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REPRODUCTIVE HEALTH ISSUES AMONG ADOLESCENT AND YOUNG MALE POPULATIONS. PART I

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Abstract

Introduction: Male reproductive health is a critical component of demographic stability and public well-being. Contemporary epidemiological studies indicate a decline in male fertility, with adolescence and early adulthood representing a particularly vulnerable period for the development of reproductive potential. Insufficient awareness, social barriers, and limited access to specialized care exacerbate the risks to male health.

Objective: To identify key factors influencing the reproductive health of adolescent and young males, with a focus on prevention and early correction of disorders.

Search strategy: Following the identification of core keywords and their synonyms, a comprehensive literature search was conducted using international (PubMed, Google Scholar, Embase) and national (Cyberleninka, e-Library) scientific databases, covering publications from the past ten years. Selected sources were evaluated for citation frequency, and abstracts were assessed for thematic relevance. Full texts of studies meeting the inclusion criteria were retrieved for detailed analytical review. Inclusion criteria comprised thematic relevance, publication language (English or Russian), year of publication (from 2015 onward), and coverage of various study types — including original research, reviews, systematic reviews, meta-analyses, clinical guidelines, monographs, and conference proceedings.

Results and Conclusion: In recent decades, Kazakhstan has seen a steady increase in the prevalence of male reproductive disorders, including erectile dysfunction, infertility, and hormonal imbalances. According to a national screening of 25,000 men, ED was identified in 56.3%, reproductive disorders in 30.4%, and STIs in 42.4% of cases. Among adolescents, urological pathologies were detected in 90.3% of cases, emphasizing the importance of early diagnosis. National studies further revealed that over 50% of men in both urban and rural areas experience symptoms of androgen deficiency and sexual dysfunction. Despite the implementation of the state program "Men and Reproductive Health," population coverage remains fragmented, and the need for systematic andrological care continues to grow.

Keywords: reproductive health, adolescents, male gender, male fertility, erectile dysfunction

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Резюме

ВОПРОСЫ РЕПРОДУКТИВНОГО ЗДОРОВЬЯ СРЕДИ ПОДРОСТКОВ И МОЛОДЫХ МУЖЧИН. ЧАСТЬ I

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Введение: Репродуктивное здоровье мужчин является важнейшей составляющей демографической стабильности и общественного благополучия. Современные эпидемиологические исследования фиксируют снижение мужской фертильности, при этом подростковый и юношеский возраст представляют собой критически уязвимый период для формирования репродуктивного потенциала. Недостаточная осведомлённость, социальные барьеры и ограниченный доступ к специализированной помощи усугубляют риски для мужского здоровья.

Цель: Оценить ключевые факторы, влияющие на репродуктивное здоровье подростков и молодых мужчин, с акцентом на профилактику и раннюю коррекцию нарушений.

Стратегия поиска: После составления перечня ключевых терминов и их синонимических вариантов был осуществлён комплексный библиографический поиск в международных (PubMed, Google Scholar, Embase) и отечественных (Cyberleninka, e-Library) научных базах данных, охватывающий публикации последних десяти лет. Отобранные источники подверглись оценке по частоте цитирования, а аннотации были проанализированы на предмет соответствия тематике исследования. Полные версии работ, соответствующих установленным критериям, были включены в углублённый аналитический обзор. В критерии отбора входили: тематическая релевантность, язык публикации (английский или русский), дата выпуска не ранее 2015 года, а также охват различных типов исследований — от оригинальных и обзорных статей до систематических обзоров, метаанализов, клинических рекомендаций, научных монографий и сборников тезисов.

Результаты и Заключение: В последние десятилетия в Казахстане наблюдается устойчивый рост распространённости мужских репродуктивных расстройств, включая эректильную дисфункцию, бесплодие и гормональные нарушения. Так, по результатам массового скрининга 25 000 мужчин, ЭД была выявлена у 56,3%, расстройств репродуктивной функции — у 30,4%, а ИППП — у 42,4% обследованных. Среди подростков урологические патологии фиксировались у 90,3% случаев, что подчёркивает важность ранней диагностики. Национальные исследования также показали, что более 50% мужчин в городах и сельской местности сталкиваются с симптомами андрогенного дефицита и сексуальных нарушений. Несмотря на реализацию государственной программы «Мужчины и репродуктивное здоровье», охват населения остаётся фрагментированным, а потребность в системной андрологической помощи продолжает расти.

Ключевые слова: репродуктивное здоровье, подростки, мужской пол, мужская фертильность, эректильная дисфункция.

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Түйіндеме

ЖАСӨСПІРІМДЕР МЕН ЖАС ЕРЛЕР АРАСЫНДА РЕПРОДУКТИВТІК ДЕНСАУЛЫҚ МӘСЕЛЕЛЕРІ. I-БӨЛІМ

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Кіріспе: Ерлердің репродуктивтік денсаулығы — демографиялық тұрақтылық пен қоғамдық игіліктің маңызды құрамдас бөлігі. Қазіргі эпидемиологиялық зерттеулер ерлердің құнарлылығының төмендеуі үрдісін көрсетіп отыр, ал жасөспірімдік және жастық кезең репродуктивтік әлеуеттің қалыптасуы үшін аса осал кезең болып табылады. Ақпараттың жеткіліксіздігі, әлеуметтік кедергілер мен мамандандырылған медициналық көмектің шектеулі болуы ерлер денсаулығына төнетін қауіптерді күшейтеді.

