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Safety of testosterone implant use in women: In light of current publications

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Abstract
Introduction: Testosterone is the most abundant biologically active hormone across a woman's lifespan.
Purpose: To evaluate the safety of using testosterone implants in women.
Materials and Methods: A narrative review of the available literature was conducted across several electronic databases (EMBASE, LILACS, Medline, Ovid, among others) using both free-text and standardized search terms, covering the period from 1940 to 2025. The outcomes assessed included androgenic adverse effects and safety in the metabolic, cardiovascular, endometrial, mammary, hematological, and mental health domains.
Results: Seventy-eight publications were included. Testosterone implants are available in different concentrations and provide sustained and prolonged, although uncontrolled, release for three to six months, producing supraphysiological peaks and wide variability in serum testosterone levels (299.36 ± 107.34 ng/dL), along with substantial interindividual variance (35.9%) and a heavy reliance on observational data. Safety reports originate mainly from records based on personal clinical practice and describe mild androgenic adverse effects and voice changes. Although some observations suggest a lower incidence of breast cancer, these findings come from cohorts without adequate adjustment for confounding factors; therefore, a causal relationship cannot be established. Evidence concerning cardiovascular, metabolic, and endometrial outcomes remains scarce and inconsistent.
Conclusions: The reported benefits of testosterone implants in women remain hypothetical in light of the published studies, and their safety has not been confirmed. In the absence of well-designed and rigorously conducted randomized clinical trials, testosterone implants should not be used in women.

Keywords: Drug implants, testosterone, women, safety, androgens, hirsutism

Introduction

Testosterone is a steroid sex hormone found in both men and women, although in smaller amounts in women, since testosterone production by Leydig cells in the male testes is 7 to 8 times greater than that produced by the ovaries (75 µg per day) [1-3].

In women, estrogens are considered the main steroid sex hormones; however, during reproductive age, serum androgen levels are higher than estrogen levels, except in the preovulatory and luteal phases of the menstrual cycle, when androgen and estrogen concentrations are comparable [3, 4].

The theca cells of the ovaries and the adrenal cortex secrete approximately 0.02 µmol of testosterone per day [5]. Peripheral conversion of androstenedione (a prohormone) in adipose tissue accounts for about half of circulating testosterone [6]. In women, the main androgens include dehydroepiandrosterone sulfate (DHEAS), dehydroepiandrosterone (DHEA), androstenedione (A), testosterone (T), and dihydrotestosterone, in descending order of serum concentration, although only the latter two bind to the androgen receptor [1, 3, 6].

Testosterone circulates both in free form and bounds to proteins; in fact, more than 98% of circulating testosterone is protein-bound, either tightly to sex hormone-binding globulin (SHBG) (approximately 66%) or weakly to other proteins such as albumin (approximately 33%) [6, 7]. However, measuring serum testosterone levels in women presents important limitations due to issues related to accuracy, precision, sensitivity, and specificity of available methods, especially given the low hormone concentrations observed in women [6-9]. In this context, the Endocrine Society recommends measuring total testosterone using liquid chromatography-mass spectrometry (LC-MS/MS) in a qualified laboratory for greater accuracy [8].

Androgen deficiency in women has been linked to a variety of symptoms [9, 10]; therefore, the use of testosterone in women has historically encompassed a wide range of prescribed indications, including decreased sexual desire, fatigue, tiredness, reduced energy, cognitive and concentration impairment, mood changes, diminished general vitality, bone health concerns, and loss of strength and muscle tone [1, 10]. However, based on the most recent evidence, the current indication for testosterone therapy is strictly limited to the treatment of hypoactive sexual desire disorder (HSDD) in postmenopausal women [11], with available data supporting only a "mild to moderate" therapeutic effect.

In women, testosterone levels naturally decline throughout life, with a reduction of approximately 25% between the ages of 20 and 40, followed by an additional decrease of 10-20% over the next decade, stabilizing around age 55 [12, 13]. Therefore, it is reasonable to consider that testosterone supplementation may have important physiological effects in women [1]; accordingly, various testosterone formulations have been employed, including intramuscular (cypionate/enanthate), oral (undecanoate), nasal, transdermal (gel/patch), and subcutaneous implants [14-16].

