AN ANTHROPOLOGICAL PERSPECTIVE ON HAND GRIP STRENGTH AS A MARKER OF HEALTH, DISEASE AND FITNESS

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Abstract: Handgrip strength is a quick way to assess overall muscle strength. Low handgrip strength is an indicator of poor health. While handgrip strength is related with mortality and morbidity, for some parameters, handgrip strength is even a stronger predictor of health than chronological age alone. Handgrip strength is highly sexually dimorphic and has a high heritability. It is thought that this is an outcome of sexual selection and intrasexual competition in our evolutionary history. Some anthropological studies confirm this view, and it is claimed that there are relationships between grip strength and aggression, athletic performance and attractiveness, especially in men. The aim of this study is to review the relationship of diseases with handgrip strength in anthropological perspective and examine the idea that handgrip strength being a marker of biological fitness.

Keywords: *Handgrip Strength, Disease Markers, Mortality, Sexual Selection, Fitness*

Sağlık, Hastalık ve Uygunluğun Bir Göstergesi Olarak El Kavrama Kuvvetine Antropolojik Bir Bakış

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Özet: El kavrama kuvveti genel kas kuvvetinin ölçümü için kullanılan hızlı, kolay ve güvenilir bir tekniktir. Düşük el kavrama kuvveti, mortalite ve morbidite ile ilişkili olmakla birlikte, yaşlanmaya bağlı sağlık göstergesi olması açısından, kronolojik yaştan bile daha güçlü bir öngörü gücüne sahiptir. El kavrama kuvveti ayrıca yüksek bir kalıtsallığa sahiptir ve yüksek oranda cinsel dimorfiktir. Cinsiyetler arasında gözlenen kuvvet farkının evrimsel tarihimizde cinsel seçilim ve cinsiyet içi rekabet ile de ilişkili olduğu düşünülmektedir. Bazı antropolojik çalışmalar bu görüşü doğrular şekilde, özellikle erkeklerde kavrama kuvveti ile saldırganlık, atletik performans ve çekicilik gibi olgular arasında ilişkilerin olduğunu ortaya koymaktadır. Bu çalışmanın amacı, el kavrama kuvvetinin sağlık, zindelik ve hastalıkların yanı sıra biyolojik uygunluk ile ilişkisini antropolojik bir bakış açısıyla ele almaktır.

Anahtar Kelimeler: *El Kavrama Kuvveti, Hastalık Göstergeleri, Mortalite, Cinsel Seçilim, Uygunluk*

İnceleme Makalesi / Review Article

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1. INTRODUCTION

As in all other mammals, a well-functioning muscular system is vital for humans. For this reason, muscular strength, along with the muscular health, is an important marker for overall health. However, assessing the overall muscular strength is complicated. Measuring hand grip strength (HGS) is an easier way to assess overall muscular strength in humans (Wind et al., 2010). Although there are different ways and procedures to assess, measuring HGS is fundamentally defined by completing a maximal grip force task using a dynamometer wherein participants are asked to squeeze the device as hard as possible in a short duration (Roberts et al., 2011). In last years, HGS has been used in many disciplines as a very popular method. Evaluating performance in sports (Cronin et al., 2017), diagnosing sarcopenia and frailty in geriatrics (Sousa-Santos and Amaral, 2017), assessing physical condition and post-operative recovery in surgery (Griffith et al., 1989; Hunt et al., 1985) are some examples. In recent years, HGS has been used for evaluating the evolutionary background of muscular strength in evolutionary behavioral sciences as well (e.g. Gallup et al., 2007; Gallup and Fink, 2018).

A decrease in HGS is related with numerous cardiometabolic and neural adverse health conditions (McGrath et al., 2020a; 2018) Low HGS is a predictor of many diseases such as stroke, diabetes, anxiety, anemia, hyperthyroidism, and more importantly coexisting chronic diseases: multimorbidity (Cheung et al., 2013; Cetinus et al., 2005; Halaweh, 2020). Moreover, some studies associate lower handgrip strength with premature deaths which has a great impact on public health (Kim, 2022). Low HGS is highly predictive of health and as a matter of fact, HGS may be a more reliable marker of health and morbidity than chronological age alone (McGrath et al., 2020b; Syddall et al., 2003; Cheung et al., 2013).

