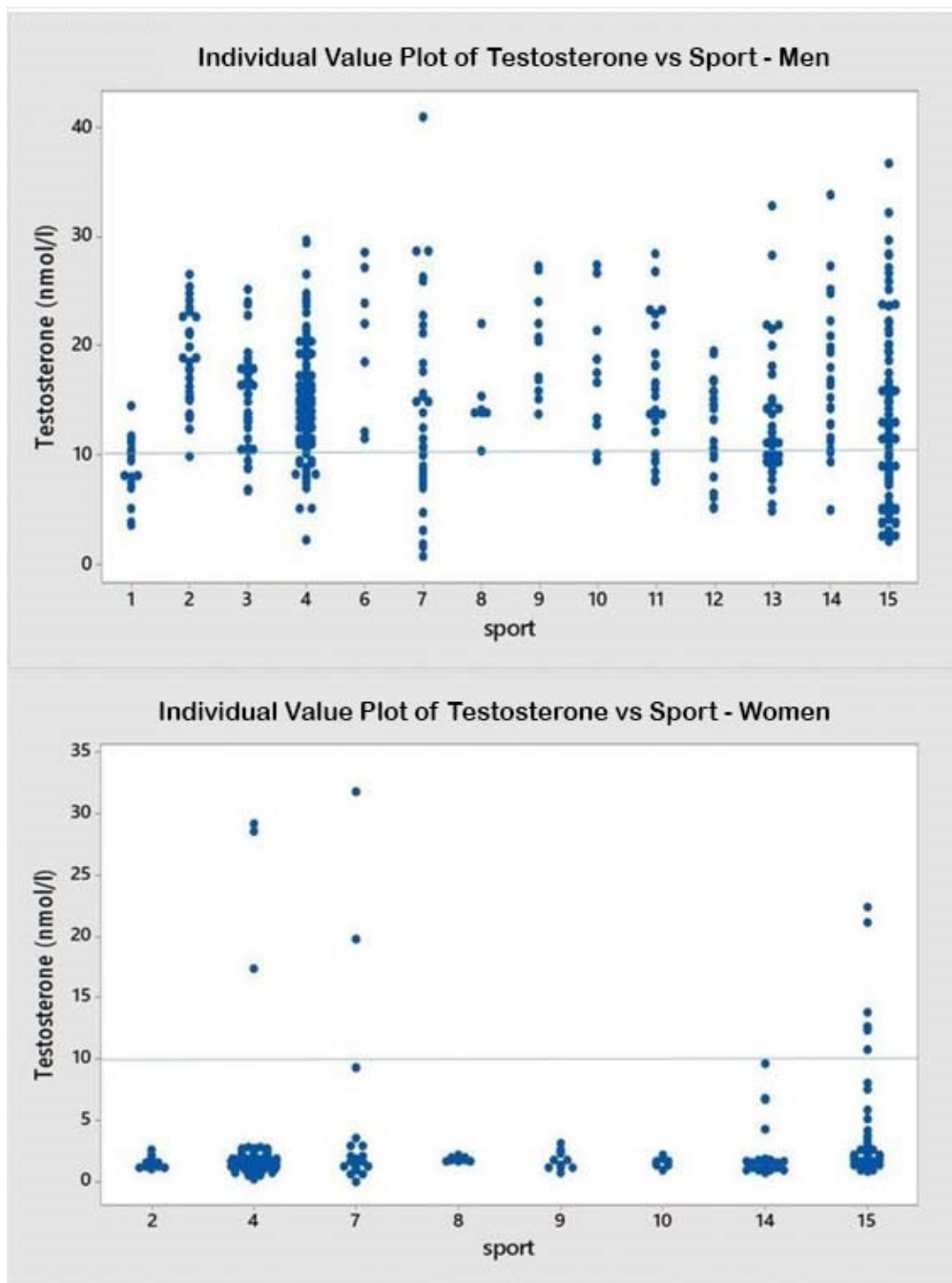




Testosterone Levels in Elite Athletes



Caption: Blood testosterone levels for 676 Olympic-level elite athletes. Individual athletes, represented by blue dots, are grouped by their biological sex (“Men” or “Women”) and sport (1-Powerlifting, 2-Basketball, 3-Soccer, 4-Swimming, 5-Marathon, 6-Canoeing, 7-Rowing, 8-Cross-Country Skiing, 9-Alpine Skiing, 10-Weight Lifting, 11-Judo, 12-Bandy, 13-Ice Hockey, 14-Handball, and 15-Track and Field). Blood samples were collected on a voluntary basis within two hours after the athletes had competed in their events. Sports missing from the plots did not have enough volunteers to be included in the study. None of the athletes were known to be intersex or to have used performance-enhancing drugs.

OBSERVATIONS, NOTES & QUESTIONS	
BACKGROUND INFORMATION	BIG IDEAS, NOTES & QUESTIONS
<p>Testosterone is a hormone that is naturally produced by most vertebrates. In humans, blood testosterone levels typically range from about 0.5 to 2.5 nmol/L in women and 9 to 35 nmol/L in men. Scientists have investigated how testosterone affects a number of characteristics in both sexes, including sexual development and athletic performance. Because some studies have shown that testosterone is associated with increased muscle mass and strength in men, some people have argued that athletes with higher testosterone levels have certain advantages over their competitors.</p> <p>In 2012, the International Association of Athletics Federations (IAAF) and the International Olympic Committee (IOC) created controversial rules that banned anyone with testosterone levels above 10 nmol/L of blood from participating in women's sports events. These rules were based on the argument that individuals with higher levels of testosterone, which are more typical of those in men, would have an unfair advantage in women's events. In 2014, Indian sprinter Dutee Chand was found to have natural testosterone levels above the 10 nmol/L threshold. The IAAF banned her from competing in national women's track events. However, a court case determined that the existing scientific evidence did not justify the IAAF's rules. As a result, the court overturned the decision to ban Chand. Although the IAAF and the IOC have since changed some of their rules, the debate about regulating testosterone levels in competitive sports continues.</p> <p>In a 2018 study, scientists examined the testosterone levels of Olympic-level elite athletes competing in national or international sports events. The scientists measured testosterone in blood samples from nearly 700 athletes to determine whether the levels varied among athletes who competed in different sports. The results were grouped according to the athletes' biological sexes and the sports they competed in. From these data, the scientists made several surprising observations about the athletes' natural testosterone levels. For example, several female athletes had testosterone levels above 10 nmol/L, the threshold that the IAAF had used to ban Dutee Chand from competing. In addition, many male athletes had testosterone levels below 10 nmol/L.</p>	