative techniques provide numerical relationships whereas, qualitative research gives rich contextual understanding of the phenomenon, which in the case of the present study is obesity gain, hormonal dysregulation and the effect on fertility outcomes.

Data Sources

The sources used for this study include, peer-reviewed articles obtained from scholarly-journals that were published between 2010 and 2025. The databases used in this study were PubMed, Scopus, Web of Science and Google Scholar and included systematic reviews, meta-analysis and original research articles. These databases were chosen based on their coverage and rigorous indexing methods so the reviewed articles were of high reliability and validity. Based on the selection criteria, the search scope was widened by including a number of databases, to obtain a variety of sources with different approaches and results regarding the topic.

Search Strategy

Various measures were used to find the pertinent papers and include only the best and most relevant data into the analysis. The search process involved the following words: obesity, reproductive hormones, fertility, female factor infertility and male factor infertility. The use of Boolean operators such as AND and OR was applied to enhance the search results and allow proper connection of terms so as to ensure inclusive search of the specified area of the research. For instance, the facets of the search strings "obesity, reproductive hormones" covered only studies that directly compared these variables, whereas "fertility and infertility" widened the search base to cover all sorts of reproductive outcomes in the evaluations. The use of a focused set of databases and apply of strict inclusion and exclusion criteria allowed consequently checking the feasibility of selected studies. Inclusion criterion included peer-reviewed articles, written in English, with human participants, and where obesity impact on reproductive hormones or fertility was examined. Excluded articles were those that were not focused on reproductive health, those involving subjects recruited only outside the reproductive age, articles published prior to 2010, and non-peer-reviewed articles. This selection procedure ensured that the study remained committed to the publication of scientifically credible and useful results.

Data Analysis

Thematic analysis allowed for data synthesis and interpretation, where the usual patterns and trends in the reviewed research can be distinguished. As a result, this method is more applicable when dealing with qualitative data since it allows for the creation of themes based on the ideas and interconnections they fraternize about inside the data. Themes were developed inductively hence giving the researchers an opportunity to allow the analysis to build emerging themes from the data collected.

These areas of concern were fertility substance and gender, obesity and fertility, hormonal changes, obesity and fertility, obesity consequences on mental health and social aspect. While distributing the findings into these thematic areas, the analysis offered a systematic albeit loose framework to compare the multiple links between obesity and reproductive health. Besides presenting the major findings, this approach exposed the existing research limitations and direction for future research on this important issue.

Results

The secondary data analysis was done in a thematic analysis method which pointed out the following major themes that explain the relationship between obesity and fertility hormones.

Effects of Obesity on Women Hormones

Overweight is a severe condition that affects hormonal balance in women, and the reproductive status of women is altered massively (Faulkner, 2021). The manipulation of female reproductive hormones by obesity is also realized through enhanced aromatase action in adipose tissue, an enzyme that catalyses the conversion of androgens into oestrogens (Kroon, Pereira and Meijer, 2020; Aladhami, 2022). This causes high levels of aromatase leading to hyperestrogenism; this is a condition in which estrogenic levels are higher than the normal standard. Hyperestrogenism upsets the steroid feedback and modulating mechanisms of the HPO axis altering the release of gonadotropins hormones such as LH and FSH (Wu, Chang and Leung, 2021). All of these lead to ovulation dysfunctions which play a part in causing infertility.

In addition, obesity particularly affects women with polycystic ovary syndrome (PCOS), which is one of the most frequent endocrinologic disorders of women of reproductive age (Barber and Franks, 2021). PCOS can also be relate to hyperandrogenism, anovulation and insulin resistance which are all made worse by obesity. The key factor common with PCOS and obesity is insulin resistance this cause hyperinsulinemia which promote androgen production in the ovaries (Zeng et al., 2020). This means that increases in the concentration of androgen will face the arrest of follicles and lead to anovulation so clients' fertility will be a different one (Zeng et al., 2020). Moreover, women with obesity and PCOS have subfertility due to anovulation, low quality oocyte and increased pregnancy morbidity including gestational diabetes and miscarriage.

In addition to central hormonal effects and changes in the neuroendocrine system, obesity is accompanied by increased systemic inflammation, including the levels of such cytokines as IL-6 and TNF-\u03b1 (Umutoni, Owolabi and Waheed, 2023). These inflammatory markers negatively affect ovarian function and increase insulin resistance which in turn produces a cycle that further distorts hormones. Altogether, all these aspects may be used to demonstrate the complex and diverse impact of obesity on female reproductive hormones to emphasize the place of the phenomenon in the problem of fertility.