2. HANDGRIP STRENGTH AS A MARKER OF HEALTH AND DISEASE

Sarcopenia is defined as the loss of muscle mass while dynapedia is the loss of strength with aging (Kalyani et al., 2014). Handgrip strength is an important tool for diagnosing and monitoring of these conditions (Sousa-Santos and Amaral, 2017) Measurement of HGS has become almost a standard procedure in many such clinical and epidemiological cases due to its inexpensiveness and ease of application, and in recent years, national health databases have included HGS into their protocols (McGrath et al., 2020a).

Along with the issues related with aging processes, HGS is a marker of nutrition (Norman et al., 2011), old age disability (Rantanen et al., 1999), risk of cardiovascular disease (Welsh et al., 2020), neural diseases, diabetes, mortality and morbidity (Buchman et al., 2007; Jiang et al., 2022; Cetinus et al., 2005; Musalek and Kirchengast, 2017; Kim, 2022). Diseases related with decreased HGS are associated with many biological systems. The possible responsible mechanism of weakness in skeletal muscles and various diseases has been discussed for a long time. In this context, it would be beneficial to take a glance at the conditions of different biological systems that are related with HGS.

3. Handgrip Strength, Metabolic and Cardiovascular Disorders

Cardiovascular health is vital for blood circulation and homeostasis. Cardiovascular disease (CVD) is the worldwide leading cause of death (Barquera et al., 2015). Identifying the biological markers of CVD is important for treatment and prevention of it. There is a relationship between lower HGS, CVD and its markers (Welsh et al., 2020; Lawman et al., 2016; Jang et al., 2020; Gale et al., 2007). In a study conducted by Welsh et al. (2020) on a large sample (n = 406.834), they suggested an inverse relationship between handgrip strength, gait speed and risk of

cardiovascular disease when general risk factors were controlled. In another study by Leong et al. (2015) on a sample of 142.861, they found that decreased HGS is related with deaths caused by CVD, stroke and myocardial infarction. Additionally, they revealed that HGS is even a stronger predictor of mortality than systolic blood pressure alone.

Metabolic syndrome (MetS) is a condition defined as the co-existence of some of the cardiovascular risk factors such as obesity, insulin resistance, atherogenic dyslipidemia and hypertension. Those risk factors usually tend to be clustered and share a common biological background. For this reason, they are considered under a separate definition as metabolic syndrome (Huang, 2009; Kassi et al., 2011). Many studies have been carried out on different populations that have addressed the relationship between muscle strength and metabolic disorders. Most of them revealed a relationship between decreased handgrip strength, MetS and its components (Wu et al., 2019; Kawamoto et al., 2016; Ji et al., 2020; Sayer et al., 2007). In a cross-sectional study by Wu et al. (2019) on a sample of 17.703 aged 40 years and older, they revealed that decreased HGS is related not only with MetS but higher triglyceride levels, higher waist circumference, higher fasting blood glucose, lower high-density lipoproteins (HDL) and higher blood pressure. They have concluded that this relationship may be explained by the role of skeletal muscle on insulin resistance and sensitivity.

Given that skeletal muscle has a role on insulin balance, it is expected to see a relationship between decreased muscle strength and diabetes. Studies suggest a relationship between type-2 diabetes and muscular strength. In a study conducted on six different ethnic groups by Van Der Kooi and his colleagues (2015), when other effects such as socio-demographic parameters or body composition were controlled, they revealed a relationship on all six ethnic groups suggesting that lower handgrip strength is related with risk of type-2 diabetes. Each 10 Newton increase in muscle strength corresponds to a 0,95 (95% CI: 0,93 – 0,97) reduction in the risk of developing type-2 diabetes.

In the light of these findings, it is possible to say that metabolic and cardiovascular diseases are in a relationship with skeletal muscle structure and that these diseases may share a common biological basis. In addition to these, lower HGS is also a sign of multimorbidity, that is, the coexistence of more than one chronic disease (Cheung et al., 2013). Therefore, it is important to consider muscle strength in studies to be carried out on the diagnosis and treatment of these diseases.

3.1. Handgrip Strength and Neural Disorders

Although the decrease in muscle strength is generally associated with the loss of muscle mass (sarcopenia) that occurs with aging, there are also views suggesting that this process is related to the degeneration of the neural systems (e.g. Manini et al., 2013; Clark et al., 2019). For this reason, it is thought that the neural degeneration that occurs with aging may result in low muscle strength. For this reason, investigating the relationship between neural disorders and HGS is important in terms of understanding these processes.