Мақсат: Жасөспірімдер мен жас ерлердің репродуктивтік денсаулығына әсер ететін негізгі факторларды бағалау, алдын алу және бұзылыстарды ерте түзету шараларына басымдық беру.

Іздеу стратегиясы: Негізгі терминдер мен олардың синонимдерін анықтағаннан кейін соңғы он жылды қамтитын халықаралық (PubMed, Google Scholar, Embase) және отандық (Cyberleninka, e-Library) ғылыми дерекқорларында кешенді әдеби шолу жүргізілді. Таңдап алынған дереккөздер дәйексөз жиілігі бойынша бағаланып, аннотациялары зерттеу тақырыбына сәйкестігі тұрғысынан талданды. Іріктеу талаптарына сәйкес келетін зерттеулердің толық мәтіндері терең аналитикалық шолуға енгізілді. Іріктеу критерийлеріне тақырыптық сәйкестік, жарияланым тілі (ағылшын немесе орыс), 2015 жылдан бастап жарияланған болуы, сондай-ақ зерттеу түрлерінің кең спектрі — түпнұсқа және шолу мақалалар, жүйелі шолулар, метаанализдер, клиникалық ұсынымдар, монографиялар және конференция материалдары кірді.

Нәтижелер мен қорытынды: Соңғы онжылдықтарда Қазақстанда ерлердің репродуктивтік бұзылыстарының, соның ішінде эректильді дисфункцияның, бедеуліктің және гормондық теңгерімсіздіктің таралуының тұрақты өсуі байқалуда. 25 000 ер адамды қамтыған ұлттық скрининг нәтижесінде ЭД 56,3%, репродуктивтік функция бұзылыстары 30,4%, ал ЖЖБИ 42,4% жағдайында анықталған. Жасөспірімдердің арасында урологиялық патология 90,3% жағдайда тіркелген, бұл ерте диагностиканың маңыздылығын көрсетеді. Ұлттық зерттеулер қала мен ауыл

тұрғындарының 50%-дан астамында андроген тапшылығы мен жыныстық дисфункция белгілері бар екенін көрсетті. «Ерлер және репродуктивтік денсаулық» мемлекеттік бағдарламасы жүзеге асырылғанына қарамастан, халықты қамту әлі де бытыраңқы сипатта қалып отыр, ал андрологиялық көмектің жүйелі түрде көрсетілуіне деген қажеттілік өсіп келеді.

Түйінді сөздер: репродуктивтік денсаулық, жасөспірімдер, ер жынысы, ерлердің құнарлылығы, эректильді дисфункция.

Дәйексөз үшін:

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Background

Male reproductive health constitutes an essential dimension of overall population well-being and plays a pivotal role in maintaining demographic sustainability. While maternal health and female reproductive care have long received significant attention in global medical and scientific discourse, male fertility has often remained underrepresented in both research and clinical priorities [69, 7]. Recent epidemiological evidence indicates a concerning global decline in both the quality and quantity of male reproductive function, with far-reaching implications for fertility rates and the health of future generations [46].

According to the World Health Organization (WHO), one in six men worldwide experiences infertility-related issues, and male factors contribute to 40–50% of all cases of childlessness in couples [5]. In Kazakhstan, healthcare records show a growing number of consultations related to sexual dysfunction, varicocele, genitourinary infections, and other conditions that directly or indirectly impair reproductive capacity [2]. Urological disorders during adolescence are frequently overlooked, particularly in rural regions where access to specialized care is limited [32].

Puberty and the development of the reproductive system mark a critical stage in the male life course [8]. It is during adolescence and early adulthood that foundational aspects of fertility are established, hormonal regulation is shaped, and sexual and reproductive behaviors begin to form [4]. However, this period is characterized by high vulnerability to multiple risk factors — including socioeconomic hardship, insufficient sexual education, harmful habits, and early sexual debut [29, 11]. Research shows that adolescents and young men often lack adequate knowledge of reproductive hygiene, STI prevention strategies, and the risks associated with self-treatment [10, 14, 15, 50]. These factors underscore the need

for an integrated approach to understanding and addressing threats to male reproductive health, particularly during the early stages of development.

Objective: To identify key factors influencing the reproductive health of adolescent and young males, with a focus on prevention and early correction of disorders.

