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Research Article

A Global Misuse of Semaglutide for Cosmetic Weight Loss in Non-diabetic Young Population, an FDA Public Database and Google Trends Data Analysis

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ABSTRACT

Background: in a world full of aesthetic trends and a pervasive focus on physical appearance, often driven by celebrities and social media influencers. The misuse of medications and increased demand on aesthetic surgeries have been documented and become increasingly concerning. Recently, the use of GLP-1 analog medications for aesthetic weight management, particularly Semaglutide (brand name Ozempic and Wegovy) has gained increasing popularity among the public on these platforms.

Subjects and Methods: Our study aimed to investigate the potential for Semaglutide misuse, particularly Ozempic based on FAERS database and Google Trends tool. We also explored the potential adverse events associated with Semaglutide medication's misuse.

Results: Our findings showed a surge in Semaglutide medication (Ozempic) for weight loss as opposed to T2DM treatment worldwide. Moreover, Ozempic popularity for weight loss outweighs the popularity of Wegovy, which was approved for weight management indications in obese patients with at least one weight-related comorbidity. Furthermore, our results demonstrated an annual increase in the number of Semaglutide-related AERs on FAERS from January 2018 to September 2024, including a rise in death related AERs. A wide verity of Semaglutide related AERs have been documented, including both serious and non-serious outcomes, with death being the most serious outcome reported. Current results have also documented a worldwide shortage in Semaglutide medications, particularly Ozempic and Wegovy, due to increased demand and off-label use of these medications.

Conclusion: collectively, our findings provide clear evidence of Ozempic and Wegovy misuse outside their approved indications to achieve aesthetic weight goals among young non-diabetic individuals. This misuse is often driven by media platforms without stressing on the potential adverse events and ethical concerns associated with the misuse of these medications.

Introduction

Semaglutide is a class of medication known as Glucagon-like peptide-1 (GLP-1) analog [1,2], which acts as an agonist to GLP-1 receptors to mimic the effect of incretin hormone (GLP-1) and hence lowers blood glucose levels and enhancing both insulin production and release from beta cells of the pancreas in type 2 diabetes mellitus (T2DM) patients [3].

Diabetes mellitus (DM) is a chronic and progressive metabolic disorder with a growing burden on public health globally, affecting more than 400 million people in the world today, with an ongoing

increase that is expected to reach 629 million DM patients by 2045 [4-6]. T2DM is the most common type of DM, accounting for 90% of total DM cases [7].

T2DM is characterized by chronic hyperglycemia due to insulin resistance and progressive pancreatic beta cell damage over time [8]. Generally, management of T2DM focuses on glycemic control [9]. This is typically done through a combination of medications and lifestyle management [10]. Medication-wise, metformin is considered the first line of treatment for T2DM alongside medical nutrition treatment, increasing physical activity, and improving the overall quality of life [11]. Despite advancements in medical approaches to T2DM management, clinical glycemic control in diabetic patients remains challenging, thus supporting the need for more innovative hypoglycemic agents [12]. Recently, advancements in pharmaceutical research have focused on developing hypoglycemic agents that agonists native GLP-1 [13]. Such hypoglycemic agents have been clinically used and achieved a successful approach in minimizing dosage frequency and better glycemic control of diabetic patients. [14]

One such hypoglycemic agent developed by Novo Nordisk, is Semaglutide with extended release and 94% homology to native GLP-1 the medication was launched clinically under brand name Ozempic® [15]. During clinical trials, Semaglutide contribution to a substantial amount of weight loss was documented; thereafter, Semaglutide was approved for chronic weight management indications in obese individuals with one or more weight-related comorbidities [16], and by 2021, Novo Nordisk clinically launched Semaglutide under brand name Wegovy which was approved for weight management indications in obese patients with weight-related comorbidities and under medical supervision [17]. The growing concern regarding weight loss in both obese and non-obese individuals has increased the demand for aesthetic and plastic surgery approaches as a means of weight loss [18]. With the growing obsession with following celebrities and social media trends, the unauthorized use of some medications for cosmetic purposes was normalized on these platforms [19]. Recently, an increased surge in the use of Semaglutide medications as a means of aesthetic weight loss has been popularized among the public [20]. This trend has raised concerns about Semaglutide misuse among young, non-diabetic individuals [21]. The current study aims to analyze the potential of Semaglutide misuse among the young population for cosmetic weight management purposes, based on data analysis from the FDA public database and Google Trends tool to raise awareness on the emerging issue of medication misuse for esthetic purposes and the potential health risks associated with off-label use of Semaglutide medications and to provide a novel insight into an emerging public health concern that has received limited regulatory and academic attention.