In the study conducted by Jang and Kim (2015) on a Korean sample of elders, a significant relationship was found between mild cognitive impairment and low handgrip strength. Similarly, in a study conducted by McGrath et al. (2019) on 13,828 Americans, an increase in cognitive impairment of 1.10 to 1.18 was observed for every 5-kilogram decrease in grip strength.

Mild cognitive impairment is a marker of dementia and Alzheimer's disease, and mild cognitive impairment is defined as a transitional process from normal cognitive health to Alzheimer's (see

Gauthier et al., 2006; Palmer et al., 2007; Su et al., 2021). Similar with cognitive impairment, studies also reveal a relationship between low muscle strength and Alzheimer's disease (Buchman et al., 2007; Su et al., 2021). Additionally, HGS is also associated with a number of psychological conditions. In a study conducted by Jiang et al. (2022), in which more than 40,000 participants were examined, higher HGS was associated with better cognitive ability, higher life satisfaction, well-being, less depression and anxiety. It was also suggested that higher HGS is related with increase in grey matter in brain especially in subcortical and temporal regions. Accordingly, low HGS seems to be related not only to the decrease in muscle mass and strength due to aging, but also to the neural degeneration in this process.

3.2. Handgrip Strength and Other Health Parameters

As a general health marker, decreased HGS is associated with a number of health parameters and biological traits, along with metabolic and neurological diseases. According to the studies, hand grip strength is related to nutritional status (Norman et al., 2011), depression (Ashdown-Franks et al., 2019), sleep quality (Lee et al., 2018; Laredo-Aguilera et al., 2019), non-alcoholic fatty liver disease (Kim et al., 2019), chronic kidney disease (Lee et al., 2021), bone mineral density in postmenopausal women (Kritz-Silverstein and Barrett-Connor, 1994), vitamin D levels in young adult women. (Von Hurst et al., 2013)

General life expectancy provides information on many issues such as the quality of life of a society and the health system. For this reason, premature death has a great impact on public health. Studies show a relationship between low muscle strength and premature death (Kim, 2022). Ortega et al. (2012) observed more than one million Swedish male adolescents aged 16-19 for 24 years. In the study, it was discovered that having higher muscle strength in adolescence reduces the risk of premature death by about 20-35%. This finding suggests that HGS is a health marker not only in geriatric populations, but also in earlier stages of life. In this respect, in order to discuss the idea that physical strength is a "phenotype quality" marker in our evolutionary process, it would be useful to examine the evolutionary background of the great difference between the sexes in physical strength.

4. INTRASEXUAL COMPETITION AND SEXUAL DIMORPHISM OF PHYSICAL STRENGTH

Total body size is a strong indicator of capacity for physical strength. Although compared to other great apes, body size sexual dimorphism is smaller in humans, physical strength is strongly sexually dimorphic (Isen et al., 2014; Plavcan and Van Schaik, 1997; Plavcan, 2012). Studies show that human males are 15 – 20% heavier and 7-8% taller than females (Isen et al., 2014) but are 90% stronger in upper body. This difference can be explained by the fact that men have 61% more total muscle mass and 75% more arm muscle mass (see Lassek and Gaulin, 2009).

It seems that total physical strength or body size are not the only sex difference that contribute to competition or fighting ability. Some studies report that men generally have larger lung capacity, stronger bones, faster mental rotation and spatial visualization. Additionally, men differ from women in ability to perceive and respond rapidly to threats, estimate the trajectory of thrown objects, resist blunt-force trauma, and accurately intercept incoming objects. (Sell et al., 2012; Gursoy, 2010; Schoenau et al., 2001; Maeda and Yoon, 2013; Der and Deary, 2006; Watson and Kimura, 1989) Men also differ in their thermoregulatory system allowing them to dissipate heat more easily, their sweat capacity is larger and they are more resistant to dehydration. (Sell et al., 2012; Burse, 1979)

It is thought that the driving factor of the difference in muscle mass and strength is very likely to be testosterone. (Chiu et al., 2020; Bhasin et al., 2001; Page et al., 2005) Testosterone is responsible for developing secondary sexual characteristics in human as well as increasing the muscle mass and causing the divergence in physical strength in sexes. Some studies also report a relationship between -as a prenatal testosterone marker- digit ratios and HGS (Fink et al., 2006; Zhao et al., 2012; Ribeiro Jr. et al., 2016) suggesting that physical strength is also related with exposure to androgenic hormones in utero. However, while the idea that digit ratios are markers of prenatal androgen exposure is still a topic of debate, when studies on this issue examined together, it turns out that the effect is quite weak and still open for debate (see Pasanen et al., 2022).