Search strategy. After formulating the primary search terms along with their synonymous expressions, a comprehensive literature review was carried out using international databases (PubMed, Google Scholar, Embase) and regional Russian-language platforms (Cyberleninka and eLibrary). The search was limited to publications released within the last ten years to ensure the inclusion of up-to-date and relevant data. The selected articles were subjected to bibliographic cross-referencing, including both references cited in the publications and subsequent studies that had cited them. Abstracts were then assessed to determine thematic relevance and compliance with the research focus. Based on clearly defined eligibility parameters, the remaining literature was categorized, and full-text versions were obtained for in-depth analysis. Only validated and methodologically sound studies were included in the final synthesis, as outlined in the search strategy (see Figure 1).

Inclusion criteria encompassed the following: (1) conceptual alignment with the scope of the review; (2) availability in English or Russian languages; (3) publication date from 2015 onward; and (4) coverage of both primary and secondary sources, including systematic reviews, meta-analyses, clinical recommendations, scholarly monographs, and conference proceedings.

Exclusion criteria involved omission of any publications that did not conform to the above inclusion standards.

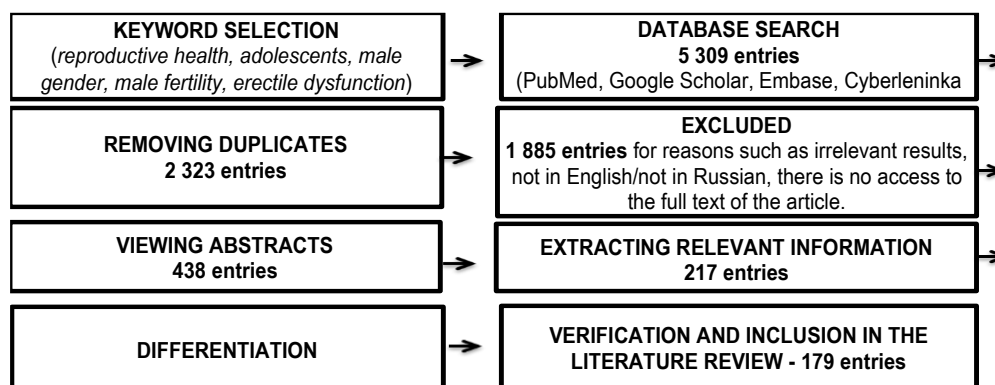


Fig. 1 Search strategy.

The main part

The role of adolescence and early adulthood in shaping male reproductive potential

The concept of reproductive health emerged in international medical and scientific discourse during the 1980s as a response to the growing need for an integrated approach to fertility, sexual well-being, and parental health protection [16]. According to the WHO 1994 definition, reproductive health refers not merely to the absence of disease, but to a state of complete physical, mental, and social well-being in relation to the reproductive system and its functions and processes [6]. However, in the context of ongoing global health challenges, the application of the term "reproductive health" to children and adolescents may be considered insufficiently precise. A more accurate and biologically grounded framework is the notion of "reproductive potential", which reflects the somatic and psycho-emotional maturity required for future fertility upon reaching biological and social adulthood [9].

Understanding the developmental stages of puberty is essential, especially in light of the updated age classifications proposed by WHO in 2022. This revised categorization defines "adolescents" as individuals aged 10–19, "young people" as those aged 10–24, and "youth" as those aged 15–24 [3]. These categories, developed through broad scientific consensus and aligned with data from international bodies such as the United Nations Population Fund (UNFPA), allow for more precise consideration of biological and psychosocial characteristics across age groups. This framework is particularly relevant for designing reproductive and sexual health programs tailored to developmental needs.

In the context of male reproductive development, adolescence plays a pivotal role [68]. During this stage, the testes begin to function as endocrine and generative organs. Their internal structure - comprising Sertoli cells, Leydig cells, and peritubular myoid cells - ensures the coordinated progression of spermatogenesis. Sertoli cells, which maintain the internal milieu of seminiferous tubules, are key regulators of spermatogenesis and are responsible for forming the blood-testis barrier that protects germ cells from autoimmune attack [34]. Spermatogenesis is a complex process involving mitosis, meiosis, and spermiogenesis. Concurrently, Leydig cells initiate robust testosterone synthesis, which supports the emergence of secondary sexual characteristics and the hormonal environment necessary for gametogenesis [51].

This maturation process is governed by the hypothalamic-pituitary-gonadal (HPG) axis. Gonadotropin-releasing hormone (GnRH), secreted by the hypothalamus, stimulates the anterior pituitary to release luteinizing hormone (LH) and follicle-stimulating hormone (FSH). LH activates Leydig cells to produce testosterone and insulin-like peptide 3 (INSL3), while FSH binds to receptors on Sertoli cells, driving spermatogenic progression [67].

The action of testosterone is mediated through androgen receptors (AR) and operates via genomic and non-genomic mechanisms. In the genomic pathway, the AR-testosterone complex translocates to the nucleus to modulate gene transcription. The non-genomic pathway, activated by low androgen concentrations, involves membrane-associated ARs and downstream signaling cascades such as ERK1/2 and CREB, which influence Sertoli cell function, blood-testis barrier integrity, and germ cell survival [25].