Obesity on Male Reproductive Hormonal Levels

Obesity also has a negative impact on androgens, and the hormonal axis in general, and a direct influence on spermatogenesis (Rabijewski, 2023). One of the prime routes is that fat converts more of the circulating testosterone to estradiol. The elevated levels of estradiol cause disproportional shift in hormonal balance in the hypothalamic pituitary testicular (HPT) axis suppressing the release of gonadotropins which include LSH and FSH (Casas-Rodriguez, Cameán and Jos, 2022). These enzymes in turn lead to decreased secretion of testosterone by the testes and causes hypogonadism. Practical indices of both TT and FT are significantly decreased in obese men mirroring their low androgen status reduced their reproductive capacities (Isidori et al., 2022). Leptin and the cytokines TNF-alpha and IL-6 which are both increased in obesity also negatively affect the HPT axis. Hyperleptinemia, characteristic for obesity, disrupts the control of GnRH and inhibits testosterone production (Khodamoradi et al., 2022). Furthermore, obesity-induced inflammation attenuates the neighbouring Leydig cells, which are the key in testosterone synthesis. These combined effects contribute to a diverse extent level of spermatogenesis depot, which in simple terms is the generally provided sperm production.

The outcomes of these hormonal disruptions are clearly reflected in the volume and quality of sperm. Hypogonadic obese males present with low sperm density, decreased motility, and incorrect shape of sperm. These are important factors that define male fertility, and their dysfunction results in less than the best fertility. Moreover, a research done on obesity pointed out that obesity causes increased oxidative stress and this reduces the chances of sperm DNA quality. This paper also shows that obesity affects male reproductive hormones in relation to ART outcome. Obese men have a reduced fertilization efficiency and poor embryo quality in ART, and unfit hormonal state of obesity requires intervention. The current findings clearly show that obesity has an extensive adverse effect on male reproductive hormones, which has no doubt to play a significant part in male infertility.

Linkage between Obesity and Fertility

Obesity and fertility are interconnected in several ways because obesity affects hormonal and physiological cycles responsible for conception (Marinelli et al., 2022). Obesity is also considered as a major cause of anovulation in women because the hormonal irregularity of the hypothalamic-pituitary-ovarian HPO axis (Chen et al., 2022). The above factors are also seen in combination with irregular menstrual cycle and poor quality oocytes, hence further compromising the fertility of obese women. These disruptions are further accompanied by insulin resistance and hyperinsulinemia that will add to hormonal imbalance and poor development of the follicle (Chen et al., 2022). Consequently, conception with normal weight women is extremely difficult among the obese female population.

Similar to the above conclusion in women, obesity dampens fertility via influencing the hypothalamic-pituitary-testicular (HPT) axis in men (Genchi et al., 2022). Low motility and abnormal forms, in addition to low concentration of sperm, dramatically reduces the chance of fertilization. All these effects are due to low levels of testosterone, high levels of estradiol, and high

levels of inflammation, all of these inhibit spermatogenesis (Genchi et al., 2022). Both the hormonal and the physiological changes in obese men lower the ability of sperm to effectively fertilize an egg.
Obesity interferes with ART, including IVF. Research reveals control women with obesity endure increased gonadotropin doses throughout ovarian stimulation and are observed to show lower accomplishment of implantation and increased likelihood of miscarriage compared to lean women (Maher, 2022). Also, oocytes collected during ART treatments may not be healthy and therefore chances of pregnancy will still remain low. This confirms the fact that obesity lowers fertility rate including through conventional conception and fertility treatments.

