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ORIGINAL ARTICLE

Effects of Performance Enhancement Drugs on Body Mass Index, Blood Pressure, and Blood Sugar Levels on a Healthy Adult Male: A Case Study

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Abstract

Background and objective: Anabolic-androgenic steroids (AASs) are used as performance enhancement and are widely utilized among athletes and non-athletes worldwide. Although the risk-benefit ratio of using Performance Enhancing Drugs (PEDs) explicitly Anabolic-androgenic steroids are primarily published as systematic reviews and post-mortem case reports, there are limited reports on the effects of PEDs on body mass index, blood pressure, and blood sugar levels. Thus, this study explored the effects of performance enhancement drugs on the body mass index, blood pressure, and blood sugar levels of an adult male with no history of diagnosed physical and mental health comorbidities, with a BMI of 36.65 percent for three months.

Methods: The present study utilized a mixed-method case study design. Data on the case presentation, investigation, treatment, physical and mental effects experienced by the patient during the three-month PED cycle were gathered from the patient through a face-to-face interview. Moreover, the data on the patient's body mass index (BMI), blood pressure (BP), and blood sugar (BS) levels were collated by the researchers at the private clinic every second week of the month and were statistically analyzed using IBM SPSS version 27.

Results: The patient's first month mean BMI was 36.65 ± 1.68 and decreased to 27.70 ± 0.71 in the third month. Moreover, the patient's mean BP in the first month was 119.83 ± 7.36/75.83 ± 8.38 mmHg and increased slightly to 125.80 ± 7.86/87.07 ± 8.25 in the third month. In terms of blood sugar levels, the patient's mean in the first month indicated 84.77 ± 8.05 mg/dL and maintained at 87.07 ± 8.25 mg/dL in the third month. The overall results of the patient's mean BMI, blood pressure, and blood sugar levels indicate significant differences in the BMI, blood pressure, and blood sugar levels following the 3-month PED cycle.

Conclusions: Our study provides evidence that performance enhancement drugs significantly affect the patient's body mass index, blood pressure, and blood sugar levels after a 3-month PED cycle.

Keywords

Performance enhancement drugs, Body mass index, Blood pressure, Blood sugar

Introduction

Anabolic-androgenic steroids (AASs) are a class of synthetic compounds generated from testosterone and its precursors [1]. The use of anabolic-androgenic steroids to enhance performance is common among athletes and non-athletes worldwide [2]. However, in addition to the desired effects on skeletal muscle, these substances may also exert adverse effects on various organs and tissues, such as the central nervous system, liver, and cardiovascular system, and recent research has described multiple cases of cardiac disease in athletes with a history of AASs use [3,4].

AASs and their synthetic compounds [5] are

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employed in therapeutic doses in the treatment of hormonal illnesses and other pathologies characterized by muscle loss (aging, cancer, and AIDS), hypogonadism, breast cancer, delayed puberty, renal failure, and anemia [3,4,6]. The market for doping substances is enormous and expanding from athletes to even non-athletes [7]. For the sake of this definition, non-athletes are individuals whose objective is to become leaner and more muscular, typically for aesthetic reasons, and who do not compete in organized sports events.

These Performance Enhancing Drugs (PEDs), explicitly the Anabolic-androgenic steroids (AASs) as referred to in our study, are frequently used in "cycling" patterns, either bulking to gain muscle mass or cutting for muscle definition explicitly for bodybuilding competitions [2]. Moreover, cycling entails taking repeated doses of PEDs over a particular amount of time, pausing for a period, and restarting treatment. People who abuse anabolic steroids generally "stack" the medications, meaning they take two or more different anabolic steroids, mix oral and injectable kinds, and occasionally even take substances intended for animals [8]. The idea that various steroids interact to create a bigger effect on muscle size than the effects of each drug has not been adequately validated [1,2,7].

One of the most common PEDs used for body recomposition is testosterone. Testosterone is the primary sex hormone in men. It performs a number of critical tasks, including the development of the penis and testes, the deepening of the voice during puberty, the growth and strength of muscles and bones, the enhancement of sex drive (libido), and the creation of sperm [9]. However, abnormally high testosterone levels in men are associated with low sperm count, shrinking testicles, and impotence; heart muscle damage and increased risk of heart attack; prostate enlargement with difficulty urinating; liver disease; fluid retention with swelling of the legs and feet; and aggressive behavior, mood swings, euphoria, irritability, impaired judgment, and delusions (although not well studied or clearly proven) [10].

