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CORRELATION OF BODY MASS INDEX AND TESTOSTERONE LEVELS IN ADOLESCENT MALES, FROM HYDERABAD, PAKISTAN

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ABSTRACT

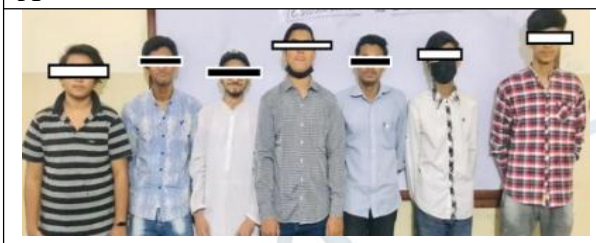
Objectives: *To set a population-based cut-off value of normal adult and to determine correlations of testicular volume with body mass index (BMI), seminal profiles, and hormone levels. Testicular volume is an index of male fertility but cut-off values of normal adult has not been reported.* ***Methods:*** *During 54 months from January 2004, 1139 normal young men, 19-27 years old in military service were enrolled. Testicular volumes were measured by ultrasonometry. Height, body weight, and BMI were measured and semen analysis and hormone assay (follicle-stimulating hormone [FSH], luteinizing hormone [LH], and testosterone) were performed.* ***Results:*** *The mean age was 23.52 ± 2.74. The mean testicular volume was 18.37 ± 3.62 cm^3 in left, and 18.13 ± 3.85 cm^3 in right. The mean body weight was 67.4 ± 7.91 kg, the mean height was 176.2 ± 6.64 cm, and mean BMI was 22.49 ± 2.02 kg/m^2. Testicular volumes had significant but weak correlations with height, body weight, and BMI. The semen analyses showed a mean pH of 7.63 ± 0.74, volume of 2.49 ± 1.12 mL, count of 68.63 ± 13.62 × 10^6, motility of 69.93% ± 10.28%, and morphology of 68.62% ± 7.48%. Sperm counts and motility had positive correlations with testicular volume. The mean hormonal levels of FSH, LH, and testosterone were 7.31 ± 2.42 mIU/mL, 7.81 ± 2.49 mIU/mL, and 6.23 ± 1.69 ng/mL, respectively. Testicular volume was negatively correlated with FSH and LH and positively with testosterone.* ***Conclusions:*** *In this population-based study, we conclude that the cut-off testicular volume in normal young adults is around 18 mL and that testicular volume is positively correlated with height, body weight, BMI, semen profile, and testosterone, and negatively correlated with FSH and LH. In all phases of life,* ***T*** *(Testosterone) is a key sex hormone required for normal physiological functions. The growth and maintenance of secondary sexual features in men depend on* ***T****. Additionally,* ***T*** *affects bone density, muscle mass, mood, and cognitive ability. Inhuman males experience reproductive problems at various periods of their lives as a result of* ***T*** *imbalances. Reduced semen quality in males, a rise in genital abnormalities, and changes in the timing or course of puberty are all associated with low* ***T*** *levels.* ***In this study*** *on adolescent guys, there was a definite positive correlation between* ***T*** *levels, energy levels, and muscle tone was recorded. The amount of* ***T*** *in* ***AD*** *(Adolescent) males increases 20 to 30 fold, boosting secondary sexual characteristics,* ***MM*** *(Muscle Mass),* ***BD*** *(Bone Density), and the* ***(B)*** *behavior.* ***T*** *influences anabolic and androgenic effects in* ***AD*** *by promoting protein synthesis, which leads to tissue development and the proliferation of* ***AR*** *(Androgen Receptor). Partakers* ***(Sample)*** *were* ***120 AD*** *males having age above 13 and below 20. As (****AD*** *according to* ***WHO*** *(World Health Organization)*

range 11 to 19). The study was conducted during the January 2021 to July 2022, from highly populated cities Hyderabad and Jamshoro.