Psychological and Social Impacts of Obesity on Fertility

By evaluating the interconnection between obesity and fertility, psychological and social points are also considered relevant aspects influencing different aspects of reproductive health (Szkodziak, Krzyżanowski and Szkodziak, 2020). The physical illustrations of obesity are linked with difficulties associated with body image and self-esteem that, in turn, may result in psychosocial morbidity. Societal prejudice and copying skinny thin or muscular looking people escalate these problems, resulting to alimenting stress and emotional distress (Clasper, 2023). In addition to the mental aspects, there are also several known physical impacts of obesity, which stems from stress acting like an endocrine disruptor and functioning through receptors that mess with reproductive health.
Obesity greatly reduces social acceptance to a level that such persons are unable to associate with people, hence they develop great psychological stress (Rubino et al., 2020). From peers and family, such negative perception makes the affected individual to feel like a shame, segregate themselves from the other people and even healthcare givers. The nature of the associations between the physical, the psychological and the social in relation to obesity and fertility requires an interactional approach (Cockerham, 2022). These interacting factors stimulate the need for coherent care that does not only focus on the physical side of obesity. The use of mental health and counselling in fertility should be incorporated in when diagnosis and treating fertility issues especially when one has a chronic of obesity (Vioreanu, 2021). Such services can assist patients in dealing with the mental and psychological processes that surround the issue of infertility, reduce tension as well as enhance the ability of those individuals who want to conceive to acquire the best solution to that problem. Integrating mental health therapies into medical treatment not only positively impacts fertility but also does other benefits (Sax and Lawson, 2022). The psychological effects of infertility may be managed by diet and stress reducing activities such as CBT, mindfulness, and support groups that may enhance the patient's rate of compliance with treatment regimens. From a psychological and social aspect, additional information about obesity proper patient-centred process targeting at maximum potential for generally positive impact on the potential reproductive outcomes by healthcare providers.

Discussion

To a certain extent, it is in accordance with the conclusion of this study: obesity has various effects on reproductive hormones and fertility. Obesity alters hormonal balance through a direct effect on aromatase activity, insulin resistance and general inflammation. These disruptions impact on the HPO and HPT axes resulting in reduced fertility in females and males, respectively. Obesity and reproductive dysfunction are causally related through complex biological processes interacting with each other in several ways (Pan and Chen, 2021). In women, hyperestrogenism and insulin resistance are core to disease states such as PCOS that severely affect ovulation and fertility. In men, obesity lead to hypogonadism which affects spermatogenesis hence poor fertility (Khmil, Khmil and Marushchak, 2020). This role of inflammation and oxidative stress in mediating these effects also show the systemic layers of obesity impact on reproductive health.
Comparing these findings with existing literature reveals a consistent pattern: They also point out that obesity is a major cause of infertility (Kurniawan, 2021). Nevertheless, differences in methods as well as participants used in the studies gives the exigency for uniform research procedures. The understanding extrapolated from this study based largely on secondary data is, therefore, considered adequate for further research. That again may require primary research with longitudinal research designs to explain causality and develop ways of reducing the adverse impact of obesity on fertility levels (Assaysh-Öberg, Borneskog and Ternström, 2023). In more detail, the significances of these findings are not only related to separate health, and are focused on optimal approaches to obesity therapy. Both healthcare providers and policymakers as well as the practitioners in public health should therefore address the effects of obesity on reproductive health. These could involve life changes, dietary plans as well as fertility treatments for the obese.

Conclusion

Thus, the results of the current study show the physical and hormonal changes as well as the effects on fertility in patients with obesity from two different gender perspectives. Obesity interferes with several endocrine and physiological dynamic processes in human body and reproductive hormones in men and women. These disruptions are anovulation in women, which results in hyperestrogenism and hypogonadism as well as impaired spermatogenesis in men. The results of this study emphasise the need to consider obesity a primary focus area in reproductive health. The narrative approach for thematic analysis of data offers strong a priori evidence that obesity should be accorded an overarching influence on fertility outcomes. Thus, this study is useful in adding to the obesity concerns in the lights of its impact on conception and healthy reproduction contributing to the view that it deserve limelight in health and population health discourses. Therefore, failure to make specific efforts to control obesity is expected to continue to produce negative impacts on reproductive health, including infertility and undesirable outcomes in ART.
The results also reinforce the need for using prospective research methods in subsequent studies to identify the mediators through which obesity influences reproductive disorders. This approach would allow for a more complex understanding of mediational processes as well as for actual data regarding the efficacy of particular kinds of interventions. For instance, weight

control interventions for persons undergoing fertility problems might be categorically assessed for the effectiveness in correcting biochemical abnormalities and enhancing fertility. Applying these results is useful in incorporating weight loss and lifestyle changes programs with fertility services. It is also very important that people learn about how obesity affects their fertility, similar to learning about a disease prompts them to take preventive measures when it is possible to do so. Health-care consumers and stake holders must therefore strive to design and implement such introductory programs taking care of the needs of diverse communities of the obese.

