

Plastic Surgery Statistics in the US: Evidence and Implications

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Received: 18 June 2015 / Accepted: 8 January 2016 / Published online: 16 February 2016
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Abstract

Background The American Society of Plastic Surgeons publishes yearly procedural statistics, collected through questionnaires and online via tracking operations and outcomes for plastic surgeons (TOPS). The statistics, disaggregated by U.S. region, leave two important factors unaccounted for: (1) the underlying base population and (2) the number of surgeons performing the procedures. The presented analysis puts the regional distribution of surgeries into perspective and contributes to fulfilling the TOPS legislation objectives.

Methods ASPS statistics from 2005 to 2013 were analyzed by geographic region in the U.S. Using population estimates from the 2010 U.S. Census Bureau, procedures were calculated per 100,000 population. Then, based on the ASPS member roster, the rate of surgeries per surgeon by region was calculated and the interaction of these two variables was related to each other.

Results In 2013, 1668,420 esthetic surgeries were performed in the U.S., resulting in the following ASPS ranking: 1st Mountain/Pacific (Region 5; 502,094 procedures, 30 % share), 2nd New England/Middle Atlantic (Region 1;

319,515, 19 %), 3rd South Atlantic (Region 3; 310,441, 19 %), 4th East/West South Central (Region 4; 274,282, 16 %), and 5th East/West North Central (Region 2; 262,088, 16 %). However, considering underlying populations, distribution and ranking appear to be different, displaying a smaller variance in surgical demand. Further, the number of surgeons and rate of procedures show great regional variation.

Conclusions Demand for plastic surgery is influenced by patients' geographic background and varies among U.S. regions. While ASPS data provide important information, additional insight regarding the demand for surgical procedures can be gained by taking certain demographic factors into consideration.

Level of Evidence V This journal requires that the authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Plastic surgery · Statistics · Esthetics · Cosmetic surgery · Surgical procedures · Regional distribution · Geography · Data analysis

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Introduction

Since 2005, the American Society of Plastic Surgeons (ASPS) [1] has published statistics on plastic surgical and minimally invasive procedures [2]. In its 2013 report, the society quotes a total of 15,116,353 cosmetic procedures performed, comprised of 1668,420 cosmetic surgical procedures and 13,447,933 cosmetic minimally invasive procedures. Compared to 2012, this represents an increase of 3 % (1 and 3 %, respectively) [2].

A recently published paper on past trends and expected future demand of surgical procedures in the U.S., based on nationwide data, critically appraised that the rise and fall of procedures are not equally distributed over time and space [5]. While esthetic surgical procedures are influenced by individual preferences, demographic characteristics, and reactions to economic changes, they also reflect the importance of geographic location [4]. As such, there also exist marked differences in demand for esthetic plastic surgery between the different regions and states of the U.S.

The 2013 ASPS report published the following ranking and distribution regarding the 1668,420 cosmetic surgical procedures:

1st Mountain Pacific states (Region 5), with 502,094 procedures (30 %);

2nd New England/Middle Atlantic states (Region 1), with 319,515 procedures (19 %);

3rd South Atlantic Region states (Region 3), with 310,441 procedures (19 %);

4th East and West South Central states (Region 4), with 274,282 (16 %) procedures; and

5th East and West North Central states (Region 2), with 262,088 procedures (16 %).

This sequence seems intuitive at first and would suggest that the highest demand for plastic surgical procedures exists in Region 5. However, while the data do provide information about the regional differences in absolute numbers of surgical procedures, to better assess the actual demand for procedures, the number of procedures performed in each region should consider the underlying base population. Further, to estimate the demand for plastic surgical procedures *per surgeon*, the number of surgeons in the five regions who actually perform the quoted procedures also needs to be accounted for.

The objective of this study was therefore to break down regional differences in demand for plastic surgical procedures within the United States by putting them into relation to the regional population and the number of practicing board-certified plastic surgeons within the respective geographic locations.