Although normal serum testosterone levels in women range from 15 to 90 ng/dL (0.5 to 3.0 nmol/L) [6, 9, 12, 17], current evidence does not support tailoring testosterone supplementation doses by age. Thus, the general recommendation is to treat women with surgical or natural menopause using doses that achieve physiological testosterone concentrations typical of premenopausal women, preferably through transdermal formulations [11].

Despite regulatory restrictions, the clinical use of testosterone implants has expanded worldwide. This excessive and widespread off-label use raises significant clinical and regulatory concerns due to the lack of standardization in manufacturing, dose consistency, and pharmacovigilance [18]. Variability in preparation practices contributes to heterogeneous release kinetics and complicates the interpretation of safety data [1, 10, 18]. Much of the available evidence comes from a small number of research groups and clinical practice-based registries with heterogeneous populations, increasing the risk of bias and limiting the generalizability of results [18-20].

The pharmacokinetics of testosterone implants is a key determinant of their clinical applicability and simultaneously the main source of controversy [18]. Unlike formulations delivered through membranes or vehicles, implants consist of compact crystalline testosterone cylinders manufactured by fusion, which release the hormone through gradual dissolution and surface erosion [18, 21, 22]. This process produces a release profile characterized by an initial rise, often exceeding female physiological ranges, followed by a plateau phase and a gradual decline over several months. Consequently, testosterone implants are not recommended for use in women of any age because the dose cannot be adjusted and the therapy frequently results in supraphysiological levels [1, 21-23].

The use of testosterone implants is not new. A publication from January 2, 1943, described the use of the so-called "male sex hormone" in the treatment of certain gynecological disorders, proposing that "The use of testosterone in the treatment of certain gynecological disorders, although it might seem paradoxical, was not antiphysiological" [24]. Since then, multiple publications have supported its use in women [25, 26], despite limited data assessing the effectiveness of testosterone implants and even less evaluating their safety in the female population. Therefore, this research aimed to evaluate the safety of testosterone implants in women in light of current publications.

Materials and Methods

A narrative review was conducted on the safety of testosterone implant use in women in light of current publications. The final research question was refined through consultation with three specialists in endocrinology. The question of interest was: Is the use of testosterone implants in women risk-free? The inclusion criteria were clinical trials, prospective cohort studies, case-control studies, cross-sectional studies, and retrospective studies with full text available for evaluation that included adult women (≥18 years). The exclusion criteria were studies with fewer than 10 participants, failure to describe the treatment protocol, posters, or abstracts.

Search Strategy

A search of the scientific literature was conducted using the following databases: APA PsycInfo, BIOSIS Previews, Cochrane Database of Systematic Reviews (Wiley platform), EBSCO, EMBASE (Elsevier), LILACS (Virtual Health Library - VHL, iAHx interface), Medline via PubMed, and OVID. An exhaustive bibliographic search was performed, including references published between January 1, 1940, and August 31, 2025, with no language restrictions. The outcomes assessed included androgenic adverse effects, metabolic safety, cardiovascular safety, endometrial safety, breast safety, hematological safety, and mental health.

The terms used to define the selection of publications were applied as both free text and controlled vocabulary (MeSH and DeCS): "Drug Implants", "Pellet" [MeSH], and "Testosterone". The terms related to the research question that were combined using the Boolean operator "OR" were "Women", "Safety", "Androgens", "Hirsutism", "Thrombosis", and "Infarction". Finally, the set of search terms defining the selection of publications was combined with the terms of the question of interest using the Boolean operator "AND". A manual snowball search was also performed, starting with the reference lists of each selected article, to identify additional publications that met the criteria of interest.

Screening of References and Study Selection

Before initiating the publication selection process, eligibility criteria were shared and any concerns regarding the methodology were addressed. The screening of publications was carried out independently by three researchers (JDO, HAQ, and OBC), without knowledge of the other reviewers' results. Afterward, the articles selected by each reviewer were compared, and any doubts regarding the inclusion of publications were resolved through consensus among the reviewers, reevaluating the title and abstract. When additional information was required, the full text was retrieved to reach a final decision on inclusion or exclusion. In cases of disagreement, a fourth researcher (LOS) was consulted.

Quality Assessment of the Evidence

The quality of the evidence and the risk of bias for each study were assessed in pairs by two investigators (FEU and CEG). The selected articles were evaluated using the risk of bias tool developed by the Cochrane Collaboration [27]. In addition, the overall quality of the evidence for each outcome was assessed using the approach developed by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group [28].