Taking care of obesity and fertility interface requires multi-dimensional approaches where input starts from endocrinology, reproductive medicine, nutrition, human psychology, and health promotion. Patient-centred obesity intervention involves the coordination of medical, psychological, and social support interventions in the care interventions, and enhancing the outcomes of these care interventions. By embracing such approaches, healthcare systems would not only achieve optimal fertility results for patients but also witness the general health of the individuals and groups suffering from obesity to wade up.

Future Implications

New investigations examining the impact of obesity and hormones to fecundity should employ prospective research designs to determine existing causal sequences more conclusively as well as gradual change over time. Although the current research has demonstrated the cross-sectional studies' valid effects of the factors, little is still known about how these factors including insulin resistance, systemic inflammation and hormonal imbalance work together in real-time setting affecting fertility outcomes. Future studies can also allow for the separation between the obesity and such disorders as PCOS or metabolic syndrome, which obscure current outcomes. One promising direction for future research is the assessment of growing specific prevention efforts relative to obesity effects on fertility. For instance an RCT could evaluate the efficacy of LM programs like diet modification, exercise and behaviour changes on hormonal indicators and fertility. They should also address implications for fertility improvements following pharmacologic therapy and bariatric surgery among obese, especially when lifestyle modifications are insufficient.

Further, studies should also be conducted on how obesity affects ART including IVF success rates and Live Births. Research could explore whether and how certain weight loss plans before beginning ART influence implantation, embryo development, and birth of viable babies. It would be important for clinical practice to learn whether certain procedures, like protocol-adjusted gonadotropin dosages, would enhance the ART success rate in obese people. The last but not the least, further research should focus is the psychosocial aspect of obesity and fertility. It is well understood that factors such as stress and body image impacts reproductive health but few studies have focused on understanding the degree to which these factors act as mediators between obesity and fertility. Perhaps, qualitative research or a combination of qualitative and surveys could help explain how social prejudice, mental disorders, and emotional health affect conception and use of treatment in obese persons.

In addition, weight status should be studied in diverse populations in order to verify whether genetic, cultural or socioeconomic differences affect the link between obesity and fertility. It is especially noteworthy to remove the health gap and improve the access to the fertility treatments since the representatives of the mentioned population often experience various barriers and limitations on receiving the necessary care. New fields like the obesity and reproductive systems, targeting the gut microbiome, provides new angle and possibility of developing new strategies and targets. Likewise, research investigations from obesity interlinked epigenetic changes could enable understanding the future generation's fertility and health impacted by maternal and paternal obesity. Therefore, the areas that require future investigation include: close endocrinology-reproductive, psychology, public health integration. In this way, new knowledge and assessments of innovative interventions will help researchers to identify treatment gaps and create effective prevention and treatment strategies to improve fertility in people with obesity.

References

1. Ahmed, B. and Konje, J.C., 2023. The epidemiology of obesity in reproduction. *Best Practice & Research Clinical Obstetrics & Gynaecology*, *89*, p.102342.
2. Aladhami, A., 2022. *Role of Estrogen in Regulating Diet-Induced Obesity in Females* (Doctoral dissertation, University of South Carolina).
3. Al-Suhaimi, E.A., Khan, F.A. and Homeida, A.M., 2022. Regulation of male and female reproductive functions. In *Emerging Concepts in Endocrine Structure and Functions* (pp. 287-347). Singapore: Springer Nature Singapore.
4. Assaysh-Öberg, S., Borneskog, C. and Ternström, E., 2023. Women's experience of infertility & treatment–A silent grief and failed care and support. *Sexual & reproductive healthcare*, *37*, p.100879.
5. Athar, F., Karmani, M. and Templeman, N.M., 2024. Metabolic hormones are integral regulators of female reproductive health and function. *Bioscience Reports*, *44*(1), p.BSR20231916.
6. Baraskar, K., Thakur, P., Shrivastava, R. and Shrivastava, V.K., 2021. Female obesity: association with endocrine disruption and reproductive dysfunction. *Obesity Medicine*, *28*, p.100375.
7. Barbagallo, F., Tiranini, L., Placentino, C., Mariacci, G., Piccinino, M., Cucinella, L., Calogero, A.E. and Nappi, R.E., 2024. Body Image and Other Mood Vulnerabilities in Adolescents with Polycystic Ovary Syndrome and Metabolic Alterations. *Children*, *11*(5), p.521.
8. Barber, T.M. and Franks, S., 2021. Obesity and polycystic ovary syndrome. *Clinical endocrinology*, *95*(4), pp.531-541.
9. Casas-Rodriguez, A., Cameán, A.M. and Jos, A., 2022. Potential endocrine disruption of cyanobacterial toxins, microcystins and cylindrospermopsin: A review. *Toxins*, *14*(12), p.882
10. Chen, X., Xiao, Z., Cai, Y., Huang, L. and Chen, C., 2022. Hypothalamic mechanisms of obesity-associated disturbance of hypothalamic–pituitary–ovarian axis. *Trends in endocrinology & metabolism*, *33*(3), pp.206-217.
11. Clasper, B., 2023. Conceptualising a preventative approach to eating disorders in New Zealand. *NZLSJ*, *4*, p.105.

