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Erectile dysfunction and its correlates among the Ariaal of northern Kenya

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To expand our crosscultural understanding of erectile dysfunction, we investigated erectile dysfunction among Ariaal men, pastoral nomads of northern Kenya. To measure erectile dysfunction, we administered the International Index of Erectile Function (IIEF-5) to 198 men aged 20 y and older during interviews. Marital status and anthropometric measures of body composition were also obtained. Men were classified into 10-y age groups. ANOVA revealed that erectile dysfunction increases with age ($P<0.0005$), with men 60 y and older showing significantly higher erectile dysfunction compared with men in their 20s, 40s and 50s. In a MANCOVA model, erectile dysfunction increased with age group ($P<0.001$), was negatively related to right-hand grip strength ($P<0.01$) and negatively related to number of wives ($P<0.05$). In addition, there was a significant interaction between age group and marital status ($P<0.01$). Erectile dysfunction showed no independent relationship to measures of body composition, including body mass index, fat free mass and percentage body fat. These findings provide further evidence of age-related increases in erectile dysfunction, even when factors commonly associated with erectile dysfunction (eg, metabolic complications of obesity, use of medicines causing erectile dysfunction) are absent. The finding that number of wives is negatively related to erectile dysfunction may represent the specific cultural conditions (political power and wealth) associated with polygyny among the Ariaal.
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Introduction

Increasing erectile dysfunction with age appears to be a robust aspect of male senescence. Following the well-publicized age-related increase in erectile dysfunction observed by the Massachusetts male aging study,[1] age-related increases in erectile dysfunction have subsequently been reported in numerous epidemiological studies.[2–6]

Part of the age-related increase in erectile dysfunction is related to health conditions, including metabolic dysfunction. Type II diabetes,[7] hypertension and heart disease[8] and other health complications[9] are all associated with elevated risk of erectile dysfunction even after controlling for age. Medications such as SSRIs, antihypertensive drugs and cancer chemotherapeutic agents also increase the risk of erectile dysfunction.[9]

Here, we investigate erectile dysfunction among the Ariaal, pastoral nomads of northern Kenya. The Ariaal exhibit very different energetic and sociocultural conditions compared to populations in which erectile dysfunction has been previously investigated. Of note, the Ariaal show high energy expenditure, low food intake, a low body mass index (BMI),[10] little access to medications causing erectile dysfunction, and may marry polygynously and father children well into old age.

Thus, we test a series of predictors concerning erectile dysfunction among the Ariaal. First, does erectile dysfunction increases with age? Second, does erectile dysfunction increase with BMI as it does in western samples, because of the metabolic complications associated with excess fat? Third, does grip strength, as an indicator of general physical functioning, predict erectile function? Grip strength has demonstrated associations with depression[11] and mortality[12] in age-related epidemiological studies, and thus may have value as a readily

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assessed index of physical function. Lastly, is a man's current number of wives a predictor of erectile function? At least one North American study has found that men reporting sexual partners had lower erectile dysfunction,[6] leading to the possibility of a positive relationship between number of wives (greater number of sexual partners) and lower erectile dysfunction among the Ariaal.

Methods

Study population

The Ariaal derive their subsistence by herding camels in dry lowlands and, at higher elevations, keeping cattle and goats and engaging in limited agriculture.[13] They experience food stress, particularly during the dry seasons, and display high energy expenditure. Consequently, previous research with the Ariaal has reported average BMIs of approximately 18,[10] on the threshold of severe undernourishment.

The Ariaal share cultural heritages with two neighboring pastoral groups from which they appear to have derived: the Rendille and Samburu.[13] The Ariaal male life course is characterized by age grades. Around the time of puberty, men are initiated in age sets approximately every 14 y. Upon initiation, men are considered warriors, allowed to have lovers but not marry, and given responsibility for herding and protecting livestock. Once a large enough set of young men was available for a subsequent class of warriors to be initiated, the current set of warriors was promoted to adulthood, and allowed to marry and father children. The age set system and the need to provide bridewealth in the form of livestock mean that the age of first marriage for Ariaal men is late—approximately 30 y of age. Men are permitted to marry multiple wives, and it is not uncommon to find older Ariaal men married to young wives with whom they continue fathering children.