Ethical aspects: As it is a literature review, it is considered a risk-free investigation; in accordance with article 11 of Resolution 8430 of 1993 [29].

Results

A total of 130 publications were obtained through the search in the different databases; after discarding duplicate articles and those without full text, 97 references remained that met the inclusion criteria based on title and abstract for full-text evaluation. In the end, 78 publications were included. Figure 1 presents the PRISMA flow diagram used to screen the references.

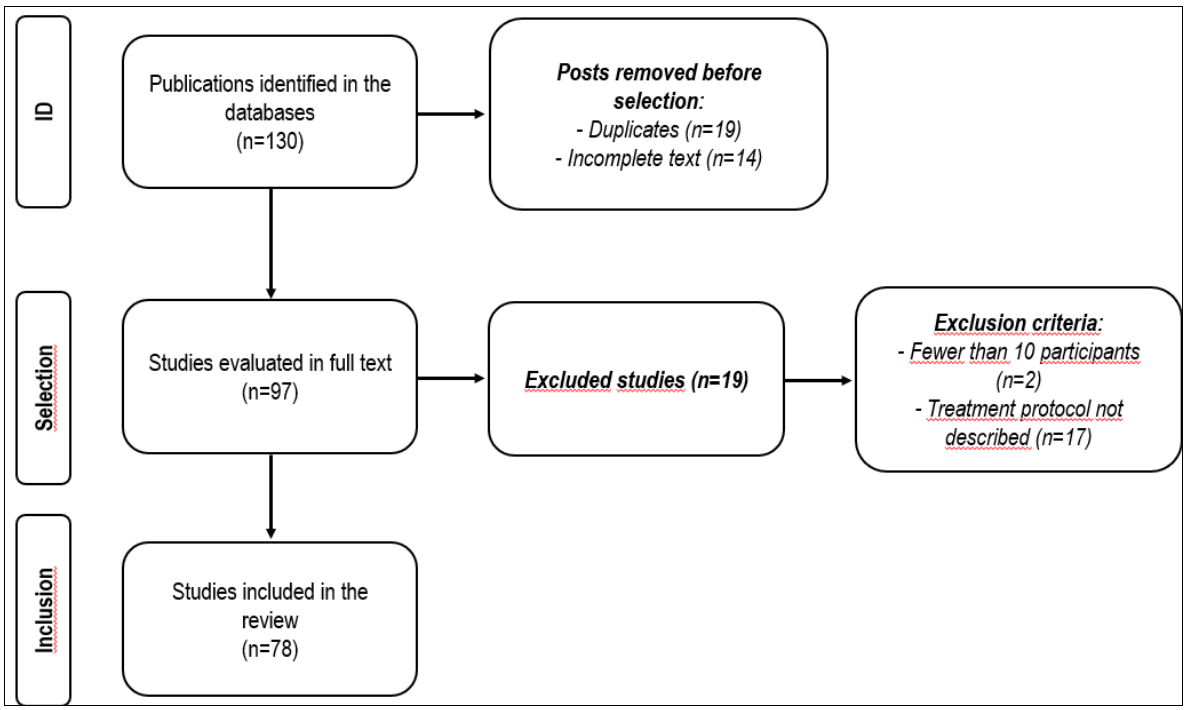

Fig 1: PRISMA flow diagram for screening and selection of publications.

Pharmacokinetics of Testosterone Implants

Testosterone implants are typically administered at doses of 75-100 mg, with effects lasting 3 to 6 months [21, 25, 26, 30]. Kapetanakis *et al*. [31], using 75 mg implants, reported that mean testosterone levels in ten women with symptoms of estrogen deficiency due to premature menopause rose abruptly to a peak mean level of 2.5 ± 1.6 ng/mL (250 ng/dL) within two weeks of implantation. A steady decline followed, with a return to baseline values within 17 to 18 weeks (four to five months). In their study, Thom *et al*. [32] reported that in 24 postmenopausal women who had undergone oophorectomy, plasma testosterone concentrations increased from a mean of 1.0 nmol/L (28.84 ng/dL) to 5.0 nmol/L (144.21 ng/dL) and 6.7 nmol/L (193.24 ng/dL) approximately four weeks after insertion of 100 mg and 200 mg testosterone implants, respectively, with levels remaining elevated for up to eight months. With 100 mg implants, Buckler *et al* [23]. Reported a peak testosterone level of 256 ng/dL at one month, which gradually decreased to 83 ng/dL over the following six months. Glaser *et al* [26]. Observed serum testosterone levels of 299.36 ± 107.34 ng/dL at week 4, with substantial interindividual variance (35.9%), in premenopausal and postmenopausal women following implantation. These studies, despite their small and heterogeneous populations, have demonstrated a consistent pattern associated with testosterone implants: prolonged and uncontrolled hormone release, with transient peaks that exceed female reference ranges (15 to 90 ng/dL for total testosterone) [6, 9, 12, 33]. LC-MS/MS-based ranges for postmenopausal women are typically narrower and lower (≈10-55 ng/dL) than those derived from older immunoassays [1, 10, 18, 33].