12. Cockerham, W.C., 2022. Theoretical approaches to research on the social determinants of obesity. *American journal of preventive medicine*, *63*(1), pp.S8-S17.
13. Ekpruke, C.D. and Silveyra, P., 2022. Sex differences in airway remodeling and inflammation: clinical and biological factors. *Frontiers in Allergy*, *3*, p.875295.
14. Faulkner, J.L., 2021. Obesity-associated cardiovascular risk in women: hypertension and heart failure. *Clinical Science*, *135*(12), pp.1523-1544.
15. Genchi, V.A., Rossi, E., Lauriola, C., D'Oria, R., Palma, G., Borrelli, A., Caccioppoli, C., Giorgino, F. and Cignarelli, A., 2022. Adipose tissue dysfunction and obesity-related male hypogonadism. *International Journal of Molecular Sciences*, *23*(15), p.8194.
16. Isidori, A.M., Aversa, A., Calogero, A., Ferlin, A., Francavilla, S., Lanfranco, F., Pivonello, R., Rochira, V., Corona, G. and Maggi, M., 2022. Adult-and late-onset male hypogonadism: the clinical practice guidelines of the Italian Society of Andrology and Sexual Medicine (SIAMS) and the Italian Society of Endocrinology (SIE). *Journal of Endocrinological Investigation*, *45*(12), pp.2385-2403..
17. Jahangir, M., Nazari, M., Babakhanzadeh, E. and Manshadi, S.D., 2024. Where do obesity and male infertility collide?. *BMC Medical Genomics*, *17*(1), p.128.
18. Khmil, M., Khmil, S. and Marushchak, M., 2020. Hormone imbalance in women with infertility caused by polycystic ovary syndrome: is there a connection with body mass index?. *Open Access Macedonian Journal of Medical Sciences*, *8*(B), pp.731-737.
19. Khodamoradi, K., Khosravizadeh, Z., Seetharam, D., Mallepalli, S., Farber, N. and Arora, H., 2022. The role of leptin and low testosterone in obesity. *International journal of impotence research*, *34*(7), pp.704-713.
20. Kroon, J., Pereira, A.M. and Meijer, O.C., 2020. Glucocorticoid sexual dimorphism in metabolism: dissecting the role of sex hormones. *Trends in Endocrinology & Metabolism*, *31*(5), pp.357-367.
21. Kumanyika, S. and Dietz, W.H., 2020. Solving population-wide obesity-progress and future prospects. *N Engl J Med*, *383*(23), pp.2197-200.
22. Kurniawan, L.B., 2021. Hypotestosterone in male with obesity. *Indonesian Journal of Clinical Pathology and Medical Laboratory*, *27*(2), pp.217-223.
23. Li, Y.L., Yan, E.Q., Zhao, G.N., Jin, L. and Ma, B.X., 2024. Effect of body mass index on ovarian reserve and ART outcomes in infertile women: a large retrospective study. *Journal of Ovarian Research*, *17*(1), p.195.
24. Lonardo, M.S., Cacciapuoti, N., Guida, B., Di Lorenzo, M., Chiurazzi, M., Damiano, S. and Menale, C., 2024. Hypothalamic-Ovarian axis and Adiposity Relationship in Polycystic Ovary Syndrome: Physiopathology and Therapeutic Options for the Management of Metabolic and Inflammatory Aspects. *Current Obesity Reports*, *13*(1), pp.51-70.
25. Mączka, K., Stasiak, O., Przybysz, P., Grymowicz, M. and Smolarczyk, R., 2024. The impact of the endocrine and immunological function of adipose tissue on Reproduction in women with obesity. *International Journal of Molecular Sciences*, *25*(17), p.9391.
26. Maher, R.A., 2022. *Exercise interventions and fertility outcomes for women with obesity and experiencing infertility: a narrative review* (Doctoral dissertation, Memorial University of Newfoundland).
27. Marinelli, S., Napoletano, G., Straccamore, M. and Basile, G., 2022. Female obesity and infertility: outcomes and regulatory guidance. *Acta Bio Medica: Atenei Parmensis*, *93*(4).