The two principal hypotheses are as follows:

- (1) the currently published ranking and regional distribution will change when taking into consideration the underlying regional population and
- (2) there should be a correlation between surgeon density and number of procedures. While in areas where fewer plastic surgeons serve a relatively larger population, those surgeons should be busier, i.e., perform more surgeries, in areas where more plastic surgeons serve a smaller population, those surgeons are expected to be less busy and perform fewer surgeries per surgeon.

The results of this study will serve to more accurately depict the actual demand for plastic surgery in the respective geographic locations and, taking into account the number of surgeons practicing in these regions might also help young or relocating plastic surgeons to identify areas within the U.S. where demand of plastic surgical procedures per surgeon is likely going to be the highest.

Methods

The analyses presented are based on the plastic surgery statistics reports from 2005 to 2013, as published by the ASPS. ASPS plastic surgery procedural statistics are collected through questionnaires and, since 2002, an online national database for plastic surgery procedures, called tracking operations and outcomes for plastic surgeons (TOPS). ASPS claims to offer the most comprehensive, reliable statistics on cosmetic and reconstructive plastic surgery procedures performed in the United States. The 2013 annual questionnaire was distributed online and via fax to 23,700 ABMS board-certified physicians. A total of 801 active physicians returned questionnaires, consisting of 479 plastic surgeons, 221 dermatologists, and 101 Otolaryngologists. Overall, 1160 active physicians were included in the final sample. ASPS statistics are then generated by extrapolating the data most likely to perform cosmetic and reconstructive plastic surgery procedures, resulting in the most accurate census available [2]. Results of the survey are based on a 95 % confidence level with a ± 3.41 % margin of error [3]. The results are published in total and relative numbers, disaggregated by five regions within the United States.

The ASPS Categorizes the U.S. Regions as Follows

“Region 1” is comprised of the New England states (CT, ME, MA, NH, RI, VT) and of the Middle Atlantic states (NJ, NY, PA),

“Region 2” refers to the East North Central (IL, IN, MI, OH, WI) and West North Central states (IA, KS, MN, MO, NE, ND, SD),

“Region 3” is located around the South Atlantic states (DE, DC, FL, GA, MD, NC, SC, VA, WV, PR),

“Region 4” includes the East South Central (AL, KY, MS, TN) and West South Central (AR, LA, OK, TX) states, and

“Region 5” includes the Mountain (AZ, CO, ID, MT, NV, NM) and Pacific (AK, CA, HI, OR, WA) states.

The combined ASPS data allow for regional analysis of plastic surgery statistics. However, due to the large aggregation of the available information into five main

geographic regions, selectional bias exists and a comprehensive analysis at the state, municipality, or even city level cannot be conducted. This would be important as state size and respective population and surgeon density may vary significantly, for instance, when comparing Alaska with California. Further, given that access to data is only available in tabulated form, cross tabulation, or even triangulation of different surgical variables is not possible.

Based on the annual reports, the authors conducted time series analyses of single datasets of cosmetic surgical procedures by regional distribution and related these to the underlying base population. Rates of plastic surgery procedures per 100,000 population in the five regions were calculated relying on population estimates according to the centennial 2010 U.S. census, as provided by the Population Division of the U.S. Census Bureau [9].

In a last step, the number of procedures was related to the total number of board-certified plastic surgeons practicing in the respective states, including all surgeons listed in the ASPS member roster.

Results

Equaling absolute numbers make actual comparison of demand between the regions difficult. By calculating rates of plastic surgery procedures per 100,000 inhabitants in the respective regions, the actual prevalence of plastic surgery can be visualized.

Procedures Per 100,000 Population

Based on the 2010 census, the U.S. has a total population of 319 million people. Taking the ASPS regions as a basis for categorization, 23.2 % of the U.S. total population lived in Region 5 (74,254,423), 21.2 % in Region 2 (67,547,890), 20.5 % in Region 3 (65,398,733), 17.7 % in Region 4 (56,599,806), and 17.5 % in Region 1 (55,943,073). On average, for the entire U.S. in 2013, 528 surgical procedures were performed for every 100,000 people.

