Self-Reported Side Effects Associated with Selective Androgen Receptor Modulators: A Social Media Data Analysis

Aditya Joshi, Diego Federico Kaune, Phillip Leff, Emily Fraser, Sarah Lee, Moustafa Hazin

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Aditya Joshi[1] MS; Diego Federico Kaune[2] BA; Phillip Leff[3] DO; Emily Fraser[1] BA; Sarah Lee[1] BS; Moustafa Hazin[1] DO

[1]Creighton University School of Medicine Phoenix US
[2]Johns Hopkins University Baltimore US
[3]Internal Medicine, Creighton University School of Medicine Phoenix Health Sciences Campus Phoenix US

Corresponding Author:
Aditya Joshi MS
Creighton University School of Medicine
3100 N Central Avenue
Phoenix
US

Abstract

Background: Selective Androgen Receptor Modulators (SARMs) are ligands designed for selective anabolic effects on muscle and bone. Despite their original therapeutic intent, SARMs remain unapproved by the FDA and are associated with various toxicities. In recent years, their abuse has increased, particularly among youth targeted through social media.

Objective: This study examines adverse symptoms and laboratory data from self-reported social media posts.

Methods: We conducted a retrospective analysis of public posts on Reddit's SARMs subforums from March 2015 to November 2023. Using Python-based scripts, we extracted posts containing relevant keywords. Data was categorized based on users' self-reported stages of SARMs use. Demographic information, specific SARMs used, concomitant medications, symptoms, and laboratory values were collected.

Results: Of 5,249 extracted posts, 3,877 were included in the analysis. Significant changes in various laboratory parameters were observed across different stages of SARMs use. 17.5% of users reported using Tamoxifen or Enclomiphene, while 7.8% used hepatoprotective supplements.

Conclusions: The study reveals an alarming increase in SARMs marketing on social media, targeting young adults despite being illegal to sell for human consumption. Many users experienced serious adverse effects, including liver toxicity and hormonal imbalances. Many individuals also self-treated without medical supervision. While the use of self-reported data may affect representativeness, our findings highlight the urgent need for increased awareness and regulation to address the growing public health crisis posed by SARMs abuse. Further research is crucial to uncover the full spectrum of adverse effects, especially in young users vulnerable to misinformation.

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Self-Reported Side Effects Associated with Selective Androgen Receptor Modulators: A Social Media Data Analysis

Aditya Joshi, MS[1]; Diego F. Kaune, BA[2]; Phillip Leff, DO[3]; Emily Fraser, BA[1]; Sarah Lee, BS[1]; Moustafa Hazin, DO[1]

1. Creighton University School of Medicine, Phoenix, AZ
2. Johns Hopkins University, Baltimore, MD
3. Internal Medicine, Creighton University School of Medicine Phoenix Health Sciences Campus, Phoenix, AZ

Corresponding Author:
Aditya Joshi
400 East Earll Drive, Unit 613
Phoenix, AZ 85012
978-495-1891
aditya.joshi.research@gmail.com

Introduction:

Selective Androgen Receptor Modulators (SARMs) are ligands of the androgen receptor designed for selective organ activity, including anabolic effects on muscle and bone.[1] SARMs were originally developed to treat osteoporosis and muscle wasting, minimizing unwanted androgenic effects in the prostate, red blood cells, and cardiovascular system. However, no SARM has received FDA approval

to date. Studies show SARMs are associated with acute liver toxicity,[2] and recent case reports indicate long-term testosterone suppression along with kidney and cardiotoxicity.[3,4] The abuse of SARMs has become increasingly prevalent, both among athletes as well as youth who are targeted through social media platforms that glorify their use for physical appearance. While reports of SARMs abuse and toxicity have been rising, no study has examined adverse symptoms and laboratory data using self-reported social media posts.