That difference is thought to be a product of a sexual selection. This argument has long been debated. Darwin (1871), in his book, "The Descent of Man" stressed that issue. He proposed that the greater size, strength and pugnacity of the male have been acquired through a sexual selection. In the following decades, the origin of sexual dimorphic features in primates, especially in humans have been studied frequently.

Consistent with the Darwin's view, modern sexual selection theory proposes that males had to obtain reproductive advantage over other males by physical power and exclude them from mating. (Plavcan and Van Schaik, 1997) According to this idea, if large bodies were advantageous in a competition, large bodies should be selected under the sexual selection. Thus, it is expected that more dominant individuals of the group should be more successful at mating. Outcomes of the studies on primates seems consistent with this hypothesis. While dominance rank and mating success is related (Cowlishaw and Dunbar, 1991), species that exhibit less physical aggression tend to be less sexually dimorphic. (Plavcan and Van Schaik, 1997; Plavcan, 2012) Given the fact that the main cause of domestic violence is male sexual jealousy and suspicion of infidelity across cultures, sexual selection theory appears to be explanatory. (Plavcan, 2012; Lepowsky, 1994; Chagnon, 1988; Daly and Wilson, 1988) One other reason to assume sexual dimorphism is related with sexual selection is that sexual dimorphism increases in adolescence, when sexual behaviors and ability to reproduce bursts.

However, the view that the main factor in the formation of sexual dimorphism in primates is competition between males and sexual selection cannot be confirmed in all species. One of the criticisms brought to this subject is that causes of the size dimorphism in primates is multifactorial and that natural selection is an important reason for this difference is often overlooked (see Cassini, 2020).

If sexual dimorphism in HGS is a consequence of intrasexual competition and males with higher physical strength were advantageous, it is expected to see a relationship between behavioral patterns related with reproduction and handgrip strength in modern humans. Some studies are confirmative to this hypothesis. For instance, Gallup et al. (2007) claimed that HGS is correlated with aggressive behavior, age at first sexual intercourse and sexual promiscuity in men but not in women (but see Shoup and Gallup, 2008). They concluded that HGS may be a signal of "genetic quality" in men.

4.1. Handgrip Strength as a Fitness Indicator

Evolutionary fitness is a concept used to describe an individual's survival and reproductive success (Demetrius and Ziehe, 2007). Although altruistic and cooperative behaviors are common in nature, one of the main factors that increase reproductive success in animals is the success

achieved in physical competition and fighting. Some researchers have suggested that there is a strong correlation between fighting ability and HGS in humans (Guidetti et al., 2002; Iermakov et al., 2016; Sariman et al., 2014; Muñoz-Reyes et al., 2012). It is thought that high physical strength and grip strength are advantageous in many aspects in intrasexual competition. Increased upper body strength might have been advantageous in use of propelled weapons such as spears, arrows, stones, etc. (Sell et al., 2012). In addition, physical strength may have provided advantages in protection from predators, hunting and tool production (Sell et al., 2012; Bardo et al., 2021). For example, Apicella (2014) revealed that handgrip strength is positively associated with hunting abilities in Hadza hunter-gatherers. In modern hunter-gatherers, better hunters are more successful in terms of reproduction, and they have higher number of offspring and higher survival rate (Smith, 2004). In particular, hand grip strength is thought to be advantageous in terms of shaping objects and making tools (Young, 2003; Marzke et al., 1992).

Considering the great impact of these skills on the evolutionary history, the idea that higher muscular strength is positively selected, especially in males, seems plausible. From the perspective of sexual selection, strong males are expected to exhibit distinctive traits to be selected. People may intuitively know strong men. In the studies conducted by Sell et al., (2009; 2010), the participants were shown photos of men and listened to male voices and asked to rate them in terms of "physical strength" or "toughness in a fight". Responses of the participants correlated almost perfectly with one's body strength ($r = 0,96$ for photos, 0,98 for sounds). Consistent with the sexual selection theory, in modern humans, cues of upper body muscularity and formidability seem to be very important criteria for mate choice. Sell et al., (2017) documented that estimates of physical strength determined over 70% of men's bodily attractiveness by women. In addition, studies demonstrated that HGS is influenced by genetic factors (Reed et al., 1991) and the estimates of heritability are sexually dimorphic (Isen et al., 2014).