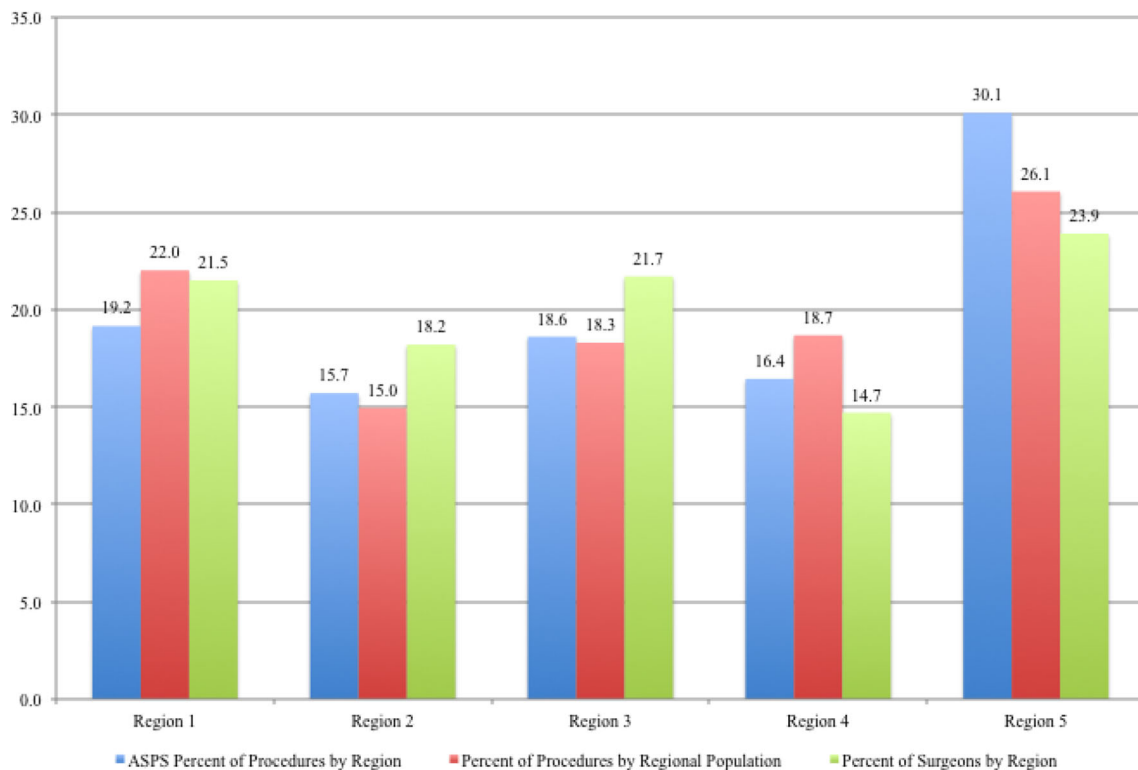
Table 1 illustrates how the total number of procedures and their respective share change when calculated per 100,000 population. It confirms that the variance between the regional shares of procedures, when related to the actual population size in the respective region, is smaller than when leaving this variable out of consideration. Doing so changes the ranking as well as the relative difference between the regions to a more equally distributed demand—less geared toward only two top performers.

