

Comparing coverage of medically indicated reduction mammoplasty among Swiss health insurers: a retrospective study

Marlon Petrus^{a*}, Silke Graul^{a*}, Rafael Loucas^a, Julius M. Mayer^b, Sebastian Leitsch^a, Thomas Holzbach^a

^a Department of Hand and Plastic Surgery, Thurgau Hospital Group, Frauenfeld, Switzerland

^b Department of Plastic Surgery and Hand Surgery, University Hospital Zurich, Zurich, Switzerland

* Equal contribution as first authors

Summary

BACKGROUND: Reduction mammoplasty is commonly used to treat macromastia, highlighting the need to address the physical and psychosocial issues associated with breast hypertrophy. However, clear inconsistencies in insurance coverage and varying criteria for medically necessary surgery are evident. The compliance of Swiss insurance companies with the 2019 recommendations of the Swiss Society of Medical Officers and Insurance Physicians has not been fully assessed.

AIM: This study aimed to investigate the proportion and variability in cost approvals for reduction mammoplasty among Swiss insurers, focusing on differences in their approval and denial rates.

METHODS: A retrospective study was conducted on patients presenting with breast disease at Spital Thurgau AG between January 2016 and December 2022. It analysed the proportion and variability in cost approval rates for reduction mammoplasty among different insurance providers. Demographic patient data were collected and statistically analysed using chi-squared and Fisher's exact tests to evaluate if a statistically significant relationship exists between insurance providers and cost approval. Only Swiss insurance providers servicing at least five patients in the final cohort were included.

RESULTS: Between January 2016 and December 2022, 1105 patients with breast disease were evaluated at Spital Thurgau AG, of whom 210 were eligible for this study on reduction mammoplasty cost approvals. Of the 210 cost approval requests made to nine different insurance companies, 54% were approved. Approval rates differed significantly among insurers ($p = 0.003$).

CONCLUSION: This study uncovered an elevated rate of cost approval denials, which depended significantly on the insurance provider. To ensure that the costs of a medically indicated breast reduction are covered consistently and fairly, a review of existing guidelines and their implementation is necessary to improve the system.

Introduction

Reduction mammoplasty, indicated by macromastia, is one of the most common plastic surgery procedures performed

worldwide [1]. It addresses a health burden associated with significant physical and psychosocial manifestations [2, 3]. The goal of breast reduction mammoplasty is to reduce excess breast tissue, thereby relieving the physical symptoms associated with breast hypertrophy. Symptoms can range from neck and shoulder pain to difficulties in hygiene and the development of infections [4].

Prospective studies have shown that conservative treatment has no lasting effect on symptom relief or does not improve a patient's quality of life [5]. There are limited treatment options for patients suffering from symptomatic breast hypertrophy. Conservative approaches such as supportive devices, physical therapy, exercise, and medications do not provide long-lasting relief of symptomatic breast hypertrophy. However, insurance companies continue to require proof of undergoing conservative treatments [3].

In contrast, surgical reduction of excess breast tissue leads to long-lasting improvements in both physical and psychological symptoms [6–8]. High-quality, randomised studies have clearly shown that early surgical intervention instead of the necessary conservative therapy reduces the psychosocial and physical suffering of young or post-menarche patients with symptomatic breast hypertrophy. Their results confirmed that patients with more than two symptoms experienced a significantly greater improvement than those who reported fewer symptoms [9].

Moreover, several studies have demonstrated that reduction mammoplasty profoundly improves patients' satisfaction with breast appearance, psychosocial well-being, sexual well-being, and physical well-being [10–12]. Nonetheless, coverage for medically indicated breast reduction is often denied, even when it is proven to relieve symptoms [13, 14].

In Switzerland, the Federal Health Insurance Act (KVG/LAMal) mandates that, for a procedure to be covered by compulsory insurance, it must fulfil the principles of effectiveness, appropriateness, and efficiency (EAE) [15]. Thus, procedures must provide a health benefit, be suitable for the patient's condition, and be cost-effective relative to their benefits. Insurance companies greatly impact determining the medical necessity of surgical procedures. However, significant differences exist in the coverage and med-

Marlon Petrus
Department of Hand and
Plastic Surgery
Kantonsspital Frauenfeld
Thurgau Hospital Group
Pfaffenholzstrasse 4
CH-8500 Frauenfeld
marlonpetrus[at]gmx.ch

ical indications for common plastic surgery procedures, including reduction mammoplasty [16–19].

Indeed, plastic surgeons have frequently considered the insurance coverage requirements for reduction mammoplasty arbitrary and not grounded in scientific evidence. Many insurance policies still use outdated criteria that do not correlate with symptom relief [20–23]. The criteria – minimum resection weight/volume, body mass index, obesity, age, related signs and symptoms (e.g. pain, headaches, rashes, intertrigo, or bra strap grooving), conservative therapy, and restrictions in quality of life – required for coverage of the medically indicated surgery by the insurance companies do not align with the current literature [21, 23–26].