Methods:

We conducted a retrospective analysis of publicly shared data from March 2015 to November 2023 on the social media platform Reddit. Data was collected using a Python-based script, extracting posts from SARMs subforums. These communities were systematically identified and queried for posts containing the keywords "liver," "AST," "ALT," "lab-work," "bloodwork," and "symptoms." Posts were categorized based on users' self-reported stages: "pre-SARMs cycle use," "mid-SARMs cycle use," and "post-SARMs cycle use." Demographic data, specific SARMs taken, mentions of other medications taken, self-reported symptoms, and self-reported laboratory values were extrapolated.

It is relevant to note that this study was determined to be exempt from Institutional Review Board approval.

Results:

We extracted 5,249 posts, of which 1,329 were excluded due to the inability to categorize their SARMs usage. Of the remaining 3,877 posts, 1,694 were pre-SARMs use, 1,412 were mid-SARMs use, and 771 were post-SARMs use. The mean reported age was 27 years (range: 13-63). Out of 418 posts reporting gender, 20 (4.8%) identified as female. Significant changes in AST, ALT, Creatinine Kinase, HDL, LDL, Total Testosterone, and Sex Hormone-Binding Globulin were observed before, during, and after SARMs use (Figure 1, Table 1, Table 2). 382 out of 2,183 (17.5%) SARMs users reported using Tamoxifen or Enclomiphene, and 170 out of 2,183 (7.8%) reported using N-Acetyl Cysteine (NAC) or other hepatoprotective supplements (Milk Thistle/Tudca) during or after SARMS use.

Discussion:

In recent years, there has been an alarming increase in marketing of SARMs on social media, targeting teenagers and young adults and portraying SARMs as safe and effective.[5] Despite being illegal to sell for human consumption, SARMs are readily available for purchase online via "underground networks" of compound pharmacies and chemical suppliers.[6] Our analysis revealed that prior, current, and prospective SARMs users frequently discuss their experiences, sources, dosing regimens, perceived benefits, labs, and adverse events on social media. Distributors also frequent these platforms to offer advice while marketing their products.

The growing use of SARMs underscores the urgent need for further investigation. Our analysis found that many Reddit users experienced serious adverse effects from SARMs, including liver toxicity, testosterone suppression, and metabolic dysfunction. We also observed individuals self-treating hepatic dysfunction with N-Acetyl Cysteine and hormonal imbalances with Tamoxifen and Enclomiphene (Selective Estrogen Receptor Modulators) without medical supervision.

While the use of self-reported data from Reddit may affect the representativeness of SARMs users, our findings highlight the urgent need for increased awareness and regulation to address a growing public health crisis posed by SARMs abuse. Additionally, since our study focused primarily on hepatotoxicity, it is probable that we did not capture the full range of adverse effects.

Further SARMs research is critical to uncover the full spectrum of their adverse effects, especially

for young users vulnerable to targeted marketing and misinformation. Until then, physicians must be aware that patients are using social media forums to seek and report medical advice, and adverse events are likely underreported in the literature.

Table 1:

Lab (Units)	Before SARMs Use	During SARMs Use	*P* Value
Aspartate Aminotransferase (U/L)	27.7 (n=121) [SD=17.6]	74.3 (n=89) [SD=85.5]	**<.001**
Alanine Aminotransferase (U/L)	29.5 (n=143) [SD=19.8]	125.6 (n=99) [SD=171.9]	**<.001**
Alkaline Phosphatase (U/L)	76.4 (n=84) [SD=25.2]	68.8 (n=43) [SD=28.7]	.06
Bilirubin (mg/dL)	1.5 (n=88) [SD=3.8]	1.0 (n=41) [SD=1.9]	.18
Creatinine (mg/dL)	1.1 (n=77) [SD=0.2]	1.1 (n=41) [SD=0.2]	.41
Creatine Kinase (U/L)	259.1 (n=9) [SD=344.6]	727.1 (n=11) [SD=675.2]	**.03**
Luteinizing Hormone (U/L)	6.1 (n=195) [SD=17.0]	4.8 (n=78) [SD=3.2]	.25
Follicle-Stimulating Hormone (U/L)	4.8 (n=187) [SD=11.1]	3.7 (n=74) [SD=2.5]	.21
High-Density Lipoprotein (mg/dL)	44.5 (n=116) [SD=17.9]	31.1 (n=59) [SD=14.9]	**<.001**
Low-Density Lipoprotein (mg/dL)	80.6 (n=115) [SD=43.4]	100.3 (n=54) [SD=50.5]	**.004**
Cholesterol (mg/dL)	132.0 (n=105) [SD=49.2]	142.8 (n=45) [SD=61.7]	.13