Broken down by regional population, the ranking is still led by Region 5, with 676 procedures per 100,000 inhabitants (however with a lower predominance among the regions with a regional share of only 26.1 % compared to 30.1 % as per ASPS ranking). The second rank is held by Region 1 with 571 procedures per 100,000 (22 vs. 19.2 %). The adjusted distribution of procedures in the remaining three regions shows 485 procedures per 100,000 in Region 4 (18.7 vs. 16.4 %), 475 procedures per 100,000 in Region 3 (18.3 vs. 18.6 %), and 388 procedures per 100,000 in

Table 1 Distribution of plastic surgical procedures and percent difference between neighboring ranked regions

ASPS rank	Region	Total procedures	Share in %	Percent difference among share
Ranking as per ASPS				
1	5	502,094	30.1	
2	1	319,515	19.2	44.2 %
3	3	310,441	18.6	3.1 %
4	4	274,282	16.4	12.6 %
5	2	262,088	15.7	4.4 %
		Total 1668,420	Total 100.0	
Adjusted rank	Region	Procedures per 100,000	Share in %	Percent difference among share
Ranking based on relative distribution				
1	5	676	26.1	
2	1	571	22.0	17.04 %
3	4	485	18.7	16.21 %
4	3	475	18.3	2.16 %
5	2	388	15.0	19.81 %
		Total 2595	Total 100.0	

Source Own calculations based on American Society of Plastic Surgeons (plastic surgery statistics) and U.S. Census Bureau



Graph 1 Percent of procedures and surgeons, by region and regional population

Region 2 (15 vs. 15.7 %). Table 1 also illustrates the percent differences and the changed rankings. When calculating procedures per 100,000 inhabitants in the respective regions, Region 4 and Region 3 change their position, which changes the ranking to:

1st Mountain Pacific states (Region 5), with 676 procedures per 100,000 (26.1 %) > formerly also Nr. 1 with a total of 502,094 procedures (30 %).

2nd New England/Middle Atlantic states (Region 1), with 571 procedures per 100,000 (22.0 %) > formerly also Nr. 2 with a total of 319,515 procedures (19 %).

3rd East and West South Central states (Region 4), with 485 procedures per 100,000 (18.7 %) > formerly Nr. 4 with a total of 274,282 procedures (16 %).

4th South Atlantic Region states (Region 3), with 475 procedures per 100,000 (18.3 %) > formerly Nr. 3 with a total of 310,441 procedures (19 %).

5th East and West North Central states (Region 2), with 388 procedures per 100,000 (15.0 %) > formerly also Nr. 5, but with a total of 262,088 procedures (16 %).

Graph 1 displays the percentage distribution of procedures and surgeons, by region and regional population. As can be seen, the population-weighted shares of procedures have a smaller statistical variance between the regions regarding their demand for surgical procedures. Graph 1 provides insight into the distribution of surgeons per

region. Both of those measures let the actual distribution appear less extreme. Instead of stating that the highest number of procedures is performed in Region 5, this analysis provides more nuanced evidence, allowing to state that 26 % of all procedures per capita are performed in Region 5 by 24 % of all surgeons in the U.S. Also, in Region 4, 19 % of all procedures per capita are performed by only 15 % of all U.S. surgeons. It is therefore Region 4 that displays the highest discrepancy between surgeon density and surgical demand.

Surgeries Per Surgeon

In a subsequent step, the number of plastic surgeons in the five regions was calculated based on the ASPS member roster. With 1329 plastic and reconstructive surgeons, Region 5 has the largest absolute number of surgeons, accounting for 24 % of all surgeons in the U.S.

However, surgeon density per regional population is highest in the states of New England and Middle Atlantic. Region 1 has more plastic surgeons per capita than any other region. In this area, with 1191 surgeons (21.5 %), the lowest number of people has to be covered per single plastic surgeon. There is one plastic surgeon for every 47 thousand inhabitants in the states of New England and Middle Atlantic compared to one plastic surgeon for every

Table 2 Distribution of procedures by plastic surgeons

Region	Regional population	Number of surgeons	Plastic Surgeons per 100,000 Capita	Inhabitants for every plastic surgeon	Number of procedures per surgeon
1	55,943,073	1191 (21.5 %)	2.128950	46,972	268
2	67,547,890	1013 (18.2 %)	1.499677	66,681	259
3	65,398,733	1203 (21.7 %)	1.839485	54,363	258
4	56,599,806	815 (14.7 %)	1.439934	69,448	337
5	74,254,423	1329 (23.9 %)	1.789792	55,872	378

Source Own calculations based on American Society of Plastic Surgeons (Member Roster) and U.S. Census Bureau

56 thousand potential patients in the Mountain and Pacific states. The ratio is most distinct in Region 4 of East and West South Central, where there is only one plastic surgeon for every 69 thousand people (Table 2).