Subject recruitment occurred at two venues: 100 men from the settled agropastoral community of Songa and 98 nomadic males from the nomadic settlement of Lowegosa on the Kasuit Plateau. Potential subjects were identified by a scattershot method in the settled community. In the nomadic community, all eligible men were asked to participate. Only a handful of men declined to participate, and the primary reason given was concern with biological specimen collection unrelated to this questionnaire.

To estimate Ariaal ages, several approaches were taken since the majority of Ariaal are not literate and lack birth records. We asked about a man's age in reference to an events calendar, which relied on well-dated and memorable events in Ariaal history. We asked subjects to state the age set in which they were initiated, allowing age estimates to be bracketed within about a 14 y period. Local informants provided additional information, such as birth orders, that clarified ambiguous ages. Nonetheless, we regard the age estimates as accurate within a few years, and caution that older ages should be viewed with skepticism. To enable conservative tests of age-related patterns of erectile dysfunction, we used age as a categorical (eg, ages 20–29 y) rather than as a continuous variable. Thus, men were stratified into 10 y ago groups: 20–29, 30–39, 40–49, 50–59 and 60 + y.

Marital status was recorded during interviews as the current number of wives a subject had. All polygynously married men ($N=44$ with two wives, $N=7$ with three wives, $N=1$ with four wives and $N=1$ with five wives) were collapsed into a single category of polygynously married men.

The International Index of Erectile Function-5 (IIEF-5) was used to assess erectile dysfunction.[14] The IIEF-5 enables rapid assessment of erectile dysfunction by including four questions regarding erectile function and one question on sexual satisfaction. The instrument shows excellent validity and reliability. Recognized as a clinical standard for assessing erectile dysfunction, the IIEF-5 has been administered in France, Korea, Malaysia, Singapore, Brazil, Japan, Morocco and other countries.[15–23] Scoring of the IEFF-5 relied on the recommended cutoffs for each of five scores (eg, 22–25 y viewed as no erectile dysfunction).

Items in the IIEF-5 were asked during an interview with the aid of local, trained translators. The IIEF-5 had not previously been translated into or revalidated in the appropriate language for this study. Piloting of the translated instrument enabled achievement of culturally relevant versions of each of the 5 questions. Subjects did not express reservations answering any of the questions comprising the IIEF-5, even with a translator present. Nonetheless, the use of local translators may have influenced the answers provided by the subjects.

Anthropometric measures, including height, weight and suprailliac skinfolds were all taken by an experienced human biologist (BC). BMI was calculated as weight (kg)/height $(m)^2$. Percentage body fat was calculated from skinfolds based on the D-W equations.[24] Fat-free mass (FFM) was calculated as weight $\times$ (1 − percentage body fat). Grip strength was obtained using a Jamar dynometer with both the right and left hand, and we report results for the right hand.

Univariate predictors of erectile function were first tested using regression with scores on the IIEF-5 as the dependent variable. Regression results are reported because the regression coefficients provide a means of assessing the relative strength of the different predictors. Since both age group and

marital status are categorical variables, however, these results were tested against ANOVA models. The relationship between predictors was determined using standard correlations.

Finally, ANCOVA was used to investigate the independent effect of predictors of erectile dysfunction. Scores on the IIEF-5 were the dependent variable. Both age group and number of wives were used as categorical variables and FFM and right-hand grip strength as covariates. IIEF-5 scores from nomadic and settled populations were not significantly different and thus residence was not used as a predictor in subsequent analyses.

Results

Table 1 gives descriptive statistics of the sample population. As indicated in the table, Ariaal men in this sample are very lean with an average body fat of 10%, and chronically undernourished with an average BMI of less than 18.9 kg/m^2, the standard for chronic energy deficiency. In addition, they exhibit a range of marital status (unmarried, monogamously married and polygynously married).

Figure 1 shows IIEF scores by age groups. Erectile dysfunction differs significantly according to age groups ($P<0.0005$). *Post hoc* analysis reveals that men aged 60 y and older have significantly higher erectile dysfunction than men in their 20s, 40s and 50s ($P<0.05$).