In response to these challenges, the Swiss Society of Medical Officers and Insurance Physicians (BGE 130 V 299) [27] established recommendations in 2019 to align insurance coverage criteria for reduction mammoplasty with the principles of effectiveness, appropriateness, and efficiency, as mandated by the KVG/LAMal [15]. These guidelines set specific criteria for cost coverage, focusing on factors like body mass index (BMI) thresholds, documented symptoms, and evidence of conservative therapy attempts. However, it remains unclear how consistently insurers adhere to these recommendations in practice.

This study aimed to assess the proportion and variability in cost approvals for reduction mammoplasty among Swiss insurers, focusing on differences in their approval and denial rates.

Patients and methods

All patients who presented with breast disease between January 2016 and December 2022 in the Department of Hand and Plastic Surgery at Spital Thurgau AG in Frauenfeld/Münsterlingen, Switzerland, were included in this retrospective single-centre study. Patients were classified into the following groups corresponding to their primary diagnosis:

- *Breast hypertrophy* (enlarged breast size relative to body morphology)
- *Breast hypoplasia* (reduced breast size relative to body morphology)
- *Ptosis* (according to the Regnault classification [28])
- *Breast cancer* (histologically confirmed)
- *Capsular contracture* (graded using the Baker classification [29])
- *Implant rupture or dislocation* (confirmed radiologically by MRI or ultrasound)
- *Gynecomastia* (confirmed radiologically by ultrasound)
- *Subcutaneous tumours* (clinically diagnosed)
- *Previous breast surgery* performed at an external hospital

Inclusion criteria:

For this study, we focused on patients with symptomatic breast hypertrophy, who were potentially eligible for insurance coverage based on the guidelines established by the Swiss Society of Insurance Physicians (BGE 130 V 299) [27]. Given the retrospective design of the study, only patients meeting the following criteria were included:

- Expected minimum resection weight of 500 grams per breast
- Documented symptoms directly related to breast hypertrophy (e.g. persistent back or neck pain)
- BMI ≤ 27.5 kg/m²

Exclusion criteria:

Patients were excluded from this study if they met any of the following conditions:

- Aged under 16 years
- Presence of a concomitant oncological breast diagnosis
- Lack of response from the insurance company regarding coverage requests
- Undergoing reduction mammoplasty on a self-pay basis
- Absence of a clear medical indication for surgery, as determined by the guidelines [27]

The results of insurance decisions regarding coverage of reduction mammoplasty were analysed. We evaluated two sets of patients. Initially, we included patients with a BMI greater than 27.5 kg/m² to achieve sufficient statistical power, not considering obesity as an exclusion criterion. In a second analysis, we narrowed the group of patients to those with a BMI ≤ 27.5 kg/m², adhering strictly to the guideline criteria outlined in BGE 130 V 299. This approach provided a comprehensive analysis while allowing us to assess whether limiting the BMI range could influence the outcomes.

The following patient-related data were retrospectively collected for each patient:

- Age
- Body mass index
- Resection weight per breast
- Health insurance provider
- Cost approval request/reconsideration request

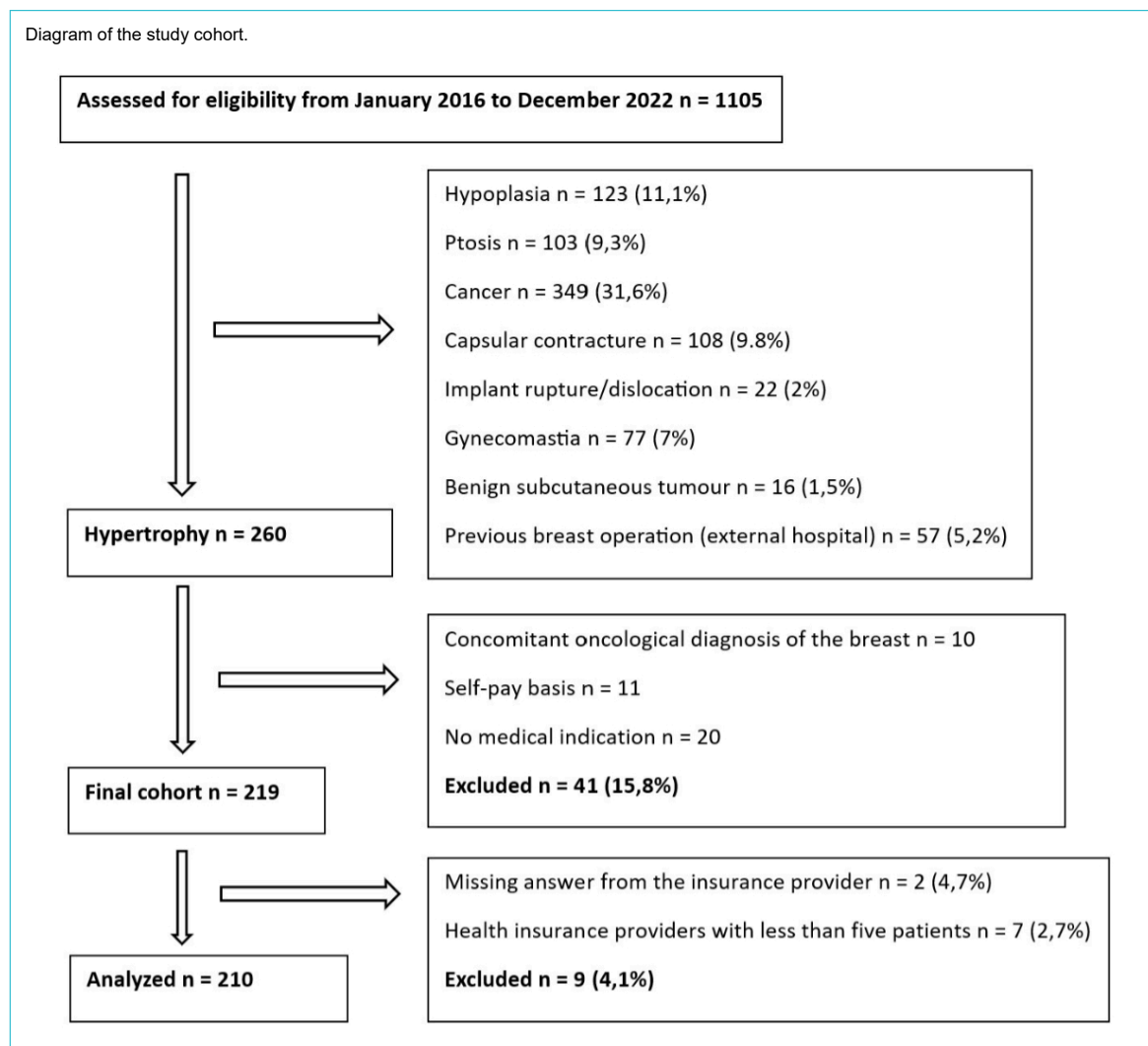
The number of requests for cost approval and reconsideration were summarised for each insurance company. To achieve sufficient statistical power, only Swiss health insurance providers with at least five patients in the final cohort were included in the analysis. The names of the insurance providers obtained during data collection and statistical analysis were omitted for data protection reasons.