Moreover, another PEDs that is utilized for the cutting cycle is Stanozolol. It is a testosterone-derived synthetic steroid with anabolic-androgenic characteristics [11]. It was introduced to the market in 1962. Due to FDA regulations and market fluctuations, the marketing and labeling of Stanozolol have evolved over time. It was removed from the US market in 2010. The federal Anabolic Steroid Control Act of 2004 and the amended Designer Anabolic Steroid Control Act of 2014 classify it as a Schedule III prohibited substance.

After running a bulking or cutting cycle for approximately 8-12 weeks, individuals using PEDs undergo Post-Cycle Therapy (PCT). PCT refers to the period immediately following the termination of PEDs and can be any mix of medications that PED users ingest and engage in after deciding to go "off-cycle" or otherwise quit PIED use [12]. Thus, PCT is a significant component of the more extensive tactics that PEDs users use to limit the negative health impacts of PIED use, both during and after usage [2]. The specific reasons that PED users conduct PCT may include the restoration of one's natural hormonal functioning (i.e., functioning prior to using PEDs) more quickly than would otherwise be possible without PCT; to more quickly reverse or mitigate the side-effects associated with PED use (e.g., testicular atrophy); and to avoid or mitigate the side-effects related to discontinuing PED use [1]. However, the evidence for these benefits is primarily speculative and anecdotal [3,6,7].

Selective estrogen receptor modulators (SERMs), Testosterone boosters, and human chorionic gonadotropin (HCG) are used for normalizing hormones following anabolic steroid use [13]. As your body rebalances hormone levels after discontinuing the use of anabolic steroids, estrogen levels rise, and testosterone levels fall. Clomid and Nolvadex (Tamoxifen) and other selective estrogen receptor modulators (SERMs) can counteract this by regulating estrogen levels and allowing testosterone levels to rise [14]. Additionally, Clomid (clomiphene) and Nolvadex (Tamoxifen) stimulate the secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which serve to increase testosterone levels [15].

Some PCT regimens are available over the counter as supplements that can be used for several weeks. Others, such as Clomid and Nolvadex (Tamoxifen), are FDA-approved prescription drugs for other conditions but may be used off-label for PCT [16]. As estrogen blockers, SERMs enhance testosterone levels and help counteract some of the unfavorable side effects of steroid use, such as gynecomastia [17]. During PCT, some men combine clomiphene and Nolvadex (Tamoxifen) [16,18].

Most literature on PEDs are mostly systematic reviews [2,4,5,19] and post-mortem case reports [1,4,20]. To the best of our knowledge, we are the first to report on the effects of PEDs on a healthy adult male's body mass index, blood pressure, and blood sugar levels. Thus, this study is conducted. The main objective of this case study is to find out if there are significant differences in the body mass index, blood pressure, and blood sugar levels of an adult male, with no history of diagnosed physical and mental health comorbidities, with a BMI of 36.65 percent after three months of PED cycle.

Methods

Study design

The present study utilized a mixed-method case study design. Data on the case presentation, investigation, treatment, physical and mental effects experienced by the patient during the three-month PED cycle were gathered from the patient through a face-to-face

interview. Moreover, data on the patient's body mass index (BMI), blood pressure (BP), and blood sugar (BS) levels were collated by the researchers at a private clinic every second week of the month and were statistically analyzed using IBM SPSS version 27.

Case presentation

A 36-year-old non-hypertensive, non-diabetic, Asian, male patient with no history of comorbidities with a body mass index of 36.65 percent presented to a private clinic for an executive check-up before commencing a cutting cycle using PEDs. Baseline vital signs include blood pressure = 115/70 mmHg, heart rate = 88 beats per minute, and respiration = 15 cycles per minute.

The patient was a non-smoker and non-alcoholic with no family history of cardiac disease. On the primary survey, the patient verbalized that he was fit and active with a normal range BMI and regularly workout for 4-6 times per week, and consumed approximately 1.2-1.7 grams of protein per kilogram of body weight per day, 5-6 grams of carbohydrates per kilogram of body weight per day, and 0.5-1.5 g/kg/day of fats. However, the patient did not follow his usual workout and diet regimen for the past six months, brought about by gym closure and the limited food choices available brought about by the pandemic.