Table 2 provides univariate relationships between predictor variables and erectile dysfunction, based on regression. The results indicate that erectile function is negatively related to age group, and positively related to BMI, FFM and grip strength. There is a marginal negative association with marital status, and no relationship with either percentage body fat or suprailliac skinfolds. The standardized coefficients (betas) indicate that age group (beta = −0.51) and grip strength (beta = 0.44) are of similar magnitude with FFM (beta = 0.19) and BMI showing much weaker effects (beta = 0.14).

Table 1 Descriptive statistics of Ariaal men

Variable	*Mean (s.d.) or prevalence*
Age (y)	47.3 (15.8)
Age group (y)	20–29 ($N=29$), 30–39 ($N=36$), 40–49 ($N=45$), 50–59 ($N=35$), 60+ ($N=53$)
IIEF-5 score	4.2 (1.2)
BMI (kg/m^2)	17.9 (2.0)
FFM (kg)	47.3 (5.6)
Percentage body fat	10.2 (4.2)
Suprailliac skinfold	4.8 (2.3)
Right-hand grip strength (kg)	36.4 (9.3)

However, the correlations shown in Table 3 indicate the predictors are interrelated. Both FFM and grip strength decline significantly with age, while percentage body fat and number of wives increase with age. As expected, measures of body composition are significantly related to each other: BMI is positively related to FFM, percentage body fat and suprailliac skinfolds; FFM is related to percentage body fat and suprailliac skinfolds; and percentage body fat and suprailliac skinfolds are positively related. Grip strength increases significantly with FFM and declines significantly with percentage body fat. Importantly, marital status is associated with physical characteristics of men. Percentage body fat increases with the number of wives while grip strength declines with the number of wives. The fact that marital status is associated with age, while percentage body fat increases and grip strength declines with the number of wives, suggests that older men, who are gaining in body fat and declining in physical strength, also have more wives.

To determine the independent effects of each of the predictor variables on erectile dysfunction, ANCOVA was performed, with age group, right-hand grip strength, FFM and number of current wives used as predictors. Results are shown in Table 4. The overall model is highly significant

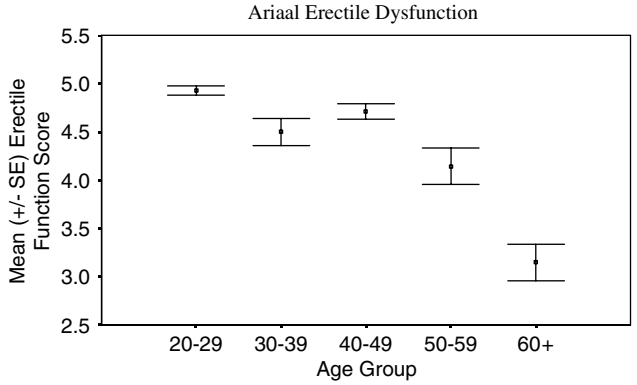

Figure 1 Erectile dysfunction scores according to age groups. Erectile dysfunction differs significantly according to age groups ($P<0.0005$). *Post hoc* analysis reveals that men aged 60 y and older have significantly higher erectile dysfunction than men in their 20s, 40s and 50s ($P<0.05$).

Table 2 Univariate predictors of erectile function

Variable	*Beta*	P
Age group	−0.51	0.000
BMI	0.14	0.048
FFM	0.19	0.007
% Body fat	0.08	0.267
Suprailliac skinfold	0.01	0.888
Grip strength	0.44	0.002
Marital status	−0.12	0.087

Table 3 Interrelationships among predictor variables

Variable	*BMI*	*FFM*	*Body fat*	*Suprailliac skinfold*	*Grip strength*	*Marital status*
Age	−0.10	−0.28**	0.32**	−0.05	−0.49**	0.57**
BMI		0.68**	0.63**	0.67**	0.31**	0.04
FFM			0.17*	0.31**	0.51**	−0.12
% Body fat					0.02	0.37**
Suprailliac SF					0.14*	0.05
Grip strength						−0.14*

*$P<0.05$; **$P<0.01$.