FSH activates intracellular signaling through the cAMP/PKA pathway as well as PI3K/Akt and MAPK cascades. These mechanisms enhance proliferation and differentiation of Sertoli cells, prevent apoptosis, and stimulate the synthesis of growth factors such as GDNF, FGF2, SCF, and BMP4, which are vital for maintaining the spermatogonial stem cell pool. FSH also regulates meiosis and facilitates galectin-3 expression, reducing spermatocyte loss [30].

At the local level, inhibin B and activin A play critical regulatory roles. Inhibin B, produced by Sertoli cells, exerts negative feedback on FSH secretion and serves as a marker of Sertoli cell activity and spermatogenic efficiency [43]. In contrast, activin A promotes FSH synthesis and supports gonocyte proliferation and epididymal development [21]. Dysregulation of these pathways is implicated in reproductive disorders.

Anti-Müllerian hormone (AMH), secreted by immature Sertoli cells, is necessary for Müllerian duct regression during fetal development. Its serum concentration serves as a diagnostic marker of Sertoli cell maturity and is utilized in conditions such as cryptorchidism and anorchia [33].

INSL3, synthesized by Leydig cells, is essential for testicular descent during embryogenesis and protects germ cells from apoptosis. INSL3 levels correlate with Leydig cell functionality and may be used as a biomarker for spermatogenic preservation in the context of hormonal therapy [42].

Although estrogens are traditionally associated with female physiology, their role in male reproductive regulation is increasingly recognized. The enzyme aromatase (CYP19A1), expressed in testicular tissue, converts androgens to estrogens, which are essential for ductal maturation, fluid absorption, and meiotic control. Estrogen imbalance can result in testicular atrophy, germ cell apoptosis, and reduced fertility [39].

Prolactin modulates Leydig cell sensitivity to LH and regulates gonadotropin secretion. Hyperprolactinemia has been linked to impaired spermatogenesis and sexual dysfunction. Although prolactin's role in male fertility remains under investigation, experimental evidence supports its regulatory importance [59].

Oxytocin, produced by the posterior pituitary, is also found in male reproductive tissues. It contributes to spermiation, enhances contractility of the seminiferous tubules, and stimulates testosterone synthesis. Oxytocin has been shown to increase the expression of proliferative and anti-apoptotic proteins in Sertoli cells [71].

In summary, male fertility is regulated by a complex network of hormonal interactions involving androgens, gonadotropins, inhibins, activins, prolactin, oxytocin, and estrogens. These hormonal factors act in concert to ensure the proper development and function of the male reproductive system. An overview of the key reproductive hormones involved in this regulatory network is provided in Table 1.

Epidemiological assessment of male reproductive disorders: global and Kazakhstani perspectives

Over the past several decades, numerous countries—including Kazakhstan—have reported a progressive deterioration in male reproductive health indicators. The prevalence of conditions such as impaired spermatogenesis, erectile dysfunction (ED), and hormonal imbalance has been steadily increasing. This trend is attributed to a wide range of

contributing factors, including population aging, lifestyle modifications, environmental exposure, and socio-economic challenges. According to the Global Burden of Disease (GBD) study, between 1990 and 2019, the global number of men diagnosed with infertility rose by nearly 77%, reaching approximately 56.5 million. The age-standardized incidence

rate climbed to 1402.98 per 100,000 males—19% higher than in 1990. Infertility was most prevalent in regions such as Eastern Europe, East Asia, and Western Sub-Saharan Africa, with the highest rates observed in men aged 30–34 and in countries with moderate to high levels of sociodemographic development [40]

Table 1.

Hormones involved in the regulation of the male reproductive system

Hormone	Secretory regions	Function during puberty	Related diseases
GnRH	Hypothalamus	Stimulates the production of LH and FSH by the pituitary gland, triggers puberty	Hypogonadism, and delayed sexual development [76]
LH	Adenohypophysis (anterior pituitary gland)	Stimulates Leydig cells to produce testosterone	Hypogonadism, infertility [60]
FSH	Adenohypophysis	Stimulates spermatogenesis in the seminal tubules	Oligospermia, azoospermia [25]
Testosterone	Leydig cells (testicles)	Development of secondary sexual characteristics, muscle growth, voice, libido	Hypogonadism, infertility, erectile dysfunction [36]
AMH	Sertoli cells (testicles)	Inhibits the development of the Muller ducts (female reproductive system)	Persistent Muller ducts, intersex conditions [33]
Inhibin B	Sertoli cell (testicles)	Inhibits FSH secretion, participates in regulation of spermatogenesis	Fertility disorders, decreased spermatogenesis [47]
Estrogen	Peripheral aromatization of testosterone	Involved in sperm maturation, maintaining bone density	Gynecomastia, and impaired fertility [39]
Prolactin	Pituitary gland (anterior lobe)	Indirectly affects gonadal functions, modulates testosterone levels	Hyperprolactinemia, decreased libido, infertility [59]
Oxytocin	Hypothalamus, released from the posterior pituitary gland	Promotes orgasm, affects social behavior	Social dysfunction, affective disorders [71]
INSL3	Leydig cell	Regulates testicular prolapse, supports the function of Leydig cells	Cryptorchidism, Leydig cell dysfunction [20]

A systematic review conducted by *Irfan M. et al.* (2020) compared the prevalence and risk factors of male sexual disorders in European and Asian populations. The findings indicated that ED (95.0% vs. 88.8%) and hypoactive sexual desire disorder (HSDD) (81.4% vs. 65.5%) were more frequently reported among Asian men, whereas anorgasmia and premature ejaculation (PE) were more common among European men [41].