Subjects and Methods

Data was collected from the FDA Adverse Event Reporting System (FAERS) Public Dashboard to conduct a retrospective observational study by analyzing the adverse events of Semaglutide from January 2018 to November 2024. CASEID and FDA_DT filters were applied to deduplicate the collected data and ensure the usage of the most recent data. The cases that involved age groups less than 18 years were excluded due to irrelevance to the aim of the study, as well as the duplicate cases to avoid redundancy. The selected data were analyzed to assess trends in total adverse reports (AERs) over time, the distribution of AERs by gender, age group, severity, and the outcome during the selected timeframe. Moreover, the collected data were categorized into “serious” and “nonserious” outcomes based on FDA regulations (21 CFR) and the International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH) guidelines. All collected data were subsequently submitted for statistical analysis.

Regression analysis was done to assess the relationship between Year and total reported cases. Using the regression equation, yielding the regression equation Total Cases = −3,895,000 + 1930.04 × Year, the intercept (−3,895−3,895) was used as a theoretical starting value, which holds little practical relevance within the given timeframe. Similar regression analysis for total death cases over time was performed, and the resulting regression equation Total Death = -18.179 + 30.107 × Year.

Statistical significance analysis

Statistical significance analysis was performed using analysis of variance (ANOVA) to evaluate the significance of changes in Total AERs and total death cases over time. The Chi-squared test was used to analyze the distribution of adverse event severities and the AERs severity level frequency between Ozempic and Wegovy. The Shapiro-Wilk and linearity diagnostic tests were conducted to validate the reliability of the regression model results.

Google Trends tool analysis

Google Trends (http://google.com/trends) Search tool was used as a marker to assess the relative public interest in search terms (Ozempic), (Wegovy), and (Ozempic for weight loss vs Ozempic for diabetes) during a given time frame (January 2018– November 2024) and (Jun 2021– November 2024) respectively and (worldwide) was selected as the location for the given search term. Google Trends tool uses a relative search volume (RSV), which is calculated by the normalized volume of a particular search interest during a particular time and location compared to all searches at the same time and location. The RSV is scaled from 0 to 100 as an interest index, with 100 representing the peak popularity of the search for the selected period and location. This tool has been widely used to evaluate the public interest of search terms of interest in many research studies [22,23].

Results

From January 2018 to September 2024, a total of 37,693 AERs were submitted on FAERS. An increase in the total number of Semaglutide-related AERs over the years can be observed (Figure1a.). From 2021 to September 2024, when the medication gained popularity for cosmetic weight loss, a significant increase of about 3-fold in AERs was observed (Figure1a.) [24]. As can be seen in (Figure 2.), the majority of Semaglutide-related AERs were from female users, which could be linked to body anxiety in women who are under relentless societal pressure to achieve the "ideal body" that is mainly driven by internet and social media efforts for advertising what is known now as body industry [25]. As for the age group, most AERs concerned younger adults age group (18–64 years) (Table 1b.). As can be seen in (Figure 1c.) An annual increase of approximately 1,930 cases was observed with an F-statistic of 52.45

and a p-value of 0.0008, and the slope's p-value (<0.001) confirming the significant linear relationship with an upward trend in total cases over the years. The Shapiro-Wilk test results showed a p-value of 0.594, which is greater than 0.05, indicating that the residuals follow a normal distribution, further supported by the Q-Q plot (Figure 1b.). The correlation coefficient was 0.955 (p= 0.00078), indicating a strong and statistically significant linear relationship.