The research committee of Spital Thurgau HPC approved this study. Additional approval from the Cantonal Ethics Board (EKOS Ostschweiz) was deemed unnecessary for the following reasons. First, this study focused on Swiss health insurance policies for treatment coverage and would not alter patient treatment recommendations. Second, this study was retrospective and used anonymised patient data, upholding confidentiality and ethical standards. Third, our methodology complied with the 1964 Declaration of Helsinki and its subsequent amendments, safeguarding ethical integrity and patient privacy.

Statistical analysis

The identified data were collected from patients' records via the clinical information system KISIM (CISTEC) and coded (anonymously) in our database in Microsoft Office Professional Plus 2016 Software (Microsoft Corporation).

Diagram of the study cohort.



Statistical analyses were performed using the RStudio statistical software (version 1.1.456). A statistical expert from Statworx, a technology-independent service provider, reviewed and verified all analyses.

The collected data included descriptive statistics like means and standard deviations for continuous and frequencies for categorical variables. Statistical significance was assessed at the 5% significance level, with a p -value < 0.05 considered statistically significant.

We calculated 95% confidence intervals to estimate the likely range of the true effect. We assessed post hoc power for nonsignificant results, using 80% as the benchmark for adequate power. Lower power suggests that nonsignificant findings might be due to a small sample size rather than a true lack of effect.

The relationship between the two categorical scaled variables – health insurance provider and cost approval – was assessed using Fisher's exact test, as the assumptions of the chi-square test could not be met. In addition, Cramer's V was calculated to determine the size of the relationship. According to Cohen (1988) [30], effect sizes like Cramer's V mean 'the degree to which the phenomenon is present in the population' (p. 9). Furthermore, Cohen provides reference values for the effect size ω that can be transferred to Cramer's V since cost approval has only two values:

- small: $\omega = 0.10$

- medium: $\omega = 0.30$

- large: $\omega = 0.50$

Standardised residuals were used to test whether the ratio of approved to rejected claims for coverage by a particular health insurance provider differed significantly from what would be expected, given the independence of the health insurance provider and cost approval. If a standardised residual was smaller than -1.96 , the actual frequency was considered significantly smaller than that which would be expected if it were independent. If a standardised residual was greater than 1.96 , the actual frequency was considered significantly greater than that which would be expected in the case of independence.

The Kruskal-Wallis test was used to assess whether the medians of the collected demographic data (age and BMI) and resected weight differed significantly between health insurance providers. The independent samples t -test was used to assess whether the means of age, BMI, and resected weight differed significantly between cost approval and denial.

Figures 2–4 were generated using the seaborn package (version 0.12.2) in Python (version 3.11).

Results

From January 2016 to December 2022, 1105 patients attended a breast consultation in the Department of Hand and Plastic Surgery at Spital Thurgau AG (figure 1).

A total of 260 patients were identified with breast hypertrophy. For 219 patients, the indication to apply for cost approval was provided by the specialist, and they were included in this study. The 50 excluded patients are summarised in figure 1. In addition, two patients were excluded because feedback from the insurance company was pending at the end of this study, and seven were excluded because only health insurance providers with at least five patients were included in the analysis. The number of patients included in the analysis for each Swiss health insurance provider (A–I) is shown in table 1.

Among the remaining 210 patients, 150 underwent breast reduction surgery. Regarding the 210 cost approval requests, 114 were approved (54%) and 96 were denied (46%).