Given that testosterone implants produce prolonged exposure, early supraphysiological peaks, and limited reversibility once inserted, the caution and prudence reflected in recent clinical guidelines and reviews are justified [1, 11, 18, 33]. Current recommendations emphasize maintaining testosterone concentrations within female physiological limits [11, 34, 35], in part because a working group convened by the Endocrine Society, the American College of Obstetricians and Gynecologists (ACOG), the American Society for Reproductive Medicine (ASRM), the European Society of Endocrinology (ESE), and the International Menopause Society (IMS) concluded that endogenous testosterone levels do not predict treatment response [33].

Safety

Androgenic Adverse Effects.

The most frequently reported adverse effects associated with testosterone implants are androgenic. In their 2013 study, Glaser *et al* [26]. Reported mild to moderate hirsutism in 85.7% of women, moderate acne in 11.2%, and transient hoarseness in 1%. Hernández *et al* [30]. in a retrospective review of medical records from 31 women who received 75 mg and 100 mg implants, described a 5.3% rate of facial hirsutism. It is important to note that these studies used non-randomized, practice-based designs, and the data relied on participant self-report without standardized classification, which likely underestimates mild or transient adverse events and lacks adequate statistical power to detect rare or irreversible outcomes such as persistent voice changes or clitoromegaly.

Hematological Adverse Effects

Evidence regarding the hematological safety of testosterone implants is very limited. Although some publications report small increases in hematocrit, none document erythrocytosis [25, 26, 30]. However, the known effect of testosterone in stimulating erythropoietin secretion, which increases hemoglobin, hematocrit, and blood viscosity and may lead to secondary polycythemia and an elevated risk of venous thromboembolism

(VTE), cannot be overlooked [36-38]. The risk of VTE associated with testosterone use likely depends on factors such as age, weight, hormonal status, and other prothrombotic conditions, underscoring the need for additional studies [1, 10, 18]. For this reason, some authors emphasize that before initiating testosterone replacement therapy in women, it is essential to perform a thorough assessment of underlying medical conditions and hereditary or acquired prothrombotic states that may further increase VTE risk. Furthermore, testosterone therapy should be tailored to physiological female levels and include close monitoring of testosterone concentrations before and after treatment [20].

In the year 2021, Campitruz *et al* [20]. Reported a case of portomesenteric venous thrombosis in a postmenopausal woman using a testosterone implant. Her testosterone level was 182 ng/dL. Hematological analysis suggested a prothrombotic state precipitated by testosterone replacement therapy. The researchers hypothesized that this hormonal device may interact with previously undiagnosed procoagulable factors.

Cardiovascular Adverse Effects

Cardiovascular risk represents a major barrier to the widespread acceptance of testosterone implant therapy. Hernández *et al* [30]. did not find an excessive risk of ischemic heart disease, stroke, erythrocytosis, or hypertension among implant users, although their statistical power to detect these outcomes was limited, because the effect estimates were imprecise (adjusted HR approximately 1.0; 95 percent CI: 0.7 to 1.5), and the information was obtained through clinical coding rather than adjudicated diagnostic criteria.

Observational studies suggest that testosterone may have favorable cardiovascular effects when measured by indirect outcomes; however, associations between endogenous testosterone and the risk of cardiovascular disease or total mortality, particularly in older women, have not been established. Similarly, adverse cardiovascular effects have not been observed in studies of transdermal testosterone therapy in women [2]. This route appears safe in the short term, and no major safety concerns have been reported to date, although long-term cardiovascular effects remain uncertain [39]. Furthermore, no studies of testosterone implants have evaluated cardiovascular risk in women of any age group over any length of follow-up, whether short term or long term.

