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Introductory Chapter: Broad Impact of Testosterone Research

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1. Introduction

Physiological functions in animals and humans undergo many developmental changes throughout their lifespans. During the fetal period, functional structures of organs are formed, and they undergo maturational changes at multiple developmental stages after birth.

The effects of androgens are broadly classified as organizational and activational effects [1, 2]. Organizational effects refer to the function of androgens in the formation and sexual differentiation of organs, mainly during the prenatal period and puberty. Biologically available androgens exert phasic effects on physiological functions through their activational effect. Organizational effects partly determine the sensitivity of tissues to androgens. Thus, the organizational and activational effects of androgens interact to influence an organism's bodily functions and behavioral patterns.

Testosterone significantly contributes to maturational changes in physiological functions and is the primary determinant of sexually dimorphic traits. Thus, it is crucial in describing the functions and behaviors of organisms to understand how testosterone functions at each stage of development. Considering this, it is natural that testosterone has been and will continue to be the focus of interest for scholars in many academic fields. Here are some examples of disciplines that benefit from the knowledge of testosterone functionality.

1. Owing to the diversity of androgenic functions, deficiency or excess testosterone leads to various malfunctions. The highly prevalent conditions of osteoporosis [3], reduced libido, erectile dysfunction [4], and depression [5] have been linked to testosterone deficiency. Therefore, ameliorating the symptoms derived from hypergonadism or hypogonadism is an important theme in many branches of medical research.
2. Androgens facilitate sexual differentiation and modulate the central nervous system functions. Behavioral endocrinology studies have consistently revealed the role of testosterone in controlling mating and parenting behaviors in wide range of species, including rodents, avians, and humans [6]. In addition, psychologists have revealed an association between peripheral testosterone levels and individual differences in personality and psychological traits such as aggression and impulsivity [7]. Several researchers have argued that the degree of masculinization induced by prenatal exposure to androgens partly determines the cognitive

style and can cause autism spectrum disorders [8]. Thus, in addition to medical and natural sciences, studies on androgenic functions have implications for humanity and the social sciences as well.

2. Relevance of investigation into androgenic function to many research fields

It is difficult to elucidate the functionality of testosterone and the precise mechanism by which it exerts its effects on testosterone. There are several reasons for the difficulties in studying androgen function and its underlying mechanisms. Testosterone modulates and controls physiological functions in combination with other hormones. Therefore, researchers must carefully exclude confounding variables to avoid spurious associations between the phenotype of interest and androgens. Second, there are multiple pathways through which androgens influence target tissues. For example, testosterone and its metabolite, dihydrotestosterone, bind to the androgen receptor, thereby inducing genomic effect on target cell function [9]. Alternatively, testosterone influences cell function indirectly through aromatization to estradiol [10]. Such complexity in an androgenic pathway makes it even more difficult for researchers to narrow down the critical steps to implement effective clinical and practical interventions targeting androgenic functions.

A large amount of knowledge has accumulated about androgenic function, and its underlying mechanisms, and analytical techniques. It should not be overlooked either to consider how to implement regulatory systems that oversee the ethical and safety issues surrounding the practical application of the findings from basic research.


It is beneficial for researchers and practitioners alike in various fields such as internal medicine, molecular biology, veterinary medicine, and evolutionary psychology to gain broad perspectives on the biology and function of testosterone and understand the diversity of academic fields impacted by incorporating insights from testosterone research.

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