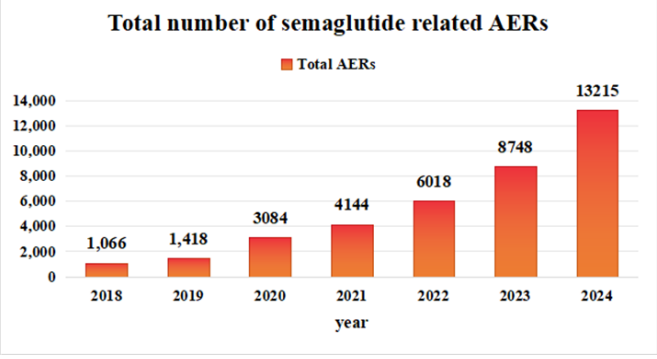

Figure 1a: Total number of semaglutide-related AERs over the years

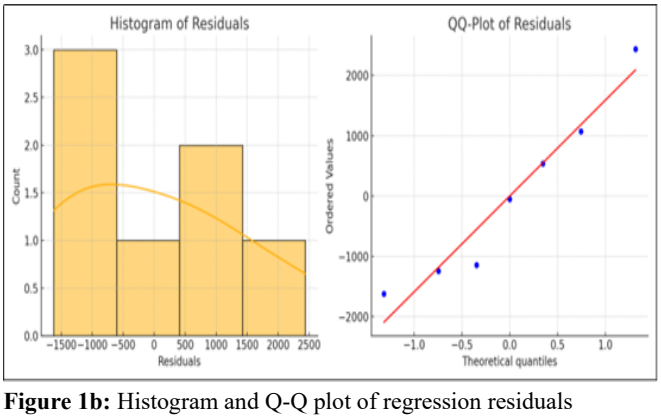

Figure 1b: Histogram and Q-Q plot of regression residuals

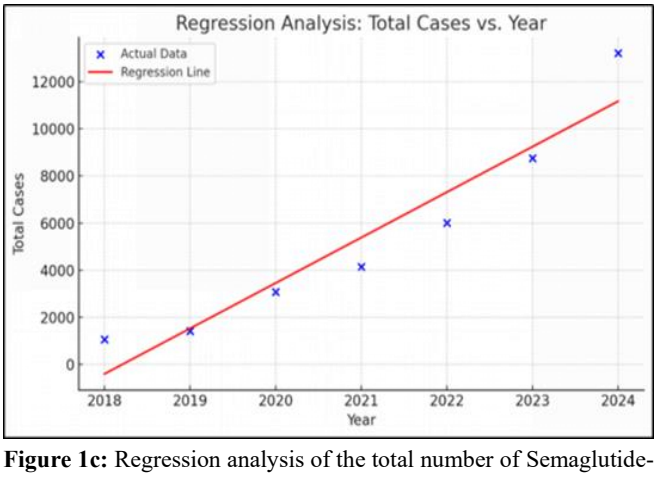

Figure 1c: Regression analysis of the total number of Semaglutide-related AERs over the years

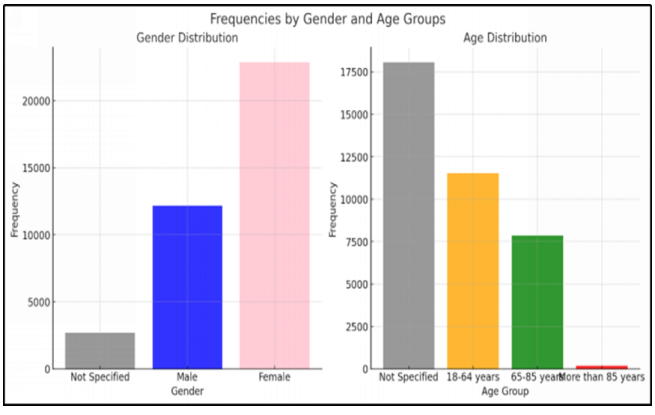

Figure 2: semaglutide-related AERs distribution by age and gender groups

Table 1: Semaglutide-related AERs distribution by age and gender groups

Groups		Total AERs (n)	n (%)		p-value	
Gender	Not specified	2694	7.15%		0.035	
				Male	12165	32.27%
				Female	22844	60.59%
Age	Not specified	18052	47.95%		0.048	
				18–64 years	11529	30.63%
				65–85 years	7868	20.90%
				more than 85 years	195	0.52%