Keywords: *Testosterone; Adolescent Males; Hormone; Hyderabad; Jamshoro.*

INTRODUCTION

A



B

C

D

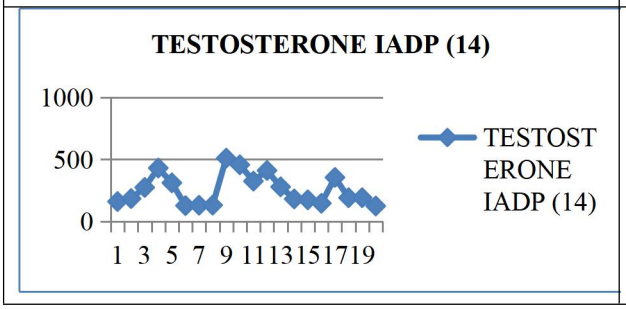
E

Age/ Group	Normal Range of Testosterone Level
14-to-16 Group-I (IADP)	20 to 800 nanograms per deciliter (ng/dl)
17-to-19 Group-II (PADP)	300 to 1000 nanograms per deciliter (ng/dl)

Table.1Normal range of testosterone

Age	Testosterone level Mean ± Sd	BMI Mean ± Sd
14(IADP)	253.65 ± 121.10	19.185 ± 2.529
15 (IADP)	314.4 ± 137.35	19.26 ± 2.238
16 (IADP)	345.6 ± 76.75	21.025 ± 2.295
17(PADP)	324.25 ± 87.24	19.65 ±. 1.67
18 (PADP)	352 ± 112.15	21.77 ± 2.536
19 (PADP)	360.3 ± 96.59	21.75 ± 3.73

Table.2Comparison of Testosterone with BMI



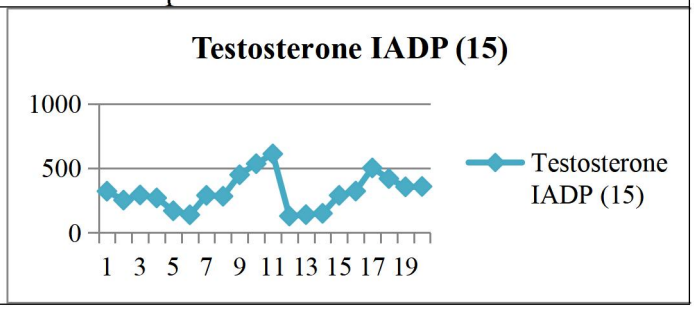


Figure. f. Level of T during IADP (14) and Figure. g. Level of T during IADP (15)

LEVEL OF T IN DURING IADP (14)

In the initial adolescent period **IADP** (age of 14 years) level of **T** range from 20 ng /dl to 1200 ng /dl but below statistics not near to half of peak level, while most of these above lowest level, they were in between the middle range some were below to 300ng/dl or 200ng/dl, were those AD which had disturbed diurnal rhythms, disturb BMI and most of them skip breakfast potentially needed for major nutrition in AD male and nutrition enhances T level in AD.

LEVEL OF T IN DURING IADP (15)

In IADP (age of 15 years) level of testosterone range from 20 ng /dl to 1200 ng /dl but below statistics not near to half of peak level, while most of these above lowest level, they were in between the middle range some were below to 300ng/dl or 200ng/dl. While same results were found as in 14 age group.

LEVEL OF T IN DURING IADP (16)

In IADP (age of 16 years) level of testosterone range from 20 ng /dl to 1200 ng /dl but below statistics not near to half of peak level, while most of these above lowest level, they were in between the middle range some were below to 300ng/dl no one below 200ng/dl, those who were below 300 ng/dl AD males. Remaining same results were found as in 14, 15 age groups.