4.2. Handgrip Strength and Measures of Sexual Selection

If there was a sexual selection that resulted with stronger and larger males, it is expected to see relationships between physical strength and other measures of intrasexual selection such as aggression and dominance. In recent years, numerous studies examined the relationship between HGS and various parameters on different populations in this context.

For example, studies show that aggression is positively related with HGS but -as expected- mostly in men. (Ribeiro Jr. et al., 2016; Gallup et al., 2007; Shetty et al., 2016; Archer and Thanzami, 2007) Perceived dominance and aggression are also connected with HGS (Windhager et al., 2011; Gallup et al., 2010; Fink et al., 2007). This is not unexpected since some studies report a relationship between facial shape, HGS and -as a prenatal testosterone marker- digit ratios. What they found in common is that men with higher HGS tend to have wider and rounder facial shape with more pronounced squarer lower face outline (Windhager et al., 2011; Butovskaya et al., 2018).

As suggested in some studies, humans appear to know stronger men intuitively by their faces and voices (Sell et al., 2009; 2010; Kleisner et al., 2021). There may be an explaining mechanism which helps to recognize testosterone markers from the faces and voices. Moreover, some studies report a relationship between handgrip strength and facial masculinity (Windhager et al., 2011; Fink et al., 2007). This might be additionally important since the immunocompetence hypothesis suggests that masculine faces are honest indicators of health. Although some studies suggest a connection between facial masculinity and health status (e.g. Rhodes et al., 2003; Thornhill and Gangestad, 2006) it is still a controversial subject.

There are also studies showing the relationship between hand grip strength and facial attractiveness (e.g. Fink et al., 2007; Shoup and Gallup, 2008; Gallup et al., 2010). Attractiveness is an important factor in reproduction. Supporting this point of view, relationships between physical strength and reproductive parameters have also been discovered. In a study by Sun et al. (2022) (n =1382), a relationship was found between handgrip strength and sperm count, motility and concentration. It has also been claimed that higher HGS has a positive correlation with the number of sexual partners and an inverse correlation with the age at first sexual intercourse (Shoup and Gallup, 2008; Gallup et al., 2007; Sneade and Furnham, 2016).

Hand grip strength also seems to have a relationship with male-typical body. For example, the shoulder-to-waist ratio (SHR) is a frequently studied measure in this regard. Higher SHR is associated with a wider shouldered male body shape, popularly described as a "triangle". It is thought that the driving factor in the formation of this body type is testosterone, which causes an increase in muscle mass, especially in the upper body (Tanner, 1981; Gallup et al., 2007). While researchers have reported an association between higher SHR and higher HGS, they also suggested that men with higher SHR have more sexual partners (Gallup et al., 2007; 2010 Hughes and Gallup Jr., 2003).

Studies investigating the relationships between sexual selection measures and HGS have only begun to draw attention in the last fifteen years and have been increasing in number. Although these studies sometimes report contradictory results, when examined as a whole, it is seen that the suggested relationships are mostly more pronounced in men, and data is insignificant or contradictory in women. This may confirm the idea that the main element of sexual selection for physical strength is men. Comprehensive research and meta-analysis on the subject will provide a better understanding of this subject in the coming years.

5. CONCLUSION: PROBLEMS AND RECOMMENDATIONS

The fact that the muscular system has an evolutionary history of approximately 560 million years (Liu et al., 2014) indicates that it has a long evolutionary interaction with other biological systems. Considering the role of mobility in survival and reproduction in living things, it is expected that muscles will be affected by changes in other systems. In the light of the findings in the literature, it can be said that hand grip strength as a measure of muscular strength is a strong health marker. In humans, many cardiovascular, metabolic, neural, and even psychological health conditions are associated with decreased muscular strength (McGrath et al., 2020a). The fact that it provides information about general life expectancy and is a stronger marker for some parameters than chronological age (Cheung et al., 2013; McGrath et al., 2020b; Syddall et al., 2003) supports that muscular strength can provide information about the functionality of other biological mechanisms beyond mobility.

The most rational and accepted explanation for the sexual dimorphic nature of physical strength seems to be sexual selection and intrasexual competition. The fact that it emerges and increases together with other sexual dimorphic features and this difference becomes evident during adolescence, just when reproductive ability bursts, suggests that the gender-related difference in physical strength has a sexual selection-based background. And the fact that in other primates, sexual dimorphic characteristics differ according to the reproductive strategy in the group, dominant individuals are more successful in reproduction in some species (Cowlishaw and Dunbar, 1991), and the level of sexual dimorphism varies depending on the aggression levels of the species (Plavcan and Van Schaik, 1997; Plavcan, 2012) supports this view.