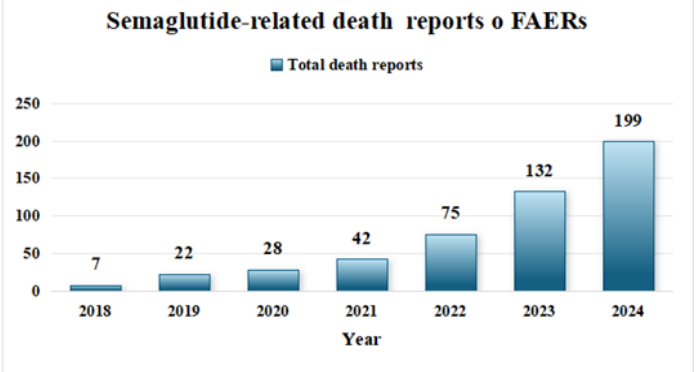

Figure 3a: Semaglutide-related death reports over the years

From January 2018 to September 2024, a total of 505 death reports were submitted to FAERS. A significant increase in death reports can be seen over the years, peaking at (199) death reports in 2024 as the medication gained trending popularity for cosmetic weight loss among young, non-diabetic populations (Figure 3a). This can be seen in (Figure 3b) which indicates a linear relationship where the number of total deaths increases by approximately 30.107 units

for each additional unit of the year variable. Semaglutide-related AERs distribution by age and gender groups shows no significant difference between males and females; however, most of these reports were from a younger population of 18–64 years of age (Table 2.).

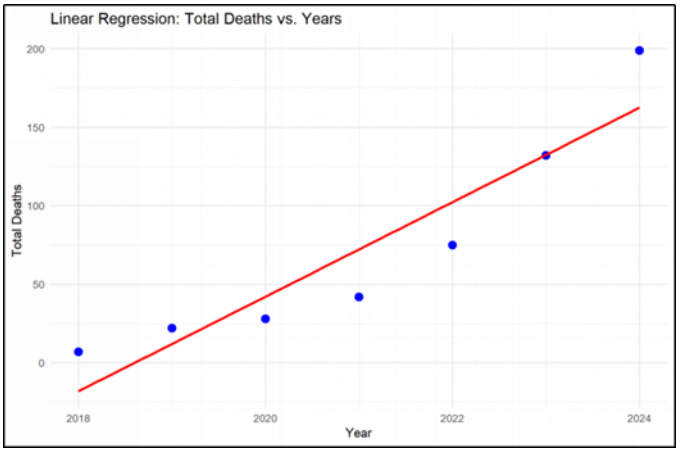

Figure 3b: Regression analysis of semaglutide-related death reports over the years

Table 2: Semaglutide-related death reports distribution by gender and age groups

Groups		Total AERs (n)	n (%)
Gender	Not specified	25	4.95%
	Male	267	52.87%
	Female	213	42.18%
Age	Not specified	146	28.91%
	18–64 years	180	35.64%
	65–85 years	136	26.93%
	more than 85 years	14	2.77%

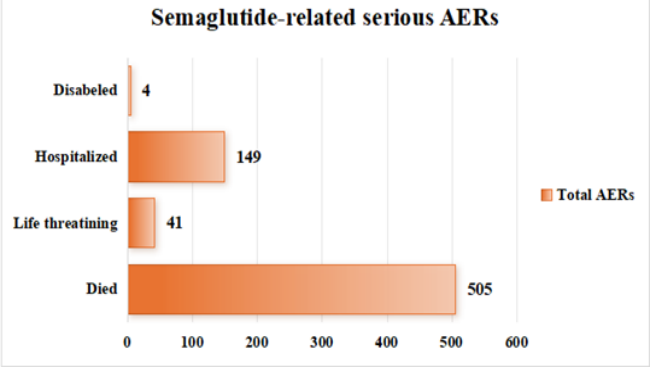

Figure 4: Semaglutide-related serious adverse event reports on FAERS

Both serious and non-serious Semaglutide-related adverse event reports were submitted on FAERS from 2018-2024, during that time frame Semaglutide-related adverse event reports ranged from non-serious conditions like injection site reaction and general fatigue among others to more serious outcomes like death, life-threatening conditions and disabilities (Figure 4), (Table 3). Among serious outcomes, most cases (72.25%) resulted in death. Hospitalizations account for 21.32% of the cases, while life-threatening events represent 5.87%, only a small fraction (0.57%) of cases resulted in disability (Table 4).