The relationship between health insurance providers and cost approval was significant ($\chi^2(8) = 22.09$, $p = 0.003$; Cramer’s $V = 0.32$ [0.26, 0.48]; figure 2).

Besides the significant relationship, the results indicated a medium effect size that was medium to large considering the 95% confidence interval (detailed analyses: table 2 and figure 3). Additionally, standardised residuals for Insur-

ance B were greater than |1.96|, indicating that applications for cost approval were denied more often than they were approved. Moreover, the standardised residuals for Insurance C and Insurance F were greater than |1.96|, indicating that applications for cost approval were almost always approved.

Among variables (figure 4), the median age, BMI, and resected weight did not differ significantly between health insurance providers ($p = 0.20$, 0.98 , and 0.49 , respectively). Additionally, all t -tests comparing cost approval and denial were nonsignificant ($p = 0.11$, 0.10 , and 0.14 , respectively). Therefore, mean age and resected weight did not differ significantly between cost denial (42.67 years and 585 g) and approval (39.25 years and 520 g). However,

Table 1:
The number of patients for each health insurance provider (A–I).

Health insurance provider	Number of patients
Insurer A	10
Insurer B	26
Insurer C	16
Insurer D	25
Insurer E	10
Insurer F	35
Insurer G	55
Insurer H	10
Insurer I	23

Table 2:
Cross table of health insurance and cost approval requests (n = 210).

Insurance	Value	Cost approval request	
		Approved	Denied
Insurance A	Actual frequency	5	5
	Expected frequency	5.438	4.562
	Standardised residuals	−0.285	0.285
Insurance B	Actual frequency	8	18
	Expected frequency	14.138	11.862
	Standardised residuals	−2.576	2.576
Insurance C	Actual frequency	14	2
	Expected frequency	8.700	7.300
	Standardised residuals	2.764	−2.764
Insurance D	Actual frequency	11	14
	Expected frequency	13.594	11.406
	Standardised residuals	−1.108	1.108
Insurance E	Actual frequency	5	5
	Expected frequency	5.438	4.562
	Standardised residuals	−0.285	0.285
Insurance F	Actual frequency	26	9
	Expected frequency	19.032	15.968
	Standardised residuals	2.582	−2.582
Insurance G	Actual frequency	28	27
	Expected frequency	29.908	25.092
	Standardised residuals	−0.598	0.598
Insurance H	Actual frequency	7	3
	Expected frequency	5.438	4.562
	Standardised residuals	1.016	−1.016
Insurance I	Actual frequency	10	13
	Expected frequency	12.507	10.493
	Standardised residuals	−1.110	1.110
Total	Actual frequency	114	96

the post-hoc power of all *t*-tests was low (0.36, 0.39 and 0.31, respectively).

When patients with a BMI of greater than 27.5 kg/m² were excluded (*n* = 117), we also observed a statistically significant difference between health insurance providers and cost approval ($\chi^2(8) = 18.9158$, *p* = 0.0135). In this limited patient group (*n* = 117), all other analyses did not reveal any new findings compared to the larger patient group (*n* = 210).

Figure 2: Approval and denial rates (*n* = 210).

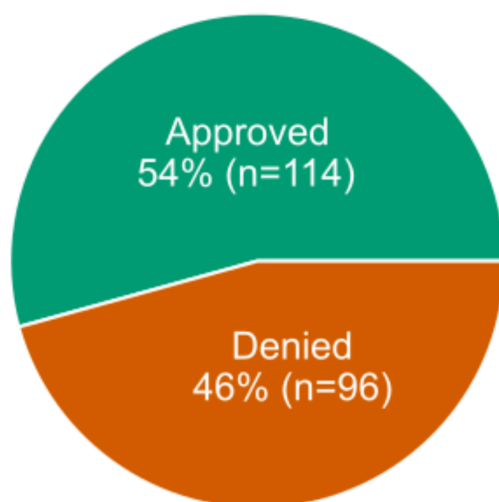


Figure 3: Differences in cost approval of health insurance providers.

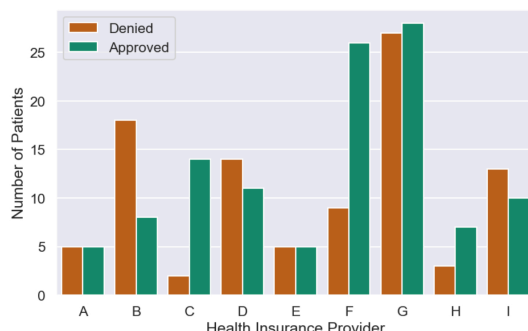
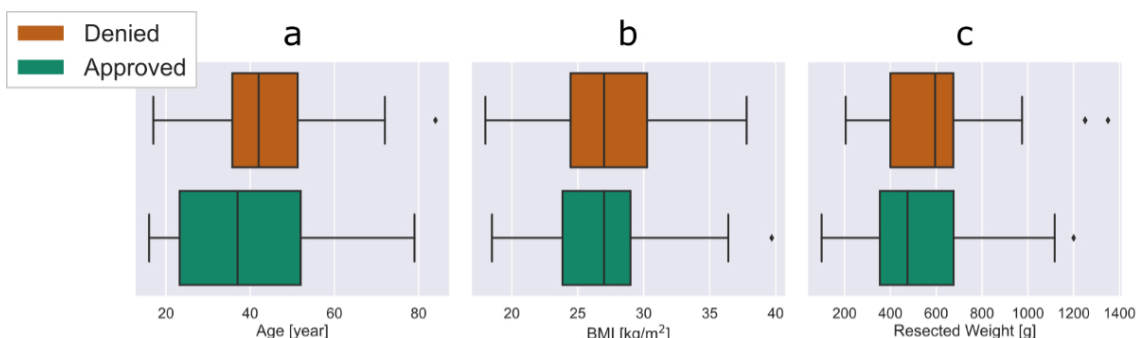