In humans, the sexual dimorphism of physical strength is prominently higher than the dimorphism in stature and total body mass (Isen et al., 2014; Plavcan and Van Schaik, 1997). Just as with sex-specific characters that develop under the influence of testosterone, differences in physical strength are thought to originate from sexual selection. Although the results of studies conducted between sexual selection marker traits and various parameters to test this idea vary, the general finding of the studies is that these markers are mostly specific to males. This may indicate that the main element of the selection pressure for physical strength is men. While the data supports the explanation of sexual selection, the relationships between the characteristics of mate selection and reproductive success and other markers are also interesting. For example, the relationship of HGS with aggression, attractiveness, number of partners, and face shape strengthens the idea of sexual selection. Similarly, the relationship of HGS with hunting and reproductive success in modern hunter-gatherers is also remarkable in this context.

Its high heritability, being a strong marker of many diseases, high sexual dimorphism, and its association with reproductive parameters suggest that hand grip strength may be a marker of evolutionary fitness (Gallup and Fink, 2018; Gallup et al., 2007). Although there are studies suggesting that muscle strength may have provided advantages for hunting, tool production and use, and especially for sexual competition in the evolutionary process, it should be noted that the discussions in this area are relatively new and the findings are based on relatively few studies. On the other hand, it should be noted that these studies carried out with the reverse engineering method are not yet based on strong hypotheses and evidence.

Research on the evolutionary background of human behavior and morphology is increasing every day. However, evolutionary behavioral sciences, as a retrospective discipline, are relatively open to speculative interpretations by their nature. Although civilization and technology are advancing at an accelerating pace, the tools we use to understand nature, people and their behaviors are relatively insufficient considering the complex and diverse cultural structure of human beings. For this reason, it is of course important to remain cautious about the data obtained and the methodology used. Although experimental and observational studies on the evolutionary basis of human behavior has been a very popular area of discussion, it should be noted that the reproducibility crisis is more prominent in this area which has emerged in many areas (for discussion, see Ertuğrul, 2019). Interesting findings from studies in the field of evolutionary-behavioral sciences conducted on small samples of university students, mostly in Western societies, usually disappear or the effect size is seen to be much lower than expected in studies of larger groups (e.g. Pound et al., 2014) or meta-analyses (e.g. Van Dongen, 2012; Van Dongen and Gangestad, 2011). On the other hand, another criticism to be brought to such studies is that the significant findings of these studies are mostly based on simple correlations (e.g. Gallup et al., 2007; Sell et al., 2012). The fact that there is a linear relationship between the two variables does not mean that the first variable (e.g. upper body strength) is the cause of the change in the second variable (e.g. number of sexual partners, attractiveness, reproductive success). There may be many factors affecting the relationship between variables (e.g. income level, medical history, education level). Thus, it is necessary to carry out such studies on HGS by performing multivariate analyzes.

Another frequently overlooked problem in disciplines investigating the evolutionary background of human behavior is the difficulty in defining concepts such as 'reproductive success' or 'evolutionary fitness'. Contrary to popular belief, these concepts are not static, but dynamic concepts which are affected by many parameters. In these studies, indirect markers and ratios are often used (e.g. the use of factors such as number of partners, number of offspring,

promiscuity for reproductive success). These indirect uses include some biological markers (e.g. finger ratios, waist-to-hip ratio, facial ratios, fluctuating asymmetry). Aside from the question of how reliable the findings from the relationship of indirect markers to another indirect marker are, the use of ratios (e.g. finger ratios, face ratios) in biology is also a controversial topic (see Atchley et al., 1976; Kronmal, 1993; Kratochvíl and Flegr, 2009; Ertuğrul and Aydık, 2023).

However, regardless of culture, people seem to have a certain set of common behavioral characteristics (Brown, 1991). It is of course possible to evaluate these features, which are defined as 'human universals', in an evolutionary framework. However, during this evaluation, it would be useful to consider the dynamic and flexible structure of concepts 'human' and 'culture' and to avoid reductions. In this respect, although it is frequently exposed to critical comments, many valuable studies have emerged in recent years in the evolutionary behavioral sciences which are mostly large-scale covering many cultures and included multivariate statistical analyses (e.g. Conroy-Beam et al., 2019; Walter et al., 2021). For this reason, methodological criticism is valuable for the development of the discipline and ultimately for understanding people.