Investigation and treatment

Since the patient's BMI increased to 36.65 percent, and he verbalized that he constantly experienced fatigue and occasional shortness of breath in his activities of daily living (ADLs), he decided to resume his workout and diet routine with the help of his professional Personal Trainer (PT). His Personal Trainer has been competing in local and national bodybuilding competitions for almost a decade and is a certified PT in the Philippines. His PT recommended that he start a 3-month cycle of PEDs under medical supervision, thus prompting him to have a check-up at a private clinic before starting the PED cycle. Before starting the cycle, we asked the patient for permission to conduct the case study through a signed Informed Consent Form (ICF). Specifically informing the patient that his participation in the case study is voluntary and without undue influence and that his name or any identification must remain anonymous, and to use the data of his PED and PCT dosage and duration, as well as his BMI, blood pressure, and blood sugar levels for the 3 months of his PED and PCT cycle. The patient's PEDs, Supplements, and PCT used, dosage, and duration is presented in Table 1.

Moreover, for the 3-month duration of the PED and PCT cycle, the patient was instructed to follow a regular workout program 4-6 times per week guided by his Personal Trainer (PT) and to consume approximately 1.2-1.7 grams of protein per kilogram of body weight per day, 5-6 grams of carbohydrates per kilogram of body weight per day, and 0.5-1.5 g/kg/day of fats 6 meals a day with 2 hours interval between each meal using the MyFitnessPal™ calorie counter application. Moreover, the patient was instructed to avoid alcohol intake and any medications except for the PEDs, supplements, and PCT used during the course of the cycle. Furthermore, the patient was also instructed to have at least 7-10 hours of sleep per night.

Monitoring

Since the patient is a registered nurse by profession, he suggested that he will be the one to record his daily data on body weight, blood pressure (BP), and blood sugar (BS) levels. His body weight was taken every morning upon waking up on an empty stomach wearing the same clothing using Xiaomi digital

Table 1: PEDs, supplements, and PCT used, dosage, and duration.

Cutting cycle (1-8 weeks)					
Week	**Stanozolol Tablet**	**Trenbolone Enanthate**	**Testosterone Cypionate**	**Fish Oil**	**Essential Forte**
1	20 mg/day	150 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
2	20 mg/day	150 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
3	20 mg/day	150 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
4	20 mg/day	150 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
5	20 mg/day	150 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
6	25 mg/day	225 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
7	25 mg/day	225 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
8	25 mg/day	225 mg/week IM	50 mg/every other day IM	4 grams/day	600 mg/day
Post-cycle therapy					
Week	**HCG**	**Clomid**	**Nolvadex**		
9	250 iu/day SQ	50 mg/day	20 mg/day		
10	250 iu/day SQ	50 mg/day	20 mg/day		
11	250 iu/day SQ	50 mg/day	20 mg/day		
12	250 iu/day SQ	50 mg/day	20 mg/day		

weighing scale. Moreover, Docteur's Choice electronic sphygmomanometer was utilized to monitor his blood pressure. In monitoring his blood sugar levels, Yasee Blood Glucose Meter was used. Blood pressure and blood sugar levels were taken daily before breakfast. The researchers gathered the patient's daily body weight, blood pressure, and blood sugar results during the last day of months 1,2, and 3. Furthermore, the researchers computed and statistically analyzed the monthly means with standard deviation of the BMI, BP, and BS. In case of a medical emergency during the three-month cycle, the patient was instructed to contact the physician with the researchers to address immediate medical concerns.

Scoring procedures

Body mass index: Body mass index (BMI) is calculated by dividing a person's weight into kilograms/pounds by the square of their height in meters/feet. BMI is a simple and inexpensive screening tool for determining weight categories, including underweight, healthy weight, overweight, and obesity [21].

BMI does not directly measure body fat. However, there is a moderate correlation between BMI and more direct measures of body fat [22]. In addition, the BMI appears to be as closely linked with metabolic and illness outcomes as these more direct measurements of body fatness [23,24].

BMI	Weight Status
Below 18.5	Underweight
18.5-24.9	Healthy Weight
25.0-29.9	Overweight
30.0 and Above	Obesity

Blood pressure (BP): Blood pressure is the force exerted by blood against the arterial walls. Arteries transport blood from the heart to the rest of the body. Blood pressure fluctuates routinely throughout the course of the day [25]. Using two numbers, blood pressure is measured: The systolic blood pressure value monitors the pressure in your arteries as your heart beats. Diastolic blood pressure measures the pressure in your arteries when the heart is at rest between beats [26].