Table 3: Semaglutide-related AERs distribution by system

Semaglutide related AERs by system	Total AERs (n)	n (%)
- Gastrointestinal disorders	15694	41%
- General disorders (fatigue, malaise and administration site condition)	10136	27%
- Injury, poisoning complication	9824	26%
- Nervous system disorders	6456	17%
- Metabolism disorders	6415	17%
- Skin and subcutaneous tissue disorders	3128	8%
- Psychiatric disorders	2942	8%
- Mucuskeletal and connective tissue disorders	2529	7%
- Eye disorders	2240	6%
- Renal disorders	1549	4%
- Cardiac disorders	1320	4%
- Hepatobiliary	1105	3%
- Neoplasm (Benign and Malignant)	1011	3%

Table 4: semaglutide-related AERs distribution by serious outcomes

Semaglutide-related serious outcomes	Total AERs (n)	n (%)	P-value
Died	505	72.25%	< 0.001
Life-threatening	41	5.87%	
Hospitalized	149	21.32%	
Disabled	4	0.57%	
Total	699	100.00%	

*Significant ($p < 0.05$)

Both Ozempic and Wegovy are Semaglutide brand names manufactured by Novo Nordisk. While Ozempic is FDA-approved for T2DM, Wegovy is FDA-approved for weight management in obese patients. Both brand names were linked to the majority of AERs on FAERS; However, Ozempic was linked to more AERs compared to Wegovy (Figure 5.). As can be seen in (Table 5) for Semaglutide brand name Ozempic, 56.51% of cases are "Not Specified," 42.31%

are "Serious Cases," and 1.18% are "Death Cases." Similarly, for Wegovy, the majority (66.43%) fall under "Not Specified," followed by 32.99% as "Serious Cases," and 0.58% as "Death Cases." While both drugs show a high proportion of unspecified cases, Ozempic reports a significantly larger proportion of serious cases (42.31% vs. 32.99%) and death cases (1.18% vs. 0.58%) compared to Wegovy. Which could be due to the longer timeframe for Ozempic availability in comparison to Wegovy which was approved four years later as well as the increased public interest in Ozempic for weight loss on internet and media platforms [26] (Figure 6 and 7).

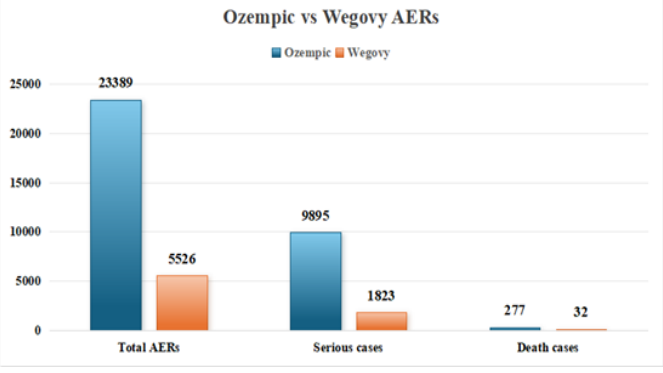

Figure 5: Ozempic vs Wegovy AERs on FAERS

Table 5: Ozempic vs Wegovy AERs on FAERS

Outcome groups	Ozempic		Wegovy	
	Total AERs (n)	(n) %	Total AERs (n)	(n) %
Not specified	13217	56.51%	3671	66.43%
Serious cases	9895	42.31%	1823	32.99%
Death cases	277	1.18%	32	0.58%
Total AERs	23389	100.00 %	5526	100.00 %
Chi Squared Test		186.4		
P-value		< 0.001		

*Significant (p< 0.05)

Google Trends tool data analysis has shown clear evidence of increasing popularity in Semaglutide medication (Ozempic) for weight loss indications as opposed to type 2 diabetes mellitus treatment worldwide over the years (Figure 6.). Moreover, Google Trend data analysis showed increasing public interest in off-label use of Ozempic for weight loss compared to Wegovy, which was approved for weight management indications (Figure7).