In post-Soviet countries, including the Russian Federation, there remains a substantial deficit in public awareness—especially among adolescents - regarding sexual education, family planning, STI prevention, and modern contraceptive methods. This lack of knowledge directly affects the reproductive health outcomes of younger populations. For example, a regional survey conducted in Irkutsk among boys and adolescents aged 7–17 found that 34.2% of respondents exhibited various forms of reproductive pathology. Specifically, delayed puberty, characterized by underdevelopment of secondary sexual characteristics, was diagnosed in 18–32% of adolescents. Among those with hypothalamic syndrome and obesity, 18–32% demonstrated pubertal delay, while 7–12.7% showed signs of pathological gynecomastia, and 2–3.6% were diagnosed with atypical sexual development. Furthermore, around one-third of participants exhibited false testicular retention, wherein testicular descent into the scrotum had not occurred appropriately [9].

An epidemiological study conducted in Kazakhstan in 2007 used standardized questionnaires - namely, the International Index of Erectile Function (IIEF) and the Aging Male Symptoms (AMS) scale—to assess the prevalence of sexual disorders in men. The survey included 2,203 men aged 18 to 74, with 70.4% residing in

urban and 29.6% in rural areas. The findings revealed that signs of ED were present in 50.8% of urban and 55.6% of rural respondents, while symptoms suggestive of androgen deficiency were reported by 29.3% and 30.3% of the respective groups [45].

According to a national screening conducted by *Alchinbayev M.* and colleagues (2014), involving 25,000 adult males across Kazakhstan, sexual and reproductive disorders were highly prevalent: ED was identified in 56.3% of participants, reproductive dysfunction in 30.4%, and STIs in 42.4%. A targeted assessment of 26,000 industrial workers showed that reproductive health disorders were present in 63.5% of oil industry employees and 53.2% of those working in the non-ferrous metallurgy sector. Among 3,563 men who underwent comprehensive urological evaluation, 82.3% were diagnosed with at least one condition affecting the reproductive system. The most common diagnoses included chronic prostatitis (33.9%) and benign prostatic hyperplasia (20.1%). Low free testosterone levels were detected in 37.3% of the men. The highest prevalence of chronic prostatitis was recorded in the cities of Aktau (54%), Ust-Kamenogorsk (45%), Taraz (44%), and Astana (42%). During the national “Men’s Health Days” campaign, 458 adolescents were examined, and urological pathologies were identified in 90.3% of them [1].

Collectively, these data illustrate a consistent upward trend in the prevalence of male reproductive dysfunctions, particularly among men aged 30–50 years.

Clinical and non-clinical approaches to diagnosing male reproductive disorders

Organizational aspects of andrological assessment in adolescent and young males

Andrology is a medical discipline that should provide comprehensive monitoring and support for male reproductive health across the entire life span—ideally beginning from the prenatal period and continuing through senescence. This necessity is underscored by the fact that many reproductive, hormonal, genitourinary, sexual, oncological, and psychosocial disorders diagnosed in adult men often have developmental origins in childhood or adolescence, and in some cases, can be traced back to intrauterine or neonatal periods [22]. Without timely diagnosis and routine andrological screening, such conditions may remain undetected and manifest at various stages - before, during, or after puberty - requiring age-specific clinical approaches based on developmental physiology.

Despite this, the coverage of basic urological and andrological services for children, adolescents, and young men remains insufficient. A retrospective study by *Olana S. et al.* (2018) examined male adolescent referrals (ages 10–19) to the andrology department at the Sapienza University Hospital in Rome. Among the 2,855 first-time male patients assessed, only 197 (6.9%) were adolescents. Notably, in 11.7% of these cases, the initial reason for referral was revised following examination—particularly in patients over 15 years old. For 15% of adolescents presenting with sexual complaints, basic education and reassurance were sufficient to alleviate anxiety. Physical examinations proved highly effective, with clinical abnormalities identified in over 60% of adolescent patients, highlighting the importance of routine andrological assessments in this age group [52].

A separate investigation by *Zampieri N. and Camoglio F.* (2020), conducted between 2009 and 2019 at a pediatric urology clinic in Italy, emphasized the role of coordinated outpatient services. Their findings pointed to the importance of interdisciplinary collaboration between primary care providers and specialists during both surgical and non-surgical consultations. Within the study period, the clinic managed 1,436 cases of varicocele, 132 cases of webbed penis, 89 cases of penile curvature, 18 cases of gynecomastia, 39 post-hypospadias repair complications, 14 instances of ED, and 47 cases involving obesity and semen abnormalities. The authors stress the significance of specialized andrology clinics staffed by experienced professionals capable of diagnosing and managing conditions that often emerge during adolescence [77].