The American College of Cardiology/American Heart Association Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults (2017 Guideline)	
Normal	Systolic: Less than 120 mmHg Diastolic: Less than 80 mmHg
Elevated	Systolic: 120-129 mmHg Diastolic: Less than 80 mmHg
High blood pressure (hypertension)	Systolic: 130 mmHg or higher Diastolic: 80 mmHg or higher

Blood sugar (BS): A blood sugar test is utilized to determine whether the individual has prediabetes, type 1, type 2, or gestational diabetes [27]. Random Blood Sugar Test is one approach for determining blood glucose levels. This determines your blood sugar level at the time of testing. The individual may take this examination at any time and is not required to fast beforehand.

Result*	Random blood sugar test
Diabetes	200 mg/dL or above
Prediabetes	N/A
Normal	N/A

*Results for gestational diabetes can differ. Source: American Diabetes Association

Statistical treatment

The patient's body mass index, blood pressure, and blood sugar results were expressed as means with standard deviations. Moreover, one-way ANOVA and Tukey test were employed to determine if significant differences existed in the first, second, and third months' mean results of the patient's BMI, BP, and BS levels undergoing a PED cycle at a significance level of 0.05. All data were analyzed using IBM SPSS version 27.

Outcome and Follow-up

First, second, and third month body progress report while on PED and PCT Cycle

As can be gleaned in Figure 1, the patient's height is 5 feet and 6 inches, with the first month's mean body weight of 226.60 lbs. The computed BMI is 36.65, indicating that the weight is in the obesity category for adults of his height [21]. During a follow-up check-up, the patient verbalized that during his first two weeks in his PED cycle, he experienced increased libido, strength, and workout duration, with occasional night sweats. On the third to fourth week of the cycle, he stated that he experienced getting agitated quickly and becoming sensitive/emotional. Moreover, he reported low quality of sleep because he usually wakes up at early dawn and finds it difficult to sleep again.

As presented in Figure 2, the patient's height is 5 feet and 6 inches, with a body weight of 190.74 lbs. The computed BMI is 30.85, indicating that the weight is in the obesity category for adults of his height [21]. During the second-month follow-up check-up, the patient verbalized that during his fourth to sixth weeks in his PED cycle, he still experienced increased libido, strength, and workout duration, without the occasional night sweats he experienced from the first four weeks of the PED cycle. On the seventh to the eighth week of the cycle, he stated that the effects he experienced from the first month, i.e., getting agitated quickly, being sensitive/emotional, and low quality of sleep, subsided.

Figure 1: First month body progress report (First-Fourth Weeks).

Photo Credit:

Resti Tito Vilarino

Location:

Moalboal, Cebu, Philippines

Date and Time Taken:

September 13, 2022 8:27 AM

Figure 2: Second month body progress result (Fifth-Eighth Weeks).

Photo Credit:

Resti Tito Vilarino

Location:

Moalboal, Cebu, Philippines

Date and Time Taken:

October 13, 2022 10:09 AM

He stated that maybe his body adapted to the PEDs, which is why he experienced fewer adverse effects than during the first four weeks of the PED cycle.

As shown in Figure 3, the patient's height is 5 feet and 6 inches, with a body weight of 171.60 lbs. The computed BMI is 27.70, indicating that the weight is in the overweight category for adults of his height [21]. During the third-month follow-up check-up, the patient verbalized that during his ninth to tenth weeks in his PED cycle, he still experienced increased libido, strength, and workout duration. He also stated that he no longer experienced getting agitated quickly or being sensitive/emotional. Moreover, he verbalized that he no longer experienced waking up at early dawn and slept approximately 7-8 hours of sleep per night. Moreover, on the eleventh to the twelfth week of the cycle, he stated that he observed that his strength and workout duration slightly decreased, but he was still able to adjust his workout routine and stick to his diet regimen.

Summary of means of the body mass index, systolic and diastolic blood pressure, and blood sugar levels during the 3-month PED cycle

The means of the body mass index, systolic and diastolic blood pressure, and blood sugar levels of the patient during the 3-month PED cycle are presented in Table 2.

Body mass index: During the first month cycle, the patient had a mean BMI of 36.65 ± 1.68, with an interpretation of obese [21]. In the second month, the patient's BMI decreased to 30.85 ± 1.88, indicating that the weight is in the obesity category for adults of his height. Moreover, in the third month, the patient's BMI further decreased to 27.70 ± 0.71, with an interpretation

Figure 3: Third month body progress result/post-cycle therapy phase (Ninth-Twelfth Weeks).