Figure 4: Relationship between the variables and cost approval. (A) Relationship between age and cost approval or denial (*n* = 210); (B) Relationship between body mass index (BMI) and cost approval or denial (*n* = 210); (C) Relationship between resected weight and cost approval or denial (*n* = 150).



Discussion

To our knowledge, this study is the first in Switzerland to analyse the proportion and variability of cost approval requests for medically indicated breast reduction mammoplasties among insurance providers. For symptomatic macromastia, the standard of care is reduction mammoplasty [20]. This surgical intervention has numerous physical and psychological benefits, including improvement in degenerative spine disease, pain, functional ability, depression, patient satisfaction, and psychosocial and sexual well-being [2, 5, 9, 31–41].

However, our study highlights significant variability in cost approval rates among insurers, which may reflect differences in how guidelines are interpreted or variations in the insured population. Of the 210 requests analysed, 54% were approved, and 46% were denied. This high denial rate is concerning and underscores systemic issues in access to medically indicated breast reduction mammoplasties. The variability was statistically significant, with some insurers (e.g. Insurance B) showing higher denial rates and others (e.g. Insurances C and F) consistently granting approvals. These findings suggest potential differences in how insurers assess cases, which may contribute to disparities in patient access to necessary treatments. Feedback from the insurance providers' approvals has been described as inconsistent and sometimes arbitrary [20], consistent with our findings that approval rates are not uniform among insurers.

While Swiss guidelines (BGE 130 V 299) [27] were developed to promote evidence-based criteria, insurers appear to apply them variably, which may indicate differences in interpretation or case evaluation. This variability highlights the need for clearer, standardised guidelines. Our study further revealed a significant relationship between cost approval and insurance provider, with medium effect sizes indicated by standardised residuals greater than 1.96, suggesting that the observed frequencies of approvals and denials were influenced by the insurer. These findings highlight the need to further assess how existing guidelines are applied in practice to ensure fair and transparent coverage decisions.

One observation in our study suggested that patients aged under 40 years had slightly higher approval rates, with a mean age of 39.25 years for approvals compared to 42.67 years for denials. However, this difference was not statistically significant, likely due to our limited sample size.

While the data suggested a trend, it is impossible to draw definitive conclusions about the influence of age on cost approvals based on our current findings.

The multidisciplinary work group of Perdakis et al. developed evidence-based patient care recommendations using the new American Society of Plastic Surgeons guideline methodology. They recommended that postmenarche patients presenting with breast hypertrophy should be offered reduction mammoplasty surgery as first-line therapy over nonoperative therapy based solely on the presence of multiple symptoms rather than resection weight [9]. While our observations hint at a possible age-related trend, further research with larger sample sizes is needed to confirm whether age may play a role in reimbursement decisions. The fact that older patients with longer-standing symptoms may face higher denial rates raises questions about equitable access to treatment.

The most common requirement for insurance coverage is a minimum resection weight (500 g per breast) and evidence of unsuccessful conservative therapy. Many studies have already demonstrated that resection weight does not correlate with symptom relief and thus should not be a criterion for reimbursement [5, 14, 21]. Our results indicated that cost approvals were more likely to be denied in cases with higher resection weights. While this might be associated with patients having a higher body mass index (BMI), existing literature consistently shows that resection weight does not correlate with patient satisfaction [31, 43].

Not all patients are suitable for surgery, as comorbidities can increase complications, especially delayed wound healing, which is associated with larger resection volumes, smoking, and advanced age [44–47]. For patients at higher risk – particularly those aged over 50 years, with a BMI greater than 35 kg/m², or on chronic corticosteroids – non-surgical therapies like physiotherapy or supportive devices may help alleviate symptoms [9].

Our analysis of insurance policies revealed that they did not explicitly specify the documentation needed for claim approval, highlighting a lack of transparency. To reduce this variability and lack of transparency in coverage decisions, we recommend establishing universally applicable, evidence-based criteria for reduction mammoplasty that are independent of the specific insurance provider. The observed inconsistency, with over 40% of requests denied, underscores the need for clearer and standardised guidelines that reduce subjective variation in reimbursement decisions [20, 42]. Consensus forums should be convened to assess how existing guidelines, such as BGE 130 V 299, are applied in practice and explore ways to enhance their clarity and consistency. Involving representative plastic surgeons from the Swiss Society for Plastic, Reconstructive, and Aesthetic Surgery will ensure that revisions align with clinical evidence and patient needs. Consideration should also be given to whether the broader legal framework of the Federal Health Insurance Act (KVG/LAMal) supports these guidelines effectively, ensuring equitable patient access to necessary surgical interventions.