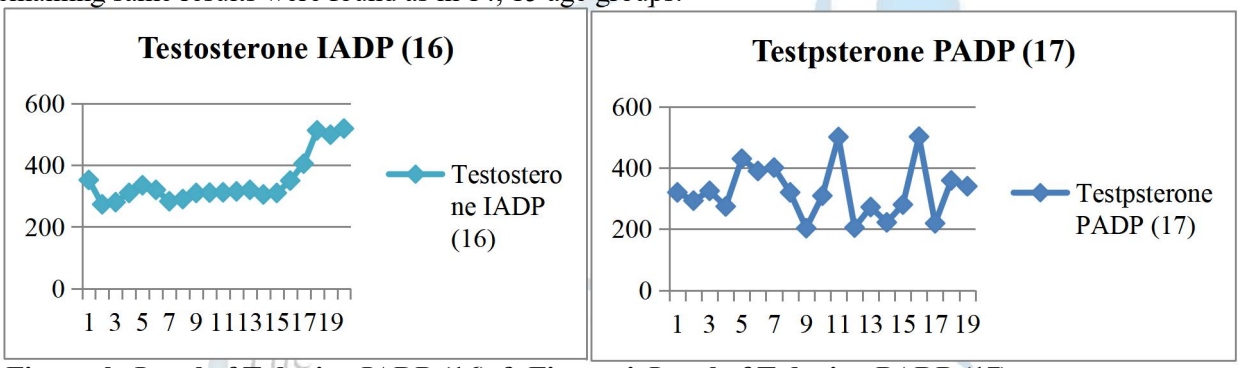


Figure. h. Level of T during IADP (16) & Figure. i. Level of T during PADP (17)

LEVEL OF T IN DURING PADP (17)

In **PADP** (age of 17 years) level of **T** range from 300 ng /dl to 1200 ng /dl but below statistics not near to half of peak level, while most of these above lowest level, they were in between the middle range some were below to 300ng/dl no one below 200ng/dl, those who were below 300 ng/dl AD males. While same results were found as in 14, 15, 16 age groups.

LEVEL OF T IN DURING PADP (18)

In PADP (age of 18 years) level of testosterone range from 300 ng /dl to 1200 ng /dl but below statistics some were near to middle of peak level, while most of these above lowest level, they were in between the middle range some were below to 300ng/dl or 200ng/dl, those who were below 300 ng/dl or 200 ng/dl AD males. Remaining same results were found as in 14, 15, 16, 17 age groups.

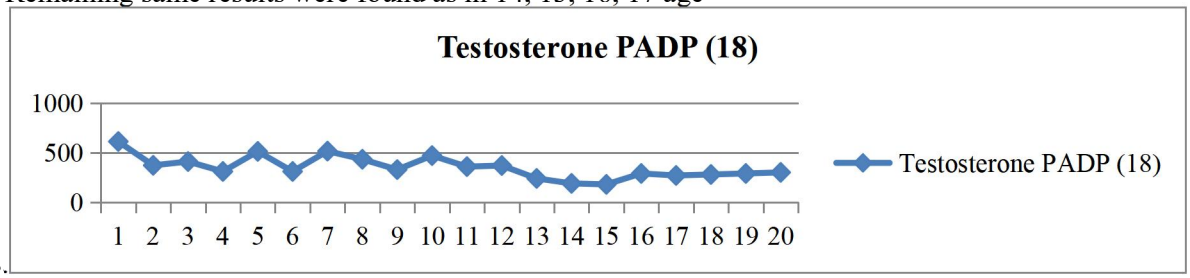


Figure.10. Level of T during PADP (18)

LEVEL OF T IN DURING PADP (19)

In PADP (age of 19 years) level of testosterone range from 300 ng /dl to 1200 ng /dl but below statistics some were near to middle of peak level, while most of these above lowest level, they were in between the middle range some were below to 300ng/dl or 200ng/dl, those who were below 300 ng/dl or 200 ng/dl AD males. Remaining same results were found as in 14, 15,16,17,18 age groups.