Particular attention is warranted for boys and young men with chronic somatic illnesses. Delayed puberty, hypogonadism, infertility, and sexual dysfunction are frequently observed in this group, often resulting from the primary disease, its complications, or long-term pharmacotherapy. Hemoglobinopathies, endocrine disorders, gastrointestinal diseases, and renal pathologies are among the most common contributors to compromised reproductive health. Despite being sexually active and concerned about future fertility, this population is frequently overlooked by healthcare providers when it comes to reproductive counseling. Adolescents and young men with long-standing or severe chronic conditions should be referred to multidisciplinary care teams - comprising endocrinologists, andrologists, geneticists, psychologists, and specialized nurses. Emphasis must be placed on education related to contraception, pregnancy, STIs, and infertility, as well as on organizing a structured and patient-centered transition from pediatric to adult healthcare services [31].

In Kazakhstan, the scope and frequency of diagnostic evaluations for urogenital conditions in children and adolescents are regulated by the Order of the Minister of Health of the Republic of Kazakhstan No. ҚР ДСМ-264/2020, dated December 15, 2020. This order outlines the rules, scope, and timing of preventive medical examinations for key population groups, including children in preschool, school, and vocational or higher education institutions. The initial stage of assessment—conducted by pediatricians, general practitioners, or internists—involves genital examinations and assessment of pubertal development using Tanner staging or puberty charts, with classification into normal, advanced, or delayed development. The specialized phase of screening is performed by surgeons (for cryptorchidism), urologists (for urinary and genital abnormalities), and endocrinologists (for pubertal and hormonal disorders). These examinations are conducted in children and adolescents aged 0–18 years, primarily in school or preschool healthcare settings [12].

Among young men of conscription age, military medical commissions serve as a key mechanism for assessing genitourinary health. The surgeon's evaluation includes palpation of the testes and epididymis, assessment of the spermatic cord and prostate, and screening for conditions such as cryptorchidism, hydrocele, testicular tumors, stones, and prostatitis [13].

It is important to recognize that school-based health screenings and military medical evaluations have the potential to identify andrological problems at early stages. However, their effectiveness is often limited by the restricted scope of examinations, shortage of trained specialists, insufficient focus on sexual and reproductive health, and lack of continuity of care through follow-up monitoring and referrals.

Core diagnostic approaches to evaluating male reproductive function

In contemporary andrological practice, diagnostic procedures are most commonly applied in cases involving reproductive dysfunction, erectile and ejaculatory disorders, oncological conditions (e.g., prior to sperm cryopreservation), and endocrine or inflammatory diseases. The standard assessment protocol typically includes a detailed collection of personal and family medical history, a thorough physical examination, and the use of supplemental imaging techniques such as testicular ultrasound, transrectal ultrasonography (TRUS), or Doppler sonography of the reproductive tract. Hormonal profiling is also an essential component of this evaluation, while semen analysis (spermogram) remains the gold standard in laboratory diagnostics of male fertility potential [38].

Although the rise of telemedicine has shifted clinical priorities toward laboratory and imaging-based assessments, in-person consultations involving clinical history and physical examination remain critical. Physical examination plays a particularly vital role in detecting palpable abnormalities in the testes, epididymis, and spermatic cord, as well as identifying clinical varicocele [66].

In young patients, imaging is frequently employed to assess the prostate and scrotal contents. According to *Vespasiani G. et al.* (1991), ultrasonography is an effective diagnostic tool for identifying acute inflammatory conditions in young men and assists in determining appropriate treatment strategies—whether surgical or conservative [74]. However, the indications for ultrasonographic evaluation extend well beyond

inflammatory disease. Transrectal ultrasound (TRUS) is used to: (1) assess prostate volume for diagnostic or preoperative planning; (2) guide prostate biopsies; (3) identify congenital anomalies; (4) investigate infertility; (5) monitor post-surgical outcomes; and (6) conduct follow-up after treatment of prostate tumors. Scrotal ultrasonography is applied to evaluate: (1) testicular trauma or torsion; (2) inguinal or scrotal masses; (3) scrotal asymmetry or swelling; (4) hernias; and (5–6) clinical or subclinical varicocele [49].

Hormonal assessment and therapeutic intervention are essential in the diagnosis and management of andrological disorders in young men. Evaluating the hypothalamic–pituitary–gonadal (HPG) axis through measurement of testosterone and gonadotropins is especially important in cases of suspected hypogonadism [24]. Early identification of hormonal abnormalities can guide timely intervention and enhance fertility outcomes [23]. A typical hormonal panel includes follicle-stimulating hormone (FSH), luteinizing hormone (LH), testosterone, inhibin B, and serum prolactin. These biomarkers, when interpreted alongside clinical findings, aid in differentiating among various endocrine pathologies, such as age-related androgen deficiency, hypogonadotropic or hypergonadotropic hypogonadism (e.g., Kallmann or Klinefelter syndromes), and prolactinomas [26].