In a 2021 publication reporting a 7-year follow-up of 1,204,012 testosterone implant insertion procedures in 376,254 patients, 85 percent (1,018,516 procedures) were performed in women (n = 307,690) and 15 percent (185,496 procedures) in men. Among the women, 54 percent were premenopausal and 46 percent postmenopausal, with ages ranging from 25 to 92 years. The three most commonly reported complications were male extrusions (4786 events, less than 3 percent), female extrusions (3621 events, less than 1 percent), male cellulitis or infection (765 events, less than 1 percent), female cellulitis or infection (285 events, less than 1 percent), and bleeding (less than 1 percent) [40]. The publication does not include any cardiovascular follow-up for this population. In addition, the statistical power to detect cardiovascular outcomes is very limited. In summary, the cardiovascular risk and overall safety of testosterone implants in women remain uncertain and controversial [10, 18, 41].

Metabolic Adverse Effects

Testosterone is necessary for the metabolism of carbohydrates, lipids and proteins; and there are no reports of association between endogenous testosterone levels in women and cardiovascular risk, although they could be part of a proatherogenic profile [42, 43]. No worsening of lipid levels, CRP, glycosylated hemoglobin or insulin sensitivity was detected with endogenous testosterone levels in the highest reference quintiles [44, 45].

According to Renke *et al* [46]. in subcutaneous testosterone therapy, a minimum dose of 100 mg and a maximum dose of 3 mg/kg may be appropriate when treating women, with few side effects if administered correctly. They recommend that doses be individualized based on a woman's weight and symptoms rather than laboratory values. However, they also emphasize that larger randomized clinical trials are needed to evaluate the long-term safety of this treatment.

Adverse Effects at the Endometrial Level

Publications regarding the impact of testosterone on endometrial safety are limited, but overall, they suggest a neutral or potentially protective profile. In 2007, Filho *et al* [47]. Published a retrospective review of medical records from 258 postmenopausal women using estradiol and testosterone implants as combined hormone therapy to assess endometrial effects after two years of continuous use. Among 44 patients with endometrial thickness greater than 5 mm at the end of the second year, the most frequent hysteroscopic finding was a polypoid lesion (61.3%), followed by a normal uterine cavity (31.8%) and a submucosal myoma (6.8%). Histology confirmed endometrial polyps in 38.6% of cases, normal endometrium in 31.8%, simple endometrial hyperplasia in 20.4%, and myoma or atrophic endometrium in 4.5%. These authors concluded that testosterone may exert antiproliferative effects on the endometrium, but not necessarily on polyps, similar to combined estrogen and progestogen therapies. Other researchers have reported that endometrial safety was not adversely affected [48-50], although biopsy-confirmed long-term data remain scarce. The absence of large prospective cohorts with systematic endometrial surveillance limits definitive conclusions.

Adverse Effects on the Breast

In an observational retrospective analysis, a lower-than-expected incidence of breast cancer was reported among users of testosterone implants, corresponding to an incidence of 144 cases per 100,000 person-years [51]. Other authors [52] also reported that women with symptoms of hormonal deficiency who were treated with pharmacological doses of testosterone, either alone or in combination with anastrozole and administered by subcutaneous implants, had a lower incidence of breast cancer. However, the lack of randomization, the absence of standardized monitoring, and the limited control of confounding factors prevent the establishment of causal relationships.

Adverse Effects on Mental Health

It has been hypothesized that reduced serotonin release and impaired neuroplasticity are central mechanisms that predispose women to depression and anxiety. It has also been suggested that higher endogenous levels of sex steroids may be protective against depressive and anxiety symptoms [53, 54]. In this regard, growing evidence suggests that higher levels of sex hormones are associated with fewer depressive symptoms [55-57].

Upon further review, it appears that, in women, study results are contradictory and range from no association to reports of both positive and negative associations with depression [58, 59]. Some researchers suggest that higher testosterone levels may contribute to greater depressive symptoms during the menopausal transition [60], or that women with depression may

present with elevated testosterone levels [61, 62].