28. Marinelli, S., Napoletano, G., Straccamore, M. and Basile, G., 2022. Female obesity and infertility: outcomes and regulatory guidance. *Acta Bio Medica: Atenei Parmensis*, *93*(4).
29. Mohajan, D. and Mohajan, H.K., 2023. Obesity and its related diseases: a new escalating alarming in global health. *Journal of Innovations in Medical Research*, *2*(3), pp.12-23.
30. Öztürk, R., Herbell, K., Morton, J. and Bloom, T., 2021. "The worst time of my life": Treatment-related stress and unmet needs of women living with infertility. *Journal of community psychology*, *49*(5), pp.1121-1133.
31. Pan, R. and Chen, Y., 2021. Fat biology and metabolic balance: On the significance of sex. *Molecular and Cellular Endocrinology*, *533*, p.111336.
32. Qaissi, A., 2024. Exploring Thematic Analysis in Qualitative Research. In *Data Collection and Analysis in Scientific Qualitative Research* (pp. 253-294). IGI Global.
33. Rabijewski, M., 2023. Male-specific consequences of obesity—functional hypogonadism and fertility disorders. *Endokrynologia Polska*, *74*(5), pp.480-489.
34. Rabijewski, M., 2023. Male-specific consequences of obesity—functional hypogonadism and fertility disorders. *Endokrynologia Polska*, *74*(5), pp.480-489.
35. Ribeiro, L.M., Sasaki, L.M., Silva, A.A., Souza, E.S., Lyrio, A.O., Figueiredo, A.C. and Gottems, L.B., 2022. Overweight, obesity and assisted reproduction: A systematic review and meta-analysis. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, *271*, pp.117-127.
36. Rubino, F., Puhl, R.M., Cummings, D.E., Eckel, R.H., Ryan, D.H., Mechanick, J.I., Nadglowski, J., Ramos Salas, X., Schauer, P.R., Twenefour, D. and Apovian, C.M., 2020. Joint international consensus statement for ending stigma of obesity. *Nature medicine*, *26*(4), pp.485-497.
37. Sax, M.R. and Lawson, A.K., 2022. Emotional support for infertility patients: integrating mental health professionals in the fertility care team. *Women*, *2*(1), pp.68-75.
38. Service, C.A., Puri, D., Al Azzawi, S., Hsieh, T.C. and Patel, D.P., 2023. The impact of obesity and metabolic health on male fertility: a systematic review. *Fertility and sterility*, *120*(6), pp.1098-1111.
39. Szkodziak, F., Krzyżanowski, J. and Szkodziak, P., 2020. Psychological aspects of infertility. A systematic review. *Journal of International Medical Research*, *48*(6), p.0300060520932403.

40. Umutoni, D., Owolabi, M.S. and Waheed, S.A.,2023. Unraveling the Complex Interactions Among Lung Cancer, COPD, Cardiovascular Disease, and Pulmonary Fibrosis: Overlapping Risks, Converging Pathways, and Integrated Care Approaches.
41. Vioreanu, A.M., 2021. The psychological impact of infertility. Directions for the development of interventions. *Mental Health: Global Challenges*, *4*(1), pp.22-37.
42. Wittert, G. and Grossmann, M., 2022. Obesity, type 2 diabetes, and testosterone in ageing men. *Reviews in Endocrine and Metabolic Disorders*, *23*(6), pp.1233-1242.
43. Wu, H.M., Chang, H.M. and Leung, P.C., 2021. Gonadotropin-releasing hormone analogs: Mechanisms of action and clinical applications in female reproduction. *Frontiers in neuroendocrinology*, *60*, p.100876.
44. Zeng, X., Xie, Y.J., Liu, Y.T., Long, S.L. and Mo, Z.C., 2020. Polycystic ovarian syndrome: Correlation between hyperandrogenism, insulin resistance and obesity. *Clinica chimica acta*, *502*, pp.214-221.