Semen analysis is an integral part of the diagnostic process, encompassing evaluation of ejaculate volume, morphology, motility, and biochemical parameters [63]. It is a fundamental method for assessing reproductive potential and identifying subclinical andrological conditions. Research has shown that many young men without overt symptoms may still exhibit semen abnormalities such as teratozoospermia, asthenozoospermia, or oligozoospermia [57]. Furthermore, semen parameters vary with age: adolescents are more likely to present with normozoospermia compared to older men [56]. However, *Tarnovska A. and Heneha A. (2024)* emphasize that differences in sperm quality are more closely linked to the presence and combination of risk factors than to chronological age alone [70].

A comprehensive uroandrological screening—consisting of semen analysis, physical examination, and blood tests—can enable early detection of a wide range of pathologies, including hypogonadism, varicocele, and even testicular neoplasms [57]. These findings highlight the importance of an integrated andrological evaluation in young men to ensure timely diagnosis and treatment of reproductive disorders.

Use of questionnaires and surveys in the assessment of male reproductive health and sexual behavior

Structured questionnaires and survey tools serve as critical instruments in systematically assessing male reproductive and sexual health. These tools facilitate the collection of standardized and comparable data concerning individuals' knowledge, attitudes, and practices (KAP), while also identifying psychosocial and behavioral determinants that influence male health outcomes. Their importance is especially pronounced in settings with limited access to healthcare services and where topics related to sexuality remain stigmatized [66]. The insights gained from such assessments provide a foundational basis for the development of targeted educational, preventive, and clinical intervention programs.

Modern andrological research has introduced a range of validated instruments for diagnosing reproductive dysfunction, evaluating risk factors, and monitoring sexual health. One such

tool is the Brief Male Sexual Function Inventory (BSFI), which was initially developed to provide normative data on the sexual function of middle-aged men in the United States. The psychometric properties of the BSFI have been thoroughly examined to ensure its reliability and validity, and the tool assesses domains such as libido, erectile capacity, ejaculation, and overall sexual satisfaction [53].

The BSFI has also been used in studies involving men with diverse clinical conditions. For instance, in a study by *Ozumba D. et al. (2003)*, 51 men who had previously sustained pelvic fractures completed the questionnaire two years post-injury. Their responses were compared to those of 53 individuals who had experienced ankle fractures. The pelvic trauma group exhibited significantly lower scores across all sexual function domains—libido, erection, ejaculation, and satisfaction—highlighting sexual dysfunction as a frequent and multifaceted consequence of pelvic injury [54].

Subsequently, the BSFI has been translated and culturally adapted for use in various populations and healthcare contexts across multiple countries. Researchers have consistently noted its ease of application and cross-cultural utility in both clinical and research settings [28, 61, 72]. In 2024, Italian researchers extended its application even further by validating the instrument for use among female respondents, thus demonstrating its versatility across sexes and enhancing its relevance in broader sexual health assessments [55].

In the context of adolescent and young male populations, examining literacy, knowledge, attitudes, and behavioral patterns is particularly important for identifying risk factors and designing preventive strategies. Recognizing this, the United Nations' Programme on Human Reproduction launched a multi-country research initiative between 1998 and 1999, aiming to explore sexual and reproductive health issues among adolescents in developing countries. The goal was to generate actionable evidence to inform interventions capable of improving health outcomes. From 1999 to 2001, 38 projects were funded under this initiative, covering themes ranging from sexual safety and autonomy to gender norms, health-seeking behavior, and the perceived quality of care.

As a result, a toolkit entitled *“Asking Young People About Sexual and Reproductive Behaviours: Illustrative Core Instruments”* was developed. This set included standardized survey templates, focus group guides, and in-depth interview protocols designed for adaptation to specific cultural and research contexts. Researchers emphasized the importance of localizing these tools and conducting rigorous pretesting, especially when instruments are translated into new languages [19].

Fergus S. et al. (2007) reported that the peak of risky sexual behavior occurs during adolescence, particularly around ninth grade in the U.S. school system [35]. In India, a large-scale survey involving 1,140 adolescents and young adults in the southern region revealed that 17.6% (n=201) reported risky sexual practices, while 8.7% (n=99) had experienced sexually transmitted infections (STIs), and only 8% demonstrated adequate knowledge of proper condom use [48]. Other Indian studies confirm the rising prevalence of poor sexual health literacy and risky behavior among male youth [64]. Early initiation of sexual activity without sufficient understanding of protection methods significantly increases the likelihood of contracting STIs, including HIV, and raises the risk of unintended pregnancies and sexual violence. Social taboos

and limited access to reliable information further exacerbate these challenges.

Comprehensive behavioral research plays a vital role in identifying knowledge gaps, cultural influences, and behavioral patterns that shape young men's sexual decision-making. Such data are essential for guiding the design of effective, culturally sensitive interventions and health education campaigns [73, 75].