The main limitation of our study was its retrospective, single-centre design restricted to 210 patients. Given incomplete data, we focused on the most consistently documented criteria. While several specialists were responsible for indication for cost approval requests, there was a lack

of control of confounders. To achieve sufficient statistical power, we had to exclude Swiss health insurance providers with fewer than five patients, potentially leading to an underrepresentation of smaller insurers. Additionally, for data protection reasons, the names of the insurance providers were anonymised, further limiting the scope of our conclusions.

A prospective study design with a patient's standardised cost approval request and a direct comparison of insurance providers would be necessary to confirm our results. To address this, future research should comprehensively assess all nine criteria, enabling better alignment with insurer guidelines and fostering more consistent coverage decisions. Larger, national, multicentre studies are needed to gain a greater generalisability.

Based on our results, while a significant correlation was observed between cost approval and insurance providers, causality cannot be definitively established. Ideally, decisions about cost approval should be based on standardised, evidence-based criteria rather than influenced by the insurance provider.

Conclusion

There is an elevated rate of cost approval denials, which depends significantly on the insurance provider. Affiliation with a particular health insurance provider should not be a primary determinant of cost approval for such an important medical treatment. To ensure that the costs of a medically indicated breast reduction are covered consistently and fairly, a review of the existing guidelines and their implementation is necessary to improve the system.

Data availability statement

The data and code (R-scripts) are available at <https://zenodo.org/records/11528824>.

Financial disclosure

This study received no funding.

Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

References

1. ISAPS. ISAPS International survey on aesthetic/cosmetic procedure. 2018. Available from: <https://www.isaps.org/media/wifiy3oo/isaps-global-survey-results-2018-1.pdf>
2. Benditte-Klepetchko H, Leisser V, Paternostro-Sluga T, Rakos M, Tratnig S, Helbich T, et al. Hypertrophy of the breast: a problem of beauty or health? *J Womens Health (Larchmt)*. 2007 Sep;16(7):1062–9. <http://dx.doi.org/10.1089/jwh.2006.0183>.
3. Kallianen LK; ASPS Health Policy Committee. ASPS clinical practice guideline summary on reduction mammoplasty. *Plast Reconstr Surg*. 2012 Oct;130(4):785–9. <http://dx.doi.org/10.1097/PRS.0b013e318262f0c0>.
4. Morris MP, Butler PD. Insurance Coverage of Reduction Mammoplasty: A Need for New Criteria. *Plast Reconstr Surg*. 2021 Sep;148(3):520e–1e. <http://dx.doi.org/10.1097/PRS.00000000000008272>.
5. Collins ED, Kerrigan CL, Kim M, Lowery JC, Striplin DT, Cunningham B, et al. The effectiveness of surgical and nonsurgical interventions in relieving the symptoms of macromastia. *Plast Reconstr Surg*. 2002 Apr;109(5):1556–66. <http://dx.doi.org/10.1097/00006534-200204150-00011>.