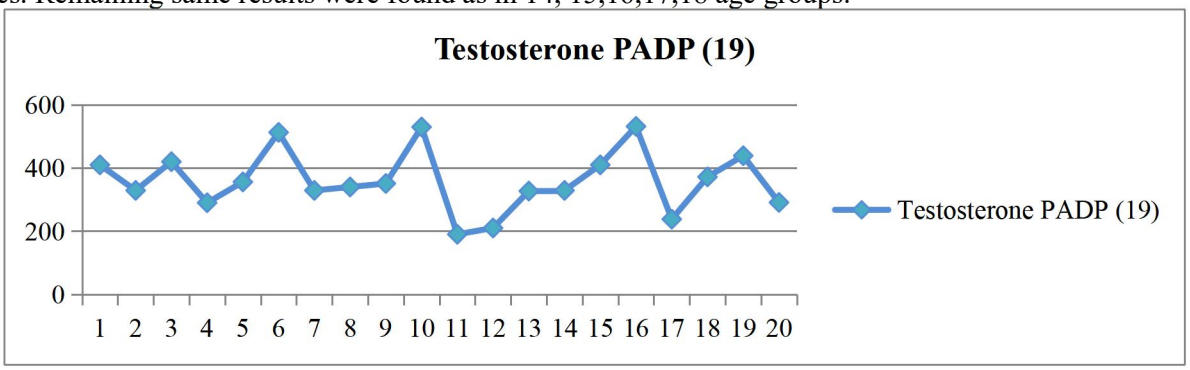


Figure. 11 Level of T during PADP (19)

COMPARISON OF T LEVEL IN IADP

This spectrum of **T** hormone among **IADP** show clear cut evidence that with age, **T** level increases in **AD**, all **AD** males were near to middle range of normal **T** level. Some were found below to middle points and a few were below to cut points (300ng/dl) (Fig.12). Those **AD** who were below to cut points of **T** level were with low and high **BMI** as compared to healthy **BMI.** Some other factors which found to influences on **T** level include diurnal rhythms and nutrition. **AD** male had healthy T level were those follows diurnal rhythms and takes 6 to 8 hours sleep in night. A major factor for normal **T** level in **AD** is nutrition those who were taking healthy breakfast had better **T** level as compare to those who skipped breakfast. Not only breakfast while had sea food or fish once in week to fulfill the nutritional requirement as salmon, prawn and some other fishes provides essential minerals and vitamins for the production of T in AD males. Mean T level during IADP is 304.55 ng/d.

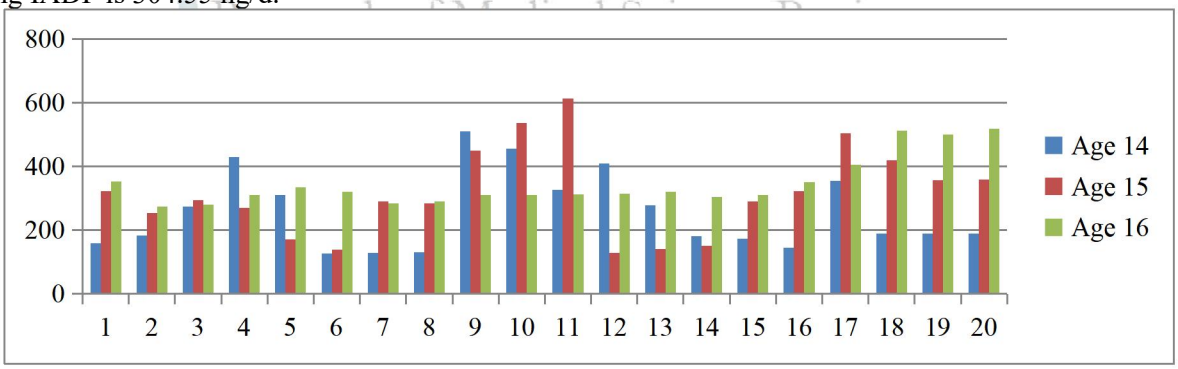


Figure 12. Comparison of T level in IADP (14 to 16)

COMPARISON OF T LEVEL IN PADP

This spectrum of **T** among **PADP,** show that along with age, **T** hormone level increases in **AD**, and measured near to middle range of normal. Some were below to middle points and even some were below to cut points (300ng/dl) **(Fig.13)**. While other results all almost and recommendations are same as in the **IADP.** Mean T level during PADP is 345.51 ng /dl.