Regarding psychiatric manifestations following the use of testosterone implants in women, Daram *et al* [63]. Recently presented a case report of a postmenopausal woman who developed severe psychiatric symptoms, including profound anxiety, agitation, insomnia, paranoid delusions, and impulsive thoughts of harm that required hospital admission, after receiving testosterone implants. Significantly elevated testosterone levels were documented in this patient (approximately 120 ng/dL). After a one-year break from testosterone therapy, the woman resumed treatment at a reduced dose and again experienced a recurrence of symptoms, which ultimately led her to recognize the association between her psychiatric manifestations and the use of testosterone implants.

Discussion

The main indication for prescribing testosterone in women is the loss of sexual desire [1, 2, 18, 30]. The fact that no formulation has been approved for this purpose has not prevented the widespread use of testosterone in women, whether off-label or as compounded bioidentical hormone therapy [10]. This review sought to identify the medical evidence available in current publications regarding the use of testosterone implants in women. However, the hierarchy of evidence is scarce or nonexistent, since most of the data come from observational studies and no randomized controlled clinical trials with adequate statistical power are available to establish clinical criteria based on solid scientific evidence.

In a study published in 1987 [22], researchers found that combined estradiol and testosterone implants significantly improved libido in postmenopausal women compared with estradiol alone. The combined therapy improved sexual desire, enjoyment, and orgasm frequency, and these effects lasted for 4 to 6 months. However, the study also documented that testosterone levels increased to supraphysiological ranges in treated women, and some experienced side effects such as hirsutism and voice changes.

Variability in the preparation of testosterone implants contributes to heterogeneous release kinetics and complicates the interpretation of their safety [18]. Unmet needs include the availability of testosterone formulations specifically approved for women and studies that clarify their potential contributions to cardiovascular, cognitive, and musculoskeletal health, as well as cancer risk [2, 10, 11, 13].

There is currently no testosterone formulation approved for women. Thus, bioidentical testosterone creams or reduced doses of male-approved therapies represent off-label use [1, 64]. Oral testosterone is associated with erratic absorption, high peaks, and adverse effects on lipids (increased LDL-C and decreased HDL-C), along with increased SHBG and reduced testosterone bioavailability [11, 33, 65]. Intramuscular injections are often painful and produce abrupt fluctuations that cause symptomatic variability [65, 66]. Transdermal preparations provide more stable release but require daily application, pose transfer risks, and can produce supraphysiological levels at higher doses [16, 65, 66]. Implants provide prolonged exposure but cause early supraphysiological peaks and have limited reversibility once inserted, making them unsuitable due to dosage risks and insufficient evidence of safety (Grade C: Low) [67].

Although clinicians should be aware that testosterone implant therapy may be a risk factor given uncertainties about safety, some authors such as van Staa *et al* [69]. in the United Kingdom conducted an observational study including women over 18 years of age prescribed testosterone via implants (72.2%), tablets (18.4%), or injections (7.9%). The study included 8412 women, with 2103 testosterone users and 6309 controls. No statistically significant differences were observed between cohorts in cerebrovascular disease, ischemic heart disease, breast cancer, deep vein thrombosis or pulmonary embolism, diabetes mellitus, or acute hepatitis. Breast cancer rates were similar between testosterone users and controls. The rate of androgenic events was higher in the testosterone cohort (relative rate 1.55, 95% CI 1.21 to 1.97). Differences between cohorts were broadly similar across age and hormone therapy subgroups. This study did not find a significant increase in cardiovascular disease or breast cancer in women using testosterone (implants, tablets, or injections), but it did identify an increased risk of androgenic events. Nonetheless, the study has major limitations, including limited statistical power, lack of randomization, and residual confounding. Therefore, the findings should be interpreted as hypothesis-generating rather than evidence of safety. Replication of these results in well-designed independent studies involving women treated for sexual dysfunction would be useful to reduce concerns about bias and conflicts of interest.

Although testosterone therapy in postmenopausal women has been associated with favorable effects on sexual function, body composition, bone health, cardiovascular function, and cognitive performance [70, 71], prescribers must always consider the potential masculinizing and somatic adverse effects, particularly in cases of overdose. They must also consider potential serious effects such as hepatocellular injury, cardiovascular harm, and hormone-dependent tumors, for which safety data are lacking. These concerns justify careful dosing, especially in women with low SHBG levels [72-74].