Although studies and information on the relationship between hand grip strength and health parameters have a long history, studies focusing on the relationship between evolutionary adaptation and HGS have only a history of the last 10 – 15 years. It should be noted that most of our knowledge on this subject is based on studies conducted on Western societies. For this reason, it is important that new studies be carried out especially in non-Western countries such as Turkey. On the other hand, taking a cross-cultural approach and conducting studies on larger samples will undoubtedly lead to more reliable results when examining HGS and other parameters.

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GENİŞLETİLMİŞ ÖZET

İnsanlarda genel kas kuvvetini değerlendirmek için el kavrama kuvvetinin (EKK) ölçümü hızlı, kolay ve tutarlı bir tekniktir. El kavrama kuvveti, spor performansının değerlendirilmesi, yaşlılığa bağlı komplikasyonların tespiti, ameliyat sonrası iyileşmenin takibi gibi birçok amaçla farklı disiplinler tarafından kullanılmaktadır. Ayrıca son yıllarda insanlarda kas kuvvetinin evrimsel arka planını incelemek için birçok çalışma EKK'yi kullanmaktadır. Çalışmalara göre düşük EKK birçok kardiyometabolik ve nöral sağlık durumuyla ilişkilidir. İnme, diyabet, anksiyete, anemi ve birden çok kronik rahatsızlığın bir arada seyrettiği metabolik sendrom ile düşük EKK korelasyon içerisindedir. Ayrıca EKK, mortalite, yaşam beklentisi, yaşlılık kalitesi gibi olgularla da ilişkilidir. Hatta EKK'nin sağlık ve hastalık açısından kronolojik yaştan bile daha güçlü bir işaretçi olduğu düşünülmektedir. Kavrama kuvveti ayrıca beslenme durumu, uyku kalitesi, kemik mineral yoğunluğu, D vitamini seviyesi gibi diğer parametreler için de istatistiksel tahmin gücüne sahiptir.

Kas sisteminin evrimsel öneminin yanı sıra, EKK'nin güçlü bir sağlık işaretçisi olması ve yüksek kalıtsallığa sahip olması, ilgili disiplinleri, insan evriminde kas kuvvetinin bir "fenotip kalitesi" ölçütü olma ihtimalini araştırmaya itmiştir. Total vücut boyutu fiziksel kuvvet ve rekabet ile doğrusal bir ilişkiye sahiptir. Diğer primatlarla karşılaştırıldığında insanlarda cinsel dimorfizm daha az olsa da hem toplam kas kütlesi hem de vücut boyutları açısından insanlar yüksek bir cinsiyetler arası fark göstermektedir. Bu farklılaşmanın temelinde önemli oranda testosteron rol oynamaktadır. Testosteron ikincil cinsiyet özelliklerinin gelişmesinin yanı sıra kas kütlesinin de artmasını sağlayarak cinsiyetler arası fiziksel kuvvet farkını arttırmaktadır. Bu farklılaşmanın evrimsel arka planında cinsel seçilimin rol oynadığı düşünülmektedir. Darwin'den beri var olan bu fikrin temelinde erkeklerin dişiler için rekabet etme zorunluluğu fikri yatmaktadır. Modern cinsel seçilim teorisi üzerine yapılan çalışmalar da bu fikri destekler niteliktedir. Yaşayan primat türlerinde gözlemlenen fiziksel saldırganlık arttıkça cinsel dimorfizm oranı da artmaktadır. Bu fikri destekleyen bir olgu da cinsiyetler arası farkın ergenlik döneminde, yani üreme yetilerinin kazanıldığı dönemde hızla artmasıdır.

Yüksek fiziksel kuvvetin alet yapma, yırtıcılardan korunma, silah kullanma gibi birçok konuda da avantaj sağladığı ve üreme başarısını arttırdığı düşünülmektedir. Örneğin modern avcı-toplayıcılarda daha başarılı avcıların daha çok çocuk sahibi olduğu ve daha yüksek hayatta kalma oranlarına sahip olduğunu gösteren çalışmalar mevcuttur.

Fiziksel kuvvette görülen farklılaşmanın temeli büyük oranda intraseksüel rekabet ise özellikle insanlarda görülen bazı davranışsal işaretçiler bu olguyu desteklemelidir. Bazı araştırmacılar yüksek EKK'nin erkeklerde saldırgan davranış, ilk cinsel ilişki yaşı ve cinsel partner seçiciliği ile ilişkili olduğunu öne sürmüştür. Üreme ile alakalı olarak sperm kalitesi ile ilgili bazı biyolojik parametrelerin de EKK ile ilişkili olduğunu öne süren çalışmalar mevcuttur.