T levels during IADP and PADP show a strong evident that it increases with age.

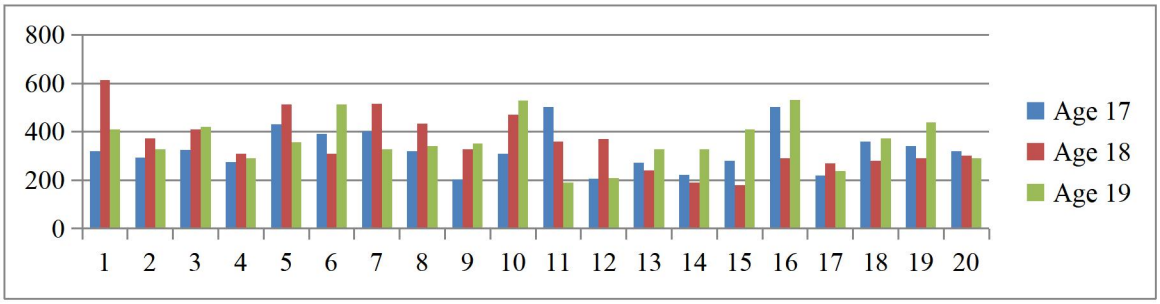


Figure 13. Comparison of T level in PADP (17 to 19)

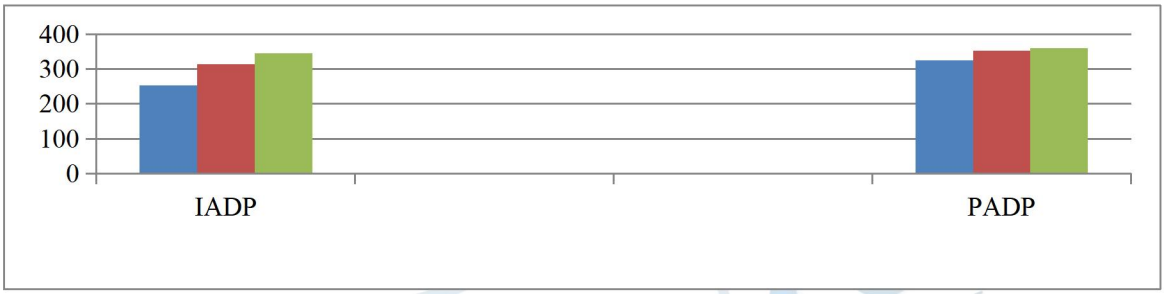


Figure.14 Comparison of T levels during IADP AND PADP

BMI DURING AD

In **AD; BMI** is found healthy which ranges from 16 kg/ m^2 to 26.2 kg/m^2, **AD** with below 16 kg/ m^2 considered as underweight and **AD** with 26.3 kg/ m^2 to 29.3 considered as overweight and **AD** with 29.4 kg/ m^2 considered as obese **(Table.3).** And research findings clearly indicate that how T levels maintained with diurnal, from above results indicate that diurnal rhythms or circadian cycle had strong impact on T levels, variations in T levels associated with changes in diurnal rhythms as shown in **(Fig.15)**.

Table. 3 BMI of the AD.