The rate of number of procedures to plastic surgeons also varies greatly between the regions. On average, a plastic surgeon in Region 5 performs 120 more surgeries on a yearly basis than a surgeon in Region 3.

As hypothesized, first, the published ASPS ranking, when adjusted to underlying demographic factors, changes in order and more importantly in composition and distribution. Secondly, surgeon density considerably impacts the actual number of surgeries a surgeon performs. Therefore, a rise in plastic surgeons within a certain area does actually not provoke the population to request more surgeries, but it impacts the actual work load of the existing number of surgeons in the respective geographic location.

Discussion

As per ASPS, with 502,094 cosmetic surgical procedures, the geographic area of the Mountain/Pacific region displayed most cosmetic procedures performed in the U.S., accounting for 30 % of all surgical procedures performed. However, as shown, different meanings of such absolute numbers may emerge depending on their interpretation. This study confirmed the authors' assumptions that U.S. demand for cosmetic surgical procedures varies from region to region through the influence of a patients' and surgeons' geographic background characteristics. While esthetic surgical procedures reflect individual preferences, demographic characteristics and reactions to economic changes, they also reflect the importance of space [4, 6].

As suspected, when taking underlying demographic and geographic factors into account, the ASPS ranking changes though only in one position. The weighted breakdown shows a substantially more balanced demand for surgeries than when merely considering absolute numbers.

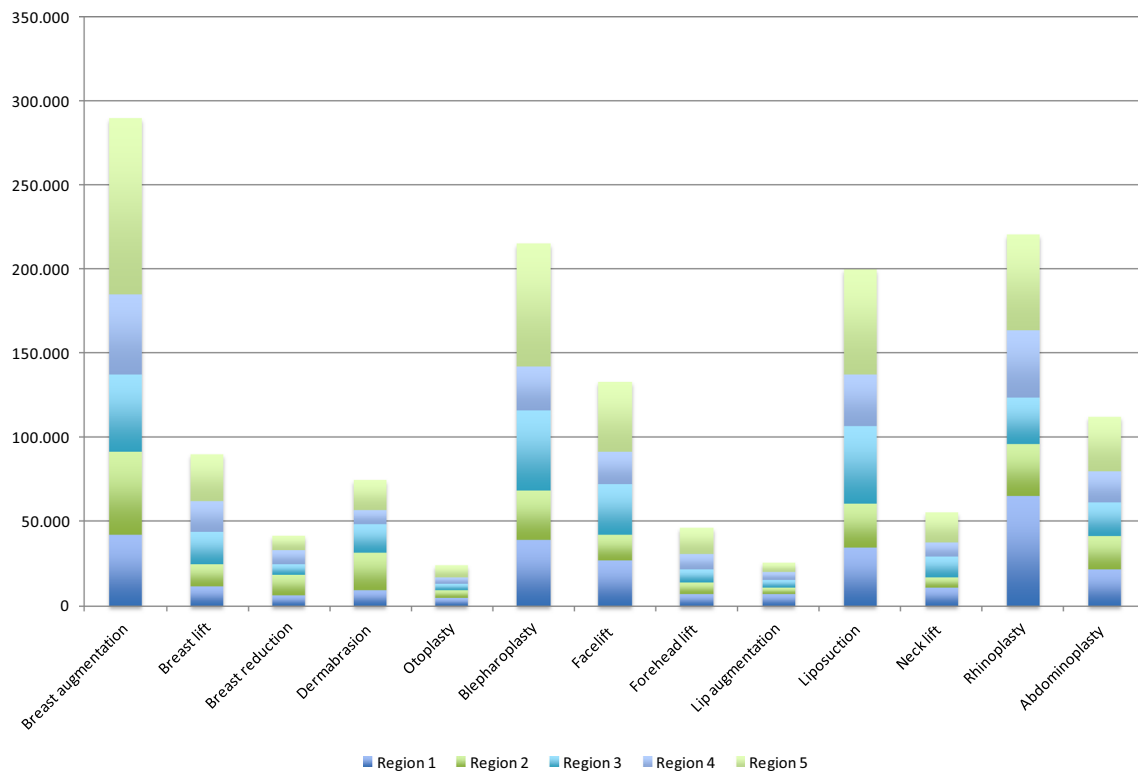
The assumption that regions with a high presence of plastic surgeons positively influences the demand, thus