Fiziksel kuvvetin erkekler için üreme açısından avantaj sağlaması için bazı fiziksel işaretçilerle uyumlu olması gereklidir. Çalışmalar erkeklerde fiziksel kuvvetin üst vücuttaki işaretçilerinin erkeklerde çekicilik oranını büyük oranda açıkladığını ileri sürmektedir. Ayrıca bazı çalışmalar insanların seslerden ve görsellerden kişilerin fiziksel kuvvetini çok yüksek oranda tahmin edebildiğini göstermiştir. Önemli bir iletişim aracı olarak yüz şekli de bu konuda rol oynamaktadır. Daha maskülen yüzlerin daha çekici bulunduğunu öne süren çalışmalar bulunmakla birlikte, farklı toplumlarda yapılan geometrik morfometri temelli çalışmalar da maskülen yüzlerin yüksek EKK ile ilişkili olduğunu göstermiştir.

Gelişim sürecinde diğer ikincil cinsiyet özellikleriyle birlikte ortaya çıkması, üreme çağında bu etkinin artması, diğer primatlarda fiziksel güç ve üreme stratejileri arasındaki ilişki, bugün fiziksel kuvvetin cinsel dimorfik yapısının en mantıklı evrimsel açıklamasının cinsel seçilim ve cinsiyet içi rekabet olduğunu göstermektedir. Yapılan çalışmalarda birçok farklı kriter ve işaretçi kullanılsa da bu çalışmaların ortak bulgusu EKK ile alakalı parametrelerin genelde erkekler özelinde anlamlı bulgular ortaya çıkarmasıdır. Bu da cinsel rekabet sürecinin erkekler özelinde olduğu fikrini desteklemektedir.

Yüksek kalıtsallığı, güçlü bir sağlık işaretçisi olması, yüksek cinsel dimorfik dağılım göstermesi ve üreme ile alakalı parametrelerle olan ilişkisi EKK'nin bir "evrimsel uygunluk" işaretçisi olduğunu düşündürse de bu konu üzerine yapılmış çalışmalar henüz son birkaç on yılda popülarite kazanmıştır. Ancak alan yazınında çelişkili sonuçlar ortaya koyan çalışmalar da mevcuttur. Ayrıca "tersine mühendislik" yöntemi ile ilerleyen söz konusu çalışmalar henüz güçlü hipotezler ve verilere dayanmamakla birlikte alan yazınında bir konsensüs henüz mevcut değildir. Ayrıca retrospektif bir alan olarak evrimsel davranış bilimleri yapısı gereği spekülatif yorumlara açıktır. Örneğin bazı çalışmalar daha büyük örneklemlerde yapıldığında etki oranının düştüğünü ya da kaybolduğunu gözlemlemek mümkündür. Ancak yine de uzun yıllardır yapılan çalışmalar göstermiştir ki kültürden bağımsız olarak insan toplumları ortak bir takım davranışsal özelliklere sahiptir. 'İnsan evrenselleri' olarak tanımlanan bu davranışsal özellikleri evrimsel bakış açısıyla ele alırken 'kültür' ve 'insan' gibi kavramların dinamik ve değişken yapısını göz önünde bulundurup indirgemelerden kaçınmak gerekmektedir. Bu açıdan son yıllarda birçok eleştiri alsa da evrimsel davranış bilimleri alanında birçok kültürü kapsayan, çok değişkenli istatistiki metotların kullanıldığı kıymetli çalışmalar da üretilmiştir.

Sağlık ve el kavrama kuvveti üzerine yapılmış çalışmalar görece daha eski bir geçmişe sahip olsa da bu ilişkinin evrimsel arka planını araştıran nitelikteki çalışmalar ancak son 10-15 yılda artmaya başlamıştır. Ayrıca bu çalışmalar çoğunlukla batılı örneklemler üzerinde gerçekleştirilmiştir. Bu açıdan Türkiye gibi batılı olmayan toplumlarda benzer çalışmaların gerçekleştirilmesi ve veri havuzunun genişletilmesi EKK ve diğer parametreler arasındaki ilişkiyi anlamaya çalışmamızda önemli rol oynayacaktır.