Triglycerides (mg/dL)	50.6 (n=84) [SD=28.0]	67.7 (n=40) [SD=54.7]	**.01**
Total Testosterone (ng/dL)	585.5 (n=388) [SD=233.8]	358.6 (n=177) [SD=325.8]	**<.001**
Free Testosterone (pg/mL)	90.1 (n=188) [SD=80.8]	94.9 (n=95) [SD=118.8]	.35
Estrogen (pg/mL)	32.2 (n=171) [SD=23.4]	41.5 (n=85) [SD=61.7]	**.04**
Sex Hormone-Binding Globulin (nmol/L)	43.9 (n=146) [SD=98.8]	12.8 (n=82) [SD=10.7]	**.002**
Hemoglobin (g/dL)	19.9 (n=58) [SD=25.4]	20.8 (n=24) [SD=28.5]	.45

Table 2:

Lab (Units)	Before SARMs Use	After SARMs Use	*P* Value
Aspartate Aminotransferase (U/L)	27.7 (n=121) [SD=17.6]	83.5 (n=125) [SD=322.1]	**.03**
Alanine Aminotransferase (U/L)	29.5 (n=143) [SD=19.8]	108.7 (n=139) [SD=318.9]	**.002**
Alkaline Phosphatase (U/L)	76.4 (n=84) [SD=25.2]	70.9 (n=78) [SD=35.5]	.12
Bilirubin (mg/dL)	1.5 (n=88) [SD=3.8]	1.3 (n=79) [SD=4.8]	.35
Creatinine (mg/dL)	1.1 (n=77) [SD=0.2]	1.1 (n=71) [SD=0.2]	.21
Creatine Kinase (U/L)	259.1 (n=9) [SD=344.6]	683.1 (n=8) [SD=450.7]	**.02**
Luteinizing Hormone (U/L)	6.1 (n=195) [SD=17.0]	6.0 (n=145) [SD=7.8]	.48
Follicle-Stimulating Hormone (U/L)	4.8 (n=187) [SD=11.1]	4.2 (n=135) [SD=3.4]	.27
High-Density Lipoprotein (mg/dL)	44.5 (n=116) [SD=17.9]	31.3 (n=107) [SD=14.6]	**<.001**
Low-Density	80.6 (n=115) [SD=43.4]	98.4 (n=108) [SD=50.7]	**.002**

Lipoprotein (mg/dL)			
Cholesterol (mg/dL)	132.0 (n=105) [SD=49.2]	136.4 (n=84) [SD=56.2]	.28
Triglycerides (mg/dL)	50.6 (n=84) [SD=28.0]	57.6 (n=71) [SD=38.6]	.10
Total Testosterone (ng/dL)	585.5 (n=388) [SD=233.8]	457.7 (n=291) [SD=346.3]	**<.001**
Free Testosterone (pg/mL)	90.1 (n=188) [SD=80.8]	86.0 (n=123) [SD=74.6]	.33
Estrogen (pg/mL)	32.2 (n=171) [SD=23.4]	33.1 (n=136) [SD=18.9]	.35
Sex Hormone-Binding Globulin (nmol/L)	43.9 (n=146) [SD=98.8]	22.0 (n=108) [SD=16.7]	**.01**
Hemoglobin (g/dL)	19.9 (n=58) [SD=25.4]	14.5 (n=51) [SD=2.9]	.07

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Supplementary Files

Figures

Mean changes in AST, ALT and Alkaline Phosphatase levels in patients before SARMs use, during SARMs use, and after SARMs use. Error bars indicate SD. *P < 0.05, **P < 0.01, ***P < 0.001.