stimulating more plastic surgeries to be performed in these regions, does not necessarily hold true. As the ratio of plastic surgeons per 100,000 capita increases, the number of procedures per surgeon decreases. These data provide insight into geographic opportunities for surgeons who want to settle. However, while interpreting past and current statistics may certainly prove valuable in an attempt to analyze and potentially even predict demand, such demand is ultimately steered by a multitude of factors, including economics. In the years of 2007 to 2009, during the U.S. economic downturn, every region lost a significant number of patients. "The recession from 2007 was exceptional in its magnitude and impacted esthetic surgery profoundly." [5].

While the downward movement stabilized in 2010, it has not recovered to levels before the recession. This slight upward trend can be explained partially by the economic recovery as well as the execution of procedures, which had previously been postponed due to financial uncertainty [7].

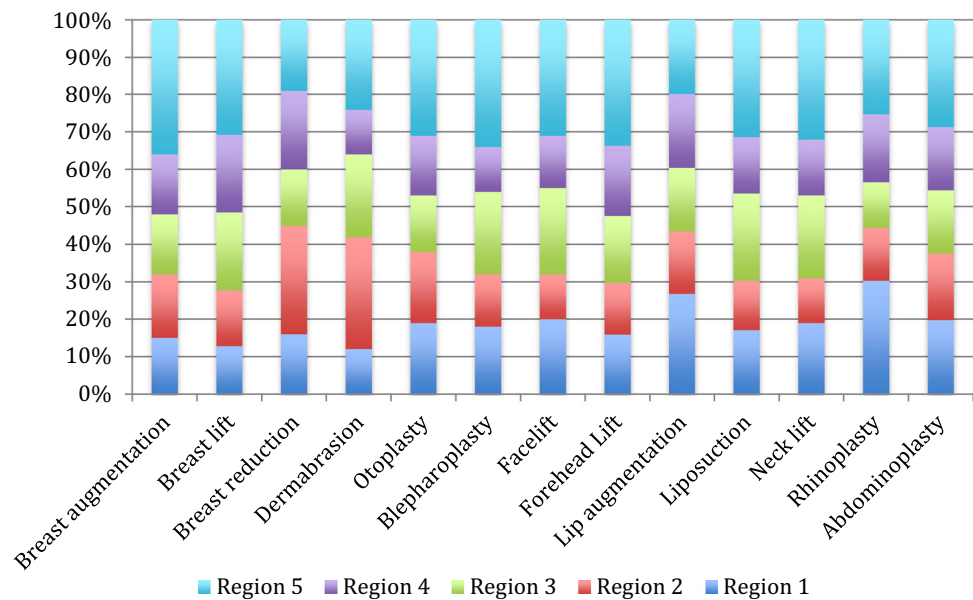
In summary, unforeseeable events such as recessions are hard to predict and may impact demand significantly.