Photo Credit:

Resti Tito Vilarino

Location:

Moalboal, Cebu, Philippines

Date and Time Taken:

November 13, 2022 09:18 AM

of overweight. The one-way ANOVA and Tukey tests revealed significant differences in the patient's mean BMI results in the first, second, and third months.

Blood pressure: The patient's mean BP in the first month is 119.83 ± 7.36/75.83 ± 8.38 mmHg with an interpretation of normal. In the second month, the patient's BP increased to 139.88 ± 4.57/83.31 ± 7.73 mmHg with an interpretation of high blood pressure according to the American College of Cardiology/ American Heart Association Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults (2017 Guideline) [26]. Moreover, the patient's BP decreased to 125.80 ± 7.86/87.07 ± 8.25 with an interpretation of elevated in the third month. The ANOVA and Tukey test results indicate significant differences in the increase and decrease of patient's blood pressure readings following the 3-month PED cycle.

Blood sugar: The patient's blood sugar mean in the first month indicated 84.77 ± 8.05 mg/dL. For the second month, the patient's blood sugar levels had a mean of 72.63 ± 13.92 mg/dL, while in the third month, the patient's blood sugar mean registered at 87.07 ± 8.25 mg/dL. The overall results of the mean blood sugar levels of the patient indicate normal blood sugar levels. Moreover, the ANOVA and Tukey results revealed significant differences in the mean blood sugar level results in the first, second, and third months of the PED cycle.

Discussion

The objective of this case study was to find out if

Table 2: Summary of means of the body mass index, systolic and diastolic blood pressure, and blood sugar levels during the 3-month PED cycle.

Factors	Mean	SD	Interpretation	F-test	p-value	Tukey Test
Body Mass Index						
1st Month	36.65	± 1.68	Obesity	270.26	< 0.00001*	21.00*
2nd Month	30.85	± 1.88	Obesity			32.41*
3rd Month	27.70	± 0.71	Overweight			11.41*
Systolic Blood Pressure						
1st Month	119.83	± 7.36	Normal	50.43	< 0.00001*	14.50*
2nd Month	139.88	± 4.57	High blood pressure			4.32*
3rd Month	125.80	± 7.86	Elevated			10.18*
Diastolic Blood Pressure						
1st Month	75.83	± 8.38	Normal	5.44	0.006*	4.87*
2nd Month	83.31	± 7.73	High blood pressure			2.24
3rd Month	79.27	± 6.06	Elevated			2.63
Blood Sugar (mg/dl)						
1st Month	84.77	± 8.05	Normal	16.57	< 0.00001*	6.37*
2nd Month	72.63	± 13.92	Normal			1.21
3rd Month	87.07	± 8.25	Normal			7.58*

*Significant at significance level α = 0.05; one way ANOVA

there were significant differences in the body mass index, blood pressure, and blood sugar levels of an adult male, with no history of diagnosed physical and mental health comorbidities, with a BMI of 36.65 percent after three months of PED cycle. Our results indicate that the first-month mean BMI of the patient was 36.65 ± 1.68, with an interpretation of obese. In the second month, the patient's BMI decreased to 30.85 ± 1.88, indicating that the weight is in the obesity category for adults of his height. In the third month, the patient's BMI further decreased to 27.70 ± 0.71, with an interpretation of overweight. Furthermore, the patient's mean BP in the first month is 119.83 ± 7.36/75.83 ± 8.38 mmHg with an interpretation of normal. In the second month, the patient's BP increased to 139.88 ± 4.57/83.31 ± 7.73 mmHg with an interpretation of high blood pressure. In the third month, the patient's BP decreased to 125.80 ± 7.86/87.07 ± 8.25, with an interpretation of elevated. The patient's blood sugar mean in the first month indicated 84.77 ± 8.05 mg/dL. For the second month, the patient's blood sugar levels had a mean of 72.63 ± 13.92 mg/dL, while in the third month, the patient's blood sugar mean registered at 87.07 ± 8.25 mg/dL. The overall results of the patient's mean BMI, blood pressure, and blood sugar levels indicate significant differences in the BMI, blood pressure, and blood sugar levels following the 3-month PED cycle.