Table 4 Multivariate analysis of erectile dysfunction

Variable	*Overall adj. $r^2 = 0.36$ F-statistic*	*Overall adj. $r^2 = 0.39$ F-statistic*
Age group	13.1***	6.7***
Marital status	3.0*	3.5*
Right-hand grip strength	7.2**	7.9**
FFM	0.5	0.2
Age group* marital status		3.0**

*$P<0.05$; **$P<0.01$; ***$P<0.001$.

($F\ [187,8] = 14.4$, $P<0.001$). Age group, right-hand grip strength, and current number of wives were all significant predictors, while FFM was not. All two-way interaction terms were tested and only the interaction of age group and number of current wives was significant.

Since the direction of effects is not clear from the MANOVA analysis, we used linear regression to determine the nature of the interaction. When controlled for age group, the relationship between number of wives and erectile function was positive, suggesting that as men age erectile function declines, but less so among those with more wives.

Discussion

The results presented here indicate that Ariaal men show increasing erectile dysfunction with age, with men aged 60 y and older having significantly higher erectile dysfunction compared with men in their 20s, 40s and 50s. In addition, erectile dysfunction is negatively related to right-hand grip strength, but not measures of body composition. Furthermore, erectile dysfunction is negatively related to a man's number of current wives, when the effects of age are taken into account.

The age-related increase in erectile dysfunction reported here is consistent with previous findings from a variety of populations. It is important to note, however, that the degree of decline between the 50 and 60 + y group may be exaggerated by the fact that the 60 + y age group includes men with estimated ages in the 70s and 80s as well.

Given evidence for chronic undernutrition and delayed reproduction among the Ariaal, the robust age-related increase in erectile dysfunction is of particular interest. Both obesity- and medication-related causes of erectile dysfunction are absent among the Ariaal, yet the age-related increase in erectile dysfunction remains. The absence of an independent relationship between any of our measures of body composition, including BMI, FFM or percentage body fat, and erectile dysfunction suggests that energetic status has little relationship to erectile dysfunction in this group.

On the other hand, the negative relationship between grip strength and erectile dysfunction suggests that erectile dysfunction may be another symptom of overall decline in physical function with age. However, the specific mechanism linking grip strength and erectile function remains unclear.

Finally, the finding that erectile dysfunction is negatively related to a man's current number of wives, when controlled for age, helps expand the social context of erectile dysfunction to include polygyny. The significant interaction between age group and marital status as predictors of erectile function can be interpreted as the result of increasing variation in both erectile dysfunction and number of wives with age. Among older men, those with more wives show less of an age-related decline in erectile dysfunction.

We can imagine several possible explanations for the interaction between age group and marital status as predictors of erectile dysfunction. First, these findings may represent psychogenic causes of erectile dysfunction,[25] whereby older men with fewer sexual partners are more likely to experience erectile dysfunction. Second, older men may be more likely to marry additional wives because they maintain greater erectile function. Third, this relationship may be an artefact of the gerontocratic structure of Ariaal marriage whereby men tend to marry additional wives as they increase in age, wealth and political power. Older politically powerful and economically successful men may, coincidentally, be less likely to have erectile dysfunction and to have additional wives, thus leading to a positive association between number of wives and erectile function when controlling for age.

This study has several limitations, based primarily on its cross-sectional design. The primary dependent variable—a prevalence estimate of the IIEF-5 score—does not provide information on the duration of erectile dysfunction. In addition, the cross-sectional design represents a single snapshot of a highly fluctuating environment, in which there may be important seasonal changes in food availability and hence nutritional status. Thus, the relationship between erectile dysfunction and

predictors such as body fat or FFM may vary across the year. Moreover, future work may identify alternative explanations for these findings based on diet, activity patterns and cultural dynamics that are not presently obvious.

Nonetheless, our findings of an age-related decline in Ariaal erectile function correspond with results from numerous cross-sectional studies conducted in other populations. Moreover, erectile dysfunction was negatively related to right-hand grip strength and unrelated to measures of body fat among the Ariaal, suggesting that even in a chronically undernourished population erectile function is more directly related to individual variation in aging than energetic status. Finally, we observed a negative relationship between number of wives and erectile dysfunction, a finding that may reflect the social processes underlying polygyny among the Ariaal rather than any direct effect of marriage on erectile function.

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