6. Lonie S, Sachs R, Shen A, Hunter-Smith DJ, Rozen WM, Seifman M. A systematic review of patient reported outcome measures for women with macromastia who have undergone breast reduction surgery. *Gland Surg.* 2019 Aug;8(4):431–40. <http://dx.doi.org/10.21037/gs.2019.03.08>.
7. Mello AA, Domingos NA, Miyazaki MC. Improvement in quality of life and self-esteem after breast reduction surgery. *Aesthetic Plast Surg.* 2010 Feb;34(1):59–64. <http://dx.doi.org/10.1007/s00266-009-9409-x>.
8. Singh KA, Losken A. Additional benefits of reduction mammoplasty: a systematic review of the literature. *Plast Reconstr Surg.* 2012 Mar;129(3):562–70. <http://dx.doi.org/10.1097/PRS.0b013e31824129ee>.
9. Perdakis G, Dillingham C, Boukoulas S, Ogunleye AA, Casambre F, Dal Cin A, et al. American Society of Plastic Surgeons Evidence-Based Clinical Practice Guideline Revision: reduction Mammoplasty. *Plast Reconstr Surg.* 2022 Mar;149(3):392e–409e. <http://dx.doi.org/10.1097/PRS.00000000000008860>.
10. Bai J, Rosen CM, Ngaage LM, McNichols CH, Diaconu SC, Ihenatu C, et al. Longevity of Outcomes Following Reduction Mammoplasty. *Eplasty.* 2019 Jul;19:e18.
11. Rogliani M, Gentile P, Labardi L, Donfrancesco A, Cervelli V. Improvement of physical and psychological symptoms after breast reduction. *J Plast Reconstr Aesthet Surg.* 2009 Dec;62(12):1647–9. <http://dx.doi.org/10.1016/j.bjps.2008.06.067>.
12. Wampler AT, Powelson IA, Homa K, Freed GL. BREAST-Q Outcomes before and after Bilateral Reduction Mammoplasty. *Plast Reconstr Surg.* 2021 Mar;147(3):382e–90e. <http://dx.doi.org/10.1097/PRS.00000000000007605>.
13. Becker H. Breast reduction insurance denials. *Plast Reconstr Surg.* 2004 Nov;114(6):1687.
14. Kerrigan CL, Collins ED, Kim HM, Schnur PL, Wilkins E, Cunningham B, et al. Reduction mammoplasty: defining medical necessity. *Med Decis Making.* 2002;22(3):208–17. <http://dx.doi.org/10.1177/0272989X0202200309>.
15. Admin B. Swiss Federal Health Insurance Act (KVG/LAMal). 1996. Available from: <https://www.bag.admin.ch/bag/en/home/versicherungen/krankenversicherung.html>
16. Ngaage LM, Knighton BJ, McGlone KL, Benzel CA, Rada EM, Bluebond-Langner R, et al. Health Insurance Coverage of Gender-Affirming Top Surgery in the United States. *Plast Reconstr Surg.* 2019 Oct;144(4):824–33. <http://dx.doi.org/10.1097/PRS.00000000000006012>.
17. Ngaage LM, Rose J, Pace L, Kambouris AR, Rada EM, Kligman MD, et al. A Review of National Insurance Coverage of Post-bariatric Upper Body Lift. *Aesthetic Plast Surg.* 2019 Oct;43(5):1250–6. <http://dx.doi.org/10.1007/s00266-019-01420-7>.
18. Rasko YM, Rosen C, Ngaage LM, AlFadil S, Elegbede A, Ihenatu C, et al. Surgical Management of Gynecomastia: A Review of the Current Insurance Coverage Criteria. *Plast Reconstr Surg.* 2019 May;143(5):1361–8. <http://dx.doi.org/10.1097/PRS.0000000000000526>.
19. Rosen CM, Ngaage LM, Rada EM, Slezak S, Kavic S, Rasko Y. Surgical Management of Diastasis Recti: A Systematic Review of Insurance Coverage in the United States. *Ann Plast Surg.* 2019 Oct;83(4):475–80. <http://dx.doi.org/10.1097/SAP.00000000000001694>.
20. Boukoulas S, Boson AL, Padilla PL, Sljivich M, Tran JP, Spratt H, et al. Insurance Denials in Reduction Mammoplasty: How Can We Serve Our Patients Better? *Plast Reconstr Surg.* 2020 Aug;146(2):127e–36e. <http://dx.doi.org/10.1097/PRS.00000000000006968>.
21. Nguyen JT, Wheatley MJ, Schnur PL, Nguyen TA, Winn SR. Reduction mammoplasty: a review of managed care medical policy coverage criteria. *Plast Reconstr Surg.* 2008 Apr;121(4):1092–100. <http://dx.doi.org/10.1097/01.prs.0000304238.43482.9c>.
22. Rawes CM, Ngaage LM, Borrelli MR, Puthumana J, Slezak S, Rasko YM. Navigating the Insurance Landscape for Coverage of Reduction Mammoplasty. *Plast Reconstr Surg.* 2020 Nov;146(5):539e–47e. <http://dx.doi.org/10.1097/PRS.00000000000007241>.
23. Wagner DS, Alfonso DR. The influence of obesity and volume of resection on success in reduction mammoplasty: an outcomes study. *Plast Reconstr Surg.* 2005 Apr;115(4):1034–8. <http://dx.doi.org/10.1097/01.PRS.0000154213.06888.F9>.
24. Frey JD, Koltz PF, Bell DE, Langstein HN. The complex insurance reimbursement landscape in reduction mammoplasty: how does the American plastic surgeon navigate it? *Ann Plast Surg.* 2014 Jan;72(1):23–9. <http://dx.doi.org/10.1097/01.SAP.0000435778.81934.cd>.
25. Koltz PF, Frey JD, Langstein HN. Insurance coverage and reduction mammoplasty: a systematic review of current health care policies. *Plast Reconstr Surg.* 2013 Oct;132(4):692e–3e. <http://dx.doi.org/10.1097/PRS.0b013e3182a014f6>.
26. Spector JA, Karp NS. Reduction mammoplasty: a significant improvement at any size. *Plast Reconstr Surg.* 2007 Sep;120(4):845–50. <http://dx.doi.org/10.1097/01.prs.0000277660.49802.76>.