Our findings aligned with other studies on the association between PED use and body mass index. According to Haerinejad (Haerinejad et al., 2016), individuals utilized PEDs for weight loss or weight gain and to prevent injuries. Moreover, since BMI is an independent predictor of insulin resistance, hyperglycemia, hypertriglyceridemia, and hyperleptinemia, managing BMI is essential in preventing lifestyle diseases such as hypertension and diabetes [28,29]. Furthermore, a study by Shen [30] established that as the BMI of individuals increases, their physical performance decreases, thus prompting individuals with high BMIs (more than 30 percent) to resort to PEDs use to achieve their ideal body weight.

In terms of the relationship between PED use and blood pressure, our results agreed with the findings from other studies [8,14,16,17,19,20] that PEDs increase blood pressure levels and put the individual at high risk of developing cardiovascular, hepatic, metabolic, and endocrine problems. Moreover, the study of Sivalokanathan [31] revealed that PEDs have numerous structural changes in the myocardium. For example, imaging and histological samples indicated left ventricular hypertrophy, cardiomegaly, and interstitial fibrosis [4]. Such remodeling has repercussions for CVS immediately and in the long term. Substantial cardiovascular effects include a rise in vascular tone and elevation in blood pressure, modifications in lipid profile, and direct myocardial toxicity, resulting in impaired left ventricular function, cardiac hypertrophy, and arterial and venous thrombosis [1,14,16,32].

Furthermore, our results on the correlation of performance enhancing drugs with blood sugar levels indicate contrasting findings in the literature since the blood sugar results of the patient from the first to the third month indicate normal blood sugar levels. According to Young and Diabetes UK [33,34] PEDs, specifically the Anabolic-androgenic steroids (AASs), can increase glucose (sugar) levels in the blood. Consequently, some PED users go on to develop diabetes. This is referred to as steroid-induced diabetes, which is more prevalent in individuals with an increased risk of type 2 diabetes. Moreover, despite significantly greater post-glucose blood insulin concentrations, PEDs users exhibited decreased glucose tolerance compared to those who did not use PEDs [33,35]. In connection to the latter study, the postglucose insulin responses of PEDs users were likewise greater than those of the sedentary nonobese and sedentary obese reference groups. Thus, Cohen's and Diabetes UK's [33,35] findings suggest that PEDs users have decreased glucose tolerance, which is likely due to insulin resistance.

The physical and mental health effects of PEDs use are well-established. According to these studies [36-39] abusing PEDs results in cardiovascular, endocrine, liver, and kidney function problems. However, these studies [40-43] established PEDs users know the consequences of taking these PEDs but still use these substances despite the adverse effects to gain an advantage over their competitors explicitly for bodybuilding and weightlifting athletes. Moreover, as verbalized by the patient, although he experienced adverse effects, i.e., decreased quality of sleep, occasional night sweats, getting agitated easily, and being sensitive/emotional during his PED cycle, the body recomposition effects he observed motivated him to continue the 3 month PED cycle and to keep his regular workout, nutrition, and sleep regimen.

Based on previous [19,38,43] and current research [14,40,44,45] PEDs are not worth the risk compared to its potential benefits. Although PEDs have potential benefits such as an increase in muscle tissue due to enhanced protein synthesis, decreased body fat percentage, increased muscle strength and power, enhanced recovery from workouts and injury, improved bone mineral density, better muscle endurance, and increased red blood cell production, these potential benefits outweigh the potential risks such as cardiovascular, metabolic, endocrine, hepatic, and urinary problems, especially for those individuals that use PEDs without medical supervision [8,16,17,46].

Our case study has some limitations. First, the outcome variables were assessed using self-reporting techniques and reported only mean differences in the patient's body mass index, blood pressure, and blood sugar levels. Second, we have no invasive blood work

done on the patient to determine the effects of PEDs on his blood values, i.e., cholesterol, metabolic, hepatic, and kidney function. Moreover, our results of this study only referred to a patient without physical or mental impairments and comorbidities.

Conclusion

PEDs, specifically AASs use, is referred to as a "hidden epidemic". Over the past four decades, PEDs use has shifted from a relatively small group of elite athletes to mainstream use among young men seeking a more muscular physique. Although our results provide evidence that performance enhancement drugs significantly affect the patient's body mass index, blood pressure, and blood sugar levels after a 3-month PED cycle, still the health risks outweigh the PEDs' potential benefits. Furthermore, based on the patient's perspective, he verbalized that although there was an improvement in his physique while doing the 3-month PED cycle, he will no longer use PEDs in the future.

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