Off-label use of Semaglutide for cosmetic weight loss as can be seen in (figure 5 & 6) has led to a persisting global shortage in Semaglutide medication (Ozempic) from at least October 2022 and is expected to continue throughout 2024 (Table 6.), (as per FDA Drug Database and Single Point Of Contact (SPOC) working party data). This shortage raises moral concerns regarding the availability of the drug for T2DM patients who rely on prescribed Ozempic for their condition's treatment

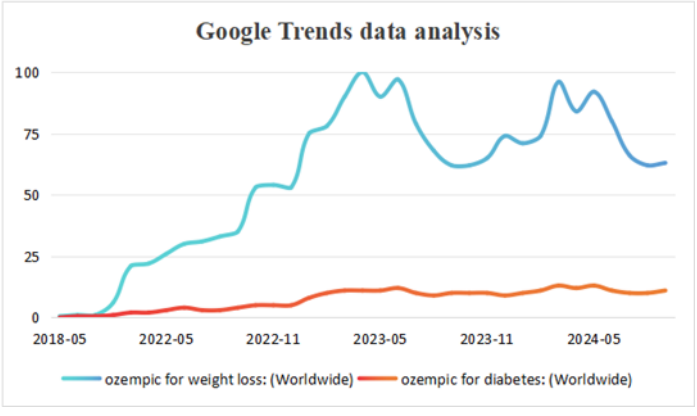

Figure 6: Google Trends data analysis for public interest in semaglutide medication Ozempic

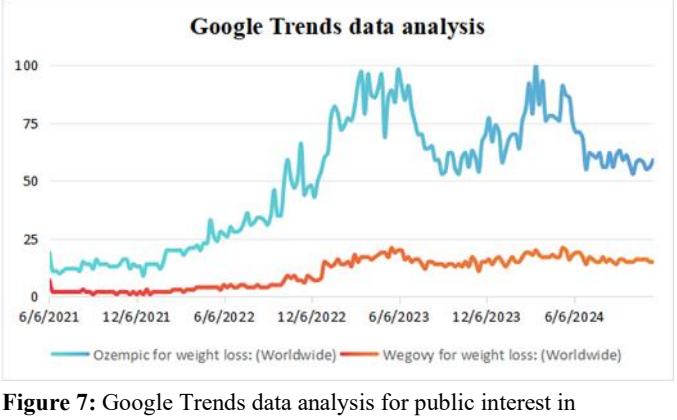

Figure 7: Google Trends data analysis for public interest in Semaglutide medications Ozempic vs Wegovy for weight loss indications

Table 6: Ozempic and Wegovy worldwide shortage due to off-label use for cosmetic weight management

	*FDA Drug shortage list	*SPOC shortage register	Listed reasons per SPOC
Drug name	Semaglutide injections (Ozempic and Wegovy)	Ozempic	Increased demand for Ozempic above the capacity constraints at some of the manufacturing sites
Month	Status	Status	
Oct-Dec-2022	in shortage	in shortage	Off-label use for weight management
Jan-Dec-2023	in shortage	in shortage	Off-label use for weight management
Jan-Jul-2024	in shortage	in shortage	Off-label use for weight management