Although tabulations published by the ASPS provide insight into the number and type of procedures broken down by sex, age ethnic group, and region, they do not allow for in-depth analysis, cross tabulation, or even triangulation of surgical or demographic variables. What can be distilled, however, is the fact that the five defined regions display diverse patterns in respect to request of certain procedures. In 2013, combined, the top five procedures at the national level of the U.S. were breast augmentations (290,000), rhinoplasties (221,000), blepharoplasties (216,000), liposuctions (200,000), and face-lifts (133,000) (Graph 2). The distribution and ranking change, however, when looking at each of the five different regions individually (average share of individual procedures per region over the past four years; Graph 3) [2]. For instance, among all breast augmentations performed in the U.S. in 2013, 36 % were performed in the Mountain and Pacific Region 5, compared to 15 % in New England and the Middle Atlantic Region 1. Similarly, Region 5 demanded 36 % of all chin augmentations, while Region 4



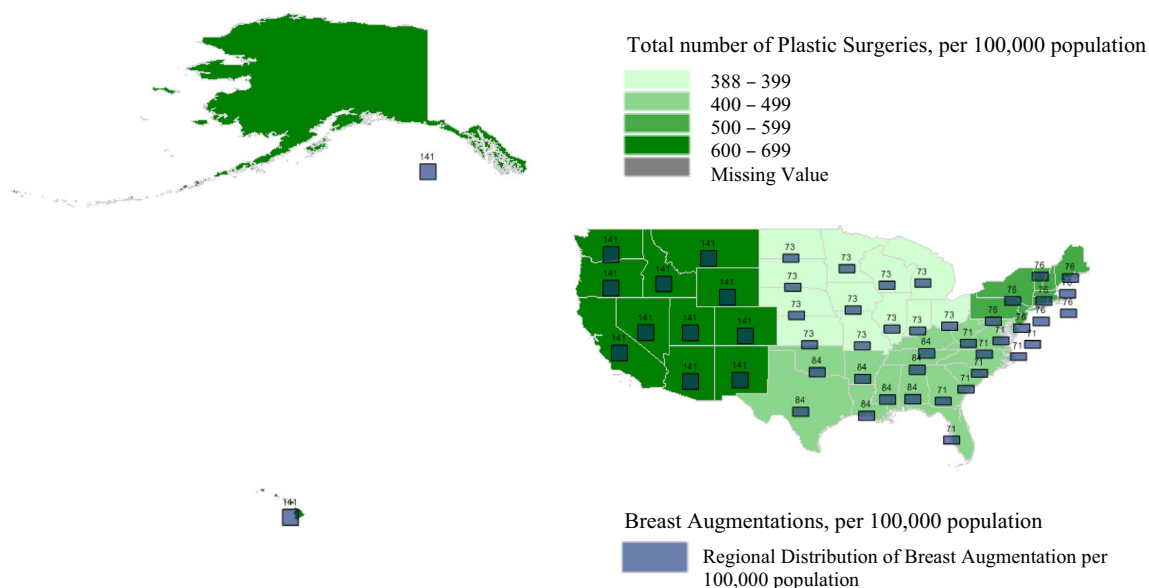
Graph 2 Regional distribution of surgical procedures, 2013

Graph 3 Average Regional proportions of surgical procedures, 2009–2013



only accounted for 11 %. The other procedures display similar rates of fluctuation. Region 5 (99) requests twice the number of blepharoplasties than Region 2 (44) and Region 4 (46). Region 1 (70) and Region 3 (72) rank closely regarding their share among eyelid surgeries. The

biggest difference in demand for liposuctions lies between Region 3 (38) and Region 5 (83). Region 4 ranks fourth with 54 liposuctions per 100,000 population, Region 1 (62) third with and Region 2 (71) second. 133,000 facelifts were requested in 2013. 56 facelifts per 100,000 population were



Map 1 Regional distribution of total plastic surgeries and breast augmentations in the U.S

performed in Region 5, compared to 48 per 100,000 in Region 1 and 46 per 100,000 in region 3. Only 33 per 100,000 population were performed in Region 4 and 23 in Region 2.