Age	Healthy BMI	Underweight	Overweight	Obese
14	16kg/ m^2 to 23.5 kg/ m^2	15.9 kg/ m^2 or below	23.6 kg/ m^2 to 25.9 kg/ m^2	26 kg/ m^2 or above
15	16.7 kg/ m^2 to 23.3 kg/ m^2	16.6 kg/ m^2 or below	23.4kg/ m^2 to 26.7 kg/ m^2	26.8 kg/ m^2 or above
16	17.3 kg/ m^2 to 24.1 kg/ m^2	17.2 kg/ m^2 or below	24.2kg/ m^2 to 27.4 kg/ m^2	27.5 kg/ m^2 or above
17	17.7kg/ m^2 to 24.8 kg/ m^2	17.6 kg/ m^2 or below	24.9kg/ m^2 to 28.1 kg/ m^2	28.2 kg/ m^2 or above
18	18.2kg/ m^2 to 25.5 kg/ m^2	18.1 kg/ m^2 or below	25.6kg/ m^2 to 28.8 kg/ m^2	28.9 kg/ m^2 or above
19	18.7kg/ m^2 to 26.2 kg/ m^2	18.6 kg/ m^2 or below	26.3kg/ m^2 to 29.8 kg/ m^2	29.9 kg/ m^2 or above

Figure. 15 Diurnal rhythms with variation T levels

DISCUSSION

T (testosterone) is vital hormone for the development of secondary sex characters in **AD** period. All these physical, behavioral, anabolic and androgenic activities are carried out by primary sex hormone is **T. AD** is period of dynamic changes in physical and behavioral structure in males. During AD level of T increases about 20 to 30 folds. It was found that T level linked with behavioral problems during AD as reported by [12]. It was found that the level of T is related to BMI, Diurnal rhythms and nutrition. High T level doesn't mean development of early AD but it is related to excess, road rage, fighting at little league games and sexual iniquity. I have found that AD with little high T were more aggressive and develop acne on skin. In most of AD having better level of T level were those taking fatty fish or meat in diet once a week as review shows [16] fatty fish like sardines and salmon necessary for hormonal health during AD. I have found that food with micronutrients like Zn and Mg good source of T health among AD. In review shows that nutrient rich with Zn and Mg great source to enhance T during AD [26]. However we had found during research AD males with minute change in T levels leads to behavioral issues as discussed by booth et al. research suggest that strong connection between diurnal rhythms associated with T levels in AD, minor differences in T levels linked with diurnal rhythms suggested by [10]. The Diurnal Rhythms of T levels is more influenced in AD males that shows larger correlations with age and pubertal status as compared to females suggest by [12]. High and low BMI influence on normal morphology of T levels in AD [20]. About 30 AD out of 120 total AD with variation in BMI having changes in levels of T as compare to their age group. We found 73% AD males with T levels near to middle range of normal which show diurnal rhythms, while 27% AD males with change in T levels were those AD males with variation in diurnal rhythms as showed in [25]. T levels in AD males decrease each hour across the day, AD sample taken in early morning between 8 am to 10 am having better curve as compare to those AD males who given samples in evening 8 pm to 10pm as in previous studies levels of T in AD during day time was carried out by [26]. I find that AD males with low attentions, anxiety and depression issues were those with little bit change in T levels as compare to normal range in T levels as discussed by Booth and colleagues during 1999 that depression in AD is associated with low T levels. AD males with better or good T levels were less normal having depression, anxiety and attention issues as compare to those AD with little change in T levels. It was fond during this research that T levels influences not only sexual characters, anabolic and androgenic activities in AD but it also influences AD behavior, concentration (attention). Higher level of depression, anxiety linked with variation or low levels of T during day time or it is linked with diurnal rhythms. During AD protein metabolism is associated with muscle strength and mass linked with nutrients necessary for activating T in AD. I found that AD males taking protein rich nutrients once in week or twice a week having normal range of T levels as compare to those who had no proper diet to maintain T levels. However many researchers suggest that changes in T levels without the use of anabolic steroids has been a highly investigated area because T levels enhancing AP [6, 15].

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