27. Burger A, Lindenblatt N, Studer S. Mammareduktionsplastik. Schweizerische Ärzte der Vertrauens- und Versicherungsärzte. 2019. Available from: <http://www.vertrauensaeerzte.ch/manual/4/mammareduktionspl/>
28. Regnault P. Breast ptosis. Definition and treatment. *Clin Plast Surg.* 1976 Apr;3(2):193–203. [http://dx.doi.org/10.1016/S0094-1298\(20\)30220-0](http://dx.doi.org/10.1016/S0094-1298(20)30220-0).
29. Spear SL, Baker JL Jr. Classification of capsular contracture after prosthetic breast reconstruction. *Plast Reconstr Surg.* 1995 Oct;96(5):1119–23. <http://dx.doi.org/10.1097/00006534-199510000-00018>.
30. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Mahwah (New Jersey): Lawrence Erlbaum Associates; 1988.
31. Bayramiçli M, Sirinoglu H, Yalçın D. Outcome After Breast Reduction Considering Body Mass Index and Resection Amount. *Aesthet Surg J.* 2017 Oct;37(10):1103–10. <http://dx.doi.org/10.1093/asj/sjx110>.
32. Cabral IV, da Silva Garcia E, Sobrinho RN, Pinto NL, Juliano Y, Veiga-Filho J, et al. Use of the BREAST-Q™ Survey in the Prospective Evaluation of Reduction Mammoplasty Outcomes. *Aesthetic Plast Surg.* 2018 Apr;42(2):388–95. <http://dx.doi.org/10.1007/s00266-017-1009-6>.
33. Cabral IV, Garcia ED, Sobrinho RN, Pinto NL, Juliano Y, Veiga-Filho J, et al. Increased Capacity for Work and Productivity After Breast Reduction. *Aesthet Surg J.* 2017 Jan;37(1):57–62. <http://dx.doi.org/10.1093/asj/sjw175>.
34. Freire M, Neto MS, Garcia EB, Quaresma MR, Ferreira LM. Functional capacity and postural pain outcomes after reduction mammoplasty. *Plast Reconstr Surg.* 2007 Apr;119(4):1149–56. <http://dx.doi.org/10.1097/01.prs.0000254358.55104.9f>.
35. Greco R, Noone B. Evidence-Based Medicine: reduction Mammoplasty. *Plast Reconstr Surg.* 2017 Jan;139(1):230e–9e. <http://dx.doi.org/10.1097/PRS.00000000000002856>.
36. Hernanz F, Fidalgo M, Muñoz P, Noriega MG, Gómez-Fleitas M. Impact of reduction mammoplasty on the quality of life of obese patients suffering from symptomatic macromastia: A descriptive cohort study. *J Plast Reconstr Aesthet Surg.* 2016 Aug;69(8):e168–73. <http://dx.doi.org/10.1016/j.bjps.2016.05.012>.
37. Knox JA, Nelson DA, Latham KP, Kurina LM. Objective Effects of Breast Reduction Surgery on Physical Fitness. *Ann Plast Surg.* 2018 Jan;80(1):14–7. <http://dx.doi.org/10.1097/SAP.00000000000001167>.
38. Mundy LR, Homa K, Klass AF, Pusic AL, Kerrigan CL. Understanding the Health Burden of Macromastia: Normative Data for the BREAST-Q Reduction Module. *Plast Reconstr Surg.* 2017 Apr;139(4):846e–53e. <http://dx.doi.org/10.1097/PRS.00000000000003171>.
39. Schnur PL, Schnur DP, Petty PM, Hanson TJ, Weaver AL. Reduction mammoplasty: an outcome study. *Plast Reconstr Surg.* 1997 Sep;100(4 Supplement 1):875–83. <http://dx.doi.org/10.1097/00006534-199709001-00008>.
40. Spector JA, Singh SP, Karp NS. Outcomes after breast reduction: does size really matter? *Ann Plast Surg.* 2008 May;60(5):505–9. <http://dx.doi.org/10.1097/SAP.0b013e31816f76b5>.
41. Strong B, Hall-Findlay EJ. How Does Volume of Resection Relate to Symptom Relief for Reduction Mammoplasty Patients? *Ann Plast Surg.* 2015 Oct;75(4):376–82. <http://dx.doi.org/10.1097/SAP.0000000000000190>.
42. Boyd CJ, Hemal K, Cohen JM, Daar DA, Gwin J, Zupko K, et al. Preauthorization Inconsistencies Prevail in Reduction Mammoplasty. *Plast Reconstr Surg Glob Open.* 2023 Oct;11(10):e5361. <http://dx.doi.org/10.1097/GOX.00000000000005361>.
43. Crittenden T, Watson DI, Ratcliffe J, Griffin PA, Dean NR; AFESA Research Group. Does breast reduction surgery improve health-related quality of life? A prospective cohort study in Australian women. *BMJ Open.* 2020 Feb;10(2):e031804. <http://dx.doi.org/10.1136/bmjopen-2019-031804>.
44. Palve J, Kuuskeri M, Luukkaala T, Suorsa E. Predictive risk factors of complications in reduction mammoplasty-analysis of three different pedicles. *Gland Surg.* 2022 Aug;11(8):1309–22. <http://dx.doi.org/10.21037/gs-22-116>.
45. Shermak MA, Chang D, Burette K, Mithani S, Mallalieu J, Manahan M. Increasing age impairs outcomes in breast reduction surgery. *Plast Reconstr Surg.* 2011 Dec;128(6):1182–7. <http://dx.doi.org/10.1097/PRS.0b013e318230c467>.
46. Simpson AM, Donato DP, Kwok AC, Agarwal JP. Predictors of complications following breast reduction surgery: A National Surgical Quality Improvement Program study of 16,812 cases. *J Plast Reconstr Aesthet*

- Surg. 2019 Jan;72(1):43–51. <http://dx.doi.org/10.1016/j.bjps.2018.09.002>.
47. Young, ZT, Close M, Herrera FA. National Surgical Quality Improvement Program Analysis of 9110 Reduction Mammoplasty Patients: Identifying Risk Factors Associated With Complications in Patients Older Than 60 Years. Ann Plast Surg. 2019 Jun;82(6S Suppl 5):S446–49. <http://dx.doi.org/10.1097/SAP.0000000000001804>.