Discussion

In the present study we aimed to explore the potential of Semaglutide medications misuse, particularly Ozempic, among the public for cosmetic weight loss purposes. Our study used public data from FAERS and Google Trends to evaluate the potential of Semaglutide misuse/abuse out of their approved indications. Our results showed that off-label use of Semaglutide brand name Ozempic, which was initially approved for T2DM management indications, was trending among the public for weight loss indications as opposed to diabetes management worldwide. Moreover, Ozempic popularity for weight loss indications outweighs the popularity of Wegovy, which was originally approved for weight management indications globally. In parallel with Semaglutide medications growing popularity for cosmetic weight loss, FAERS database showed an annual increase of approximately 1,930 AERs, this increase highlights a substantial and consistent rise in total AERs from 2018 to 2024 which could be associated with the growing popularity of Semaglutide medications for off-label use as a means of cosmetic weight loss achievement in non-diabetic young individuals [24]. Knowing that Semaglutide brand name Ozempic and Wegovy were the most reported brand names on FAERS would probably further support the association between the annual increase in AERS and off-label use of these medications for aesthetic purposes, as those brand names are trending among public for weight loss indications driven by celebrities and influencers on social media platforms [20]. The influence of celebrities and media platforms on cosmetic trends including medical choices of surgeries, dentistry and pharmaceuticals were previously documented [27-29]. Recently, GLP-1 analog Semaglutide gained great popularity as a breakthrough treatment not only for diabetes but other disorders like chronic obesity with at least one weight-related comorbidity, reduces the risk of cardiovascular diseases and showed a promising potential for alcohol use disorder management [30-32]. However, Semaglutide medication's potential in substantial weight loss has gained great popularity among non-diabetic young individuals who are seeking the use of Semaglutide to achieve weight loss for aesthetic purposes [33]. Misuse of pharmaceutical agents such as beta 2-agonists, dinitrophenol/DNP and others for weight loss has been previously documented, moreover, the potential misuse of Semaglutide among other GLP-1analog molecules have been recently suggested [34-36]. However, the former pharmaceutical agents like DNP and Clenbuterol are associated with toxicity and were linked to mortality [37,38]. Popularizing Semaglutide medications for weight loss on different media platforms without stressing on the potential health risks associated with abusing such medications has potentially led to increase AERs on FAERS each year [39]. A wide spectrum of Semaglutide-related adverse events has been reported on FAERS over the past years ranging from injection site reaction to life-threatening threatening events and death, most of these AERs concerned young adult females; Thus, emphasizing the need of limiting the use of these medications in prescription form and under medical supervision. However, Semaglutide medications possess an overall favorable risk/benefit profile for patients with T2DM and obese patients with cardiovascular risks [40]. Research has shown Ozempic effectiveness in lowering mortality rates among diabetes patients [30]. However, the mortality reports linked to Ozempic exceed any other serious outcome on FAERS database as well as mortality reports linked to Wegovy on FAERS, which could possibly indicate misuse of these medications outside their approved indications by the young population. Moreover, our study documents a persisting worldwide shortage in semaglutide medication (Ozempic) from at least October 2022 and is expected to continue throughout 2024 as per FDA Drug Database and SPOC data. Increased public demand and off-label use of Semaglutide medications for esthetic use were documented as the cause of this global shortage, which intern raises ethical concerns regarding prioritizing patient's needs potentially through restricting off-label prescription and dispensing of Semaglutide medications as well as establishing regulatory enforcement against off-label medications promotion and beauty trends involving pharmaceuticals on internet and social media platforms [41,42]. However, although FAERS and Google Trends data are widely used research tools certain limitations associated with these tools must be highlighted, our study relies on FAERS data which is subjected to reporting biases and unproven causality. Moreover, these data either self-reported or reported by medical health professionals hence “not specified” categories and the lack of raw data from Google Trends tool which interns lead to a lack of context of these trends that may reflect overall interest rather than an actual action thus collectively these limitations may potentially alter the context of the reported data which suggest the need for further empirical studies to further support these data.

Conclusion

Collectively, our study highlights a potential misuse pattern of Semaglutide medications for cosmetic weight loss proposed by celebrities and social media platforms without stressing on the potential adverse events associated with Semaglutide medications use outside their approved indications which led to an ongoing shortage of these medications. Thus, raising ethical concerns regarding the availability of these medications for T2DM and obese patients with cardiovascular risks and prioritizing patients need. Collectively, our study highlights the need for stricter regulatory policies for Semaglutide medication's prescription and dispensing guidelines, as well as the need for raising public awareness on the potential adverse events associated with the misuse of these medications and calls for establishing regulatory enforcement against beauty trends that involves the off-label use of pharmaceuticals on the internet and social media platforms.

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This research did not receive any specific fund.

Conflict of Interest

Authors declare no conflict of interest.

Data availability

Data are available upon reasonable request.

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