There may be several reasons accounting for these facts: “The factor that seems to play the biggest role in influencing why a type of plastic surgery is more popular in one region than another, experts suggest, is the weather.” [8].

The population of Region 5, which includes warm and sunny weather states such as California and Arizona, wear less clothing year-round, which might lead to more body consciousness. As such, individual preferences are influenced on where patients live and what they see: what procedures are performed does not only depend on the individual’s cultural and ethnic background but also on geographic factors which influence peoples’ esthetic perception.

The causal warm weather assumption might help explain why people in colder climates concentrate more on surgical procedures around the face, such as blepharoplasties, rhinoplasties, and facelifts as in Regions 2, 3, and 4. Region 1 of New England and the Middle Atlantic had the highest proportion of rhinoplasties (30 %) and lip augmentations (27 %).

Further, demand for different surgical procedures also tends to be self-feeding. The environment people live in and what prospective patients see among others seem to impact their surgical choices [8].

As recent studies have confirmed the impact of ethnic characteristics on esthetic preferences, the ethnic distribution within a certain region will further factor in surgical decision-making [8].

When evaluating ASPS procedural trends over the past years, it became apparent that certain regional patterns seem to have evolved. Based on the presented approach, a different regional break down could be applied. As Map 1 shows, regional trends in plastic surgery in the U.S. could be categorized along four geographic groups: West, Northeast, South, and Midwest (in order of ranking). According to the authors’ analysis of total plastic surgery procedures, little difference exists between the South Atlantic and East and West South Central States of Region 3 and Region 4, respectively. The geographic breakdown could also change with respect to individual procedures, where even more striking differences are revealed. Per 100,000 population, Region 5 has twice as many breast augmentations (141) as Region 3 (71) and almost doubles Region 1 (76), Region 2 (73), and Region 4 (84) (Map 1). As seen, the regional breakdown of surgical procedures hides statistical differences between the States of the U.S. An attempt should be made to publish procedure statistics at the state level, per province or even municipality. Such disaggregated data by state could certainly provide a more nuanced profile of plastic surgical patterns within the U.S. than is possible to draw with current data access.

Further limitations of the study include the fact that, while quoted by the ASPS to provide the highest quality data available, the latter is still based on extrapolations and not on officially gathered data points. To counteract this limitation and provide the surgical community with higher quality data, TOPS has recently been established. TOPS, which entails an electronic database to enter case information online or via physician practice management software, is intended to offer plastic surgeons a tool to submit “clinical and demographic information into multiple, confidential databases, minimize redundant data entry and provide clinical/practice information to plastic surgeons and their specialty.” [1] Updating and gaining unlimited access to TOPS information in an anonymized format would allow for in-depth analysis and enrich the evidence about current clinical trends and allow for future projections. As of yet, and as such an additional limitation of the presented study, the fact that many of the information provided by the respondents of the surveys are based on respective subjective estimates by the surgeons regarding their procedures performed.

To conduct more rigorous research in this area, following cohorts over time and cross-tabulating patient characteristics, including single year of age of patients, would be beneficial. Procedural statistics should further be disaggregated by sex, age, and ethnic group [5].

In a next step, it would also be worthwhile investigating if similar regional differences exist over time in respect to minimally invasive procedures.

Conclusion

Surgeon density per regional population varies largely between the regions, providing evidence for which geographic regions to target when scaling up surgical performance. However, the assumption that more surgeons feed the demand for surgery does not hold. Based on still limited access to clinical and demographic data in the area of plastic surgery, the authors advocate for open data, for

example, through access to TOPS to analyze anonymous case information and strengthen the evidence base with clinical and practice information to plastic surgeons and their specialty. In summary, while demand for esthetic surgery reflects individual preferences, demographic characteristics, and reactions to economic changes, the importance of space needs to be considered as it impacts demand significantly.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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