Comprehensive programs and initiatives for the promotion and protection of male reproductive health

In recent decades, the issue of male reproductive health has increasingly gained prominence in both scientific discourse and public health policy discussions. Nonetheless, at the global level, most healthcare and preventive strategies continue to prioritize women, while the reproductive, sexual, and hormonal health needs of men remain largely underrepresented. Various barriers—including persistent social stigma, limited access to specialized services, and insufficient awareness—impede men's engagement with reproductive health services.

A number of countries have launched targeted initiatives to address these gaps. For instance, the U.S. Department of Health and Human Services began promoting male-focused clinical and educational programs in the mid-1990s, emphasizing family planning, prevention of sexually transmitted infections (STIs), and treatment of sexual dysfunctions [27]. A noteworthy example is a male health clinic in New York designed to serve ethnically diverse youth aged 13 to 30, offering services in STI testing, reproductive health education, and psychosocial support [18]. Another significant initiative, "Man2Man" in Philadelphia, fosters responsibility and sexual health awareness among young men through mentorship and peer-led education [65]. In Canada, the "Men's Sheds" movement—originally designed to promote men's mental well-being—has expanded its scope to include STI prevention and sexual health awareness by creating inclusive spaces for social interaction, screening, counseling, and health education [44]. Australia's public health system has adopted a more institutionalized approach through its National Male Health Policy, which promotes holistic programs targeting infertility, hormonal imbalances, erectile dysfunction, and mental health as a determinant of sexual wellness. One of the central pillars of this strategy is ensuring men's active participation at all levels of health promotion, from guideline development to service delivery integration in primary care settings [62].

At the international level, organizations such as the World Health Organization (WHO) have advocated for life-course and interdisciplinary approaches to male reproductive health. According to WHO's Global Reproductive Health Strategy (2022), health systems must guarantee access not only to basic services but also to advanced diagnostics, hormonal treatment, STI management, and fatherhood counseling [37]. For example, in Iran, culturally adapted mobile clinics and awareness campaigns were implemented to integrate men into family planning services [58].

Kazakhstan has also undertaken national-level initiatives to incorporate male reproductive health into its public health framework. The National Health Development Plan of the Republic of Kazakhstan (2020–2025) highlights the importance of andrological care and the prevention of male infertility [12]. A pioneering example is the nationwide initiative Men and Reproductive Health, introduced by Professor M. Alchinbaev. It remains the first and only comprehensive program in

Kazakhstan addressing male reproductive diagnostics, prevention, and social-medical support. Based on extensive scientific research, the program led to the establishment of Male Health and Family Longevity Centers (MHFLCs) across the country within primary healthcare institutions. Legal authorization for these centers was granted on January 8, 2014, under Order No. 3 of the Ministry of Health, which mandated the inclusion of urology and andrology specialists in the primary care workforce. Concurrently, a Comprehensive Plan for the Development of Uroandrological Services (2014–2019) was implemented to enhance diagnostics, treatment, and rehabilitation for male patients. Evaluation data from 2013 showed that out of 5,648 men examined, 4,928 were placed under dispensary observation and received treatment. The average age of patients was 42.5 ± 8.4 years. The most successful centers operated in Kyzylorda and Zhambyl regions due to full staff capacity and ongoing public awareness campaigns. Conversely, areas such as Akmola, Almaty, East Kazakhstan, and Mangystau regions experienced lower service utilization due to late program rollouts and limited population awareness [1]. The absence of a sustained follow-up or similar programs in subsequent years underscores the urgent need for a strategic overhaul of male reproductive health policy, with attention to regional disparities in service access and public awareness.

Promising directions include expanding digital tools such as online consultations for men's health, implementing self-testing platforms for STIs, and introducing reproductive health education for boys within school health systems. Crucially, the long-term viability of such programs depends on the meaningful involvement of men as partners, fathers, and citizens in shaping culturally sensitive and gender-inclusive healthcare models.

In summary, the development of holistic, evidence-based programs to support male reproductive health requires cross-sector collaboration, political commitment, and sustained public engagement. A systems-level approach—blending prevention, care, and education—is essential to ensure optimal reproductive well-being for men in Kazakhstan and globally.

Conclusion

Male reproductive health is increasingly recognized as a critical component of public health, yet epidemiological evidence reveals a steady rise in reproductive disorders, including infertility, erectile dysfunction, and hormonal imbalance, both globally and in Kazakhstan. Early-life factors, particularly during adolescence and young adulthood, play a decisive role in shaping long-term reproductive potential, highlighting the importance of age-specific screening and preventive strategies. Despite national efforts, such as screening programs and clinical guidelines in Kazakhstan, access to specialized andrological care remains limited, especially in rural areas and among adolescents. Diagnostic approaches—combining hormonal profiling, physical examination, imaging, semen analysis, and standardized questionnaires—are essential for early detection and intervention. Addressing knowledge gaps and integrating multidisciplinary, youth-focused reproductive health services are key priorities for improving male reproductive outcomes.

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