This review found wide variability in the concentrations of testosterone implants used in women. Because potential benefits and risks remain uncertain, further long-term and methodologically robust studies are needed to better assess the safety of testosterone implants in women. Methodological limitations identified in the analyzed publications included practice-based records, lack of standardized measures, absence of randomization or control groups, heterogeneous populations, diverse dosage regimens and formulations, case series designs, evident selection bias, and potential conflicts of interest. These limitations reduce scientific validity, obscure current evidence, and limit the ability to generate conclusive recommendations.

At present, because no rigorous comparative studies exist between conventional hormone therapy and testosterone implants that provide strong evidence supporting their use in women, their use is discouraged and they are not approved for women [1, 10, 11, 75]. Their preparation as compounded formulations are also questioned because concentrations vary between pharmacies and involve heterogeneous production and monitoring processes. This results in differences in bioavailability, bioactivity, and potency between batches, along with substantial risks of overdose or underdose, impurities, lack of sterilization, insufficient regulation, and unknown pharmacokinetic properties [75-78].

Historically, the clinical use of subcutaneous testosterone implants in women focused on hypoactive sexual desire disorder (HSDD) [25, 26, 40]. However, their use has expanded to other indications such as relief of menopausal symptoms, promotion of physical and mental energy, improved sleep quality, mood stabilization, osteoporosis prevention, and enhanced sexual performance [10]. Nevertheless, the only formally endorsed indication for testosterone uses in women, according to current international consensus, remains the treatment of sexual desire disorder in postmenopausal women [11, 72, 76, 77]. This

recommendation is supported by clinical trials demonstrating efficacy and short-term safety. This likely reflects a continuing tension between conservative academic guidelines and patient interest in accessible testosterone formulations for women.

In recent years, healthcare has increasingly emphasized precision medicine, encouraging individualized approaches. Many individuals seek to take an active role in their care and aim to maintain vitality and longevity through healthy aging [10, 75]. Therefore, health professionals must maintain a delicate balance between scientific knowledge, clinical observation, intuitive skill, personal experience, and adherence to medical evidence, especially when addressing controversial topics [1, 10, 75, 78]. They must be guided by the long-standing Hippocratic ethical principle: "First, do no harm," which reminds clinicians to pursue solutions that maximize benefit while minimizing adverse effects.

In Colombia, in accordance with current health regulations, INVIMA (National Institute for Drug and Food Surveillance) issued Health Alert 150-2023 on May 30, 2023, regarding the product marketed under the brand name REJUVCHIP Testosterone Pellets. The product is promoted on various websites and social media platforms and is used in some healthcare institutions. INVIMA considers it fraudulently marketed because it lacks health registration and poses health risks. Individuals are advised to refrain from purchasing it, discontinue its use, and report any adverse effects. Authorities and healthcare establishments must strengthen surveillance and control, and report findings to INVIMA.

Finally, at the time of this review, research on testosterone implants in women continues to be limited by the lack of standardized laboratory methods for testosterone measurement, diversity of participants, heterogeneity of questionnaires, methodological weaknesses, insufficient statistical significance, confounding factors, and selection bias due to lack of randomization or unclear randomization procedures. These limitations result in uncertain or restricted conclusions.

The main strength of this research is the extensive and broad search of scientific literature, expanded by the snowball methodology, which attempted to identify as many relevant publications as possible, although this cannot be guaranteed with absolute certainty. Among the limitations, the absence of Colombian participants in the evaluated studies may represent a potential constraint, although an unavoidable one and likely to have only marginal impact on the results.

Conclusion

The use of testosterone implants in women, in light of current publications, is supported by observational studies and by the clinical experience of the authors who cite benefits in areas such as sexuality, psychological well-being, body composition, bone health, and vitality. Their safety likewise relies on these same publications, many of which contain methodological inconsistencies, conflicts of interest, heterogeneous analyses, and non-standardized dosing. For these reasons, the findings must be interpreted with caution and examined under the lens of scientific rigor.

Current publications on the use of testosterone implants in women, although useful for generating hypotheses, are insufficient to support any statement about their safety, since the types of studies conducted make it difficult to isolate the dependent variable, which may result in misleading or overly optimistic conclusions.

In the absence of well-designed and properly executed randomized clinical trials, testosterone implants should not be used in women.

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Contribution of the Authors

- **FJE:** study conceptualization and design; data acquisition, analysis, and interpretation; critical revision; and final approval of the manuscript.
- **LOS:** data acquisition and analysis; critical revision; and final approval of the manuscript.

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