

Increasing incidence of rotator cuff surgery: A nationwide registry study in Chile

Catalina Vidal

Pontifical Catholic University of Chile

María J Lira

Pontifical Catholic University of Chile

Rodrigo de Marinis

Pontifical Catholic University of Chile

Rodrigo Liendo

Pontifical Catholic University of Chile

Julio J Contreras (✉ juliocontrerasmd@gmail.com)

Pontifical Catholic University of Chile

Research Article

Keywords: Rotator Cuff Surgery, Nationwide Registry, Chile, Healthcare system

Posted Date: May 7th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-481925/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background The rotator cuff surgery (RCS) incidence is rising rapidly in North America, Europe, Asia, and Australia. Despite this, multiple factors limit patients' access to surgery. In Latin America, barriers to orthopedic surgery have been largely ignored. The purpose of this study was to calculate the rate of RCS in Chile between 2008 and 2018, investigating possible associated factors to access such as age, sex, and the healthcare system.

Methods An ecological study was carried out with nationwide data obtained from the Database of Hospital Discharges of the Department of Statistics. All Chilean inhabitants aged 25 years or more were included. We used the ICD-10 codes M751, M754, and S460. The annual incidence rate of surgeries and the incidence rate for the period studied per 100,000 inhabitants were calculated. Data were analyzed stratified by age, sex, year of study, and the healthcare system. Negative binomial regression was used to compare. Statistical analyzes were performed with Stata v.14 software.

Results 39,366 RCSs were performed, with a total rate for the period of 32.36 per 105 inhabitants. The annual rate of surgeries from 2008 to 2018 increased from 24.55 to 49.11 per 10⁵/year. When adjusting for year, an annual increase in surgery rates of 8.19% (95% CI 6.7–9.6) and 101% growth between 2008 and 2018 (95% CI 90–109%, $p < 0.001$) was observed. When comparing the global rates according to the healthcare system, the public system corresponds to 21.3 per 10⁵ and the private system to 72 per 10⁵, the latter being 3.4-times higher (95% CI 2.7–4.4; $p < 0.001$).

Conclusion RCS rates are increasing in Chile concordantly with previous reports of other western countries. The most important factor associated with RCS rate found was the patients' healthcare system, with higher rates observed for the private sector.

Background

Shoulder pain is a frequent musculoskeletal complaint, affecting between 4.7% and 46.7% of the adult population each year [1]. Rotator cuff tears are the leading cause of shoulder-related disability, and surgical volume is increasing [2–4]. Rotator cuff repair (RCR) is the most frequent shoulder surgery in the United States [5], and most of the patients that undergo surgery are in their fifth or sixth decade of life [3]. A cost-effectiveness analysis showed that, compared with nonoperative treatment, the lifetime age-weighted mean total societal savings per patient from RCR is \$13,771 [6].

The RCR incidence is rising rapidly in North America, Europe, Asia, and Australia [7–14]. Despite this, multiple factors, such as healthcare organization, culture, educational level, socioeconomic, and geographic factors, limit patients' access to surgery [15].

In Latin America, barriers to orthopedic surgery have been largely ignored. The rate of RCR in Brazil performed through the Brazilian Unified Health System increased from 0.83 to 2.81 between 2003 and 2015 yet remaining lower than developed countries [16].

Chile is a developing country, and its economy is known as one of the steadiest in the continent, and in 2010 it became the first full member of the OECD in South America due to the recognition of its economic advances in the last decades, social development, and strong institutional restructuring. In Chile, public and private healthcare systems differ widely on their access to elective orthopedic surgery, with limited evidence being available. Historically, the private system has shorter waiting times, more health personnel, and better access to surgical opportunities.

Since 2005, to increase access to surgical procedures for the public health system, a new out of pocket spending (OOPS) approach has been allowed for rotator cuff surgery (RCS) and several other procedures [17]. Probably, the implementation of this strategy has increased the rate of RCS in patients from the public health system. Nevertheless, the rates of RCS in Chile are unknown to date.

The purpose of this study was to calculate the rate of RCS in Chile between 2008 and 2018 based on a nationwide registry, investigating possible associated factors to access such as age, sex, and the healthcare system.

Methods

Study design and setting

An ecological study was carried out with nationwide data obtained from the Database of Hospital Discharges of the Department of Statistics (DEIS) of the Chilean Ministry of Health (MINSAL) between 2008 to 2018. Founded in 1964, DEIS collects information on all hospitalizations in Chilean public and private care settings. These data are entered on a mandatory basis for all health centers around the country, considering both inpatient and outpatient care, and provides information on age, gender, healthcare system (public or private), diagnosis, and year of surgery. This database is open access (<https://deis.minsal.cl/>).

Population

Population data were obtained from the National Statistics Institute (INE) for each year. All Chilean inhabitants aged 25 years or more were included, since the number of surgeries in those under 25 years of age is very low (5468 surgeries). We used the ICD-10 codes M751 "rotator cuff syndrome", M754 "painful abduction syndrome of the shoulder", and S460 "trauma to the shoulder rotator cuff tendon" to identify patients who received surgical treatment for a rotator cuff disease (these codes include all patients who perform surgery for rotator cuff disease in our country). These codes are used for both open and arthroscopic RCS. Therefore, this coding system did not allow us to differentiate between open and arthroscopic techniques. Also, concomitant procedures associated with RCS, such as acromioplasty, tenotomy, or tenodesis of the long head of the biceps tendon and resection of the distal end of the clavicle, do not have a specific code and are considered within the comprehensive management of the pathology.

Statistical analysis

Descriptive statistical analyses were used to calculate the annual number of RCS in the Chilean population aged 25 or over. The annual incidence rate of surgeries and the incidence rate for the period studied per 100,000 inhabitants were calculated. Data were analyzed stratified by age, sex, year of study, and the public or private healthcare system. Negative binomial regression was used to compare population adjusted for differences between private versus public healthcare system by year, calculating the Incidence Rate Ratio (IRR). Statistical analyzes were performed with Stata v.14 software.

Ethics Committee

This project was approved by the scientific ethics committee of the Faculty of Medicine of the Pontificia Universidad Católica de Chile (ID: 16–196).

Results

During the period analyzed, 39,366 RCSs were performed, with a total rate for the period of 32.36 per 10⁵ inhabitants. More than half (54.26%, n = 21,360) correspond to female patients and 45,74% (n = 18,005) male (male:female ratio, 0.84:1). The annual rate of surgeries from 2008 to 2018 increased from 24.55 to 49.11 per 10⁵/year (Fig. 1). When adjusting for year, an annual increase in surgery rates of 8.19% (95% CI 6.7–9.6) and 101% growth between 2008 and 2018 (95% CI 90–109%, p < 0.001) was observed.

The increase in the rate of RCSs for female patients was significantly higher throughout the period compared to males (33 vs. 30 per 10⁵ for the total period), with a difference of 10.7% in rates (p < 0.01) (Fig. 2, Table 1).

Table 1
Incidence rate ratio (IRR) to compare incidence rate between groups.

Factors	IRR	Std. Err.	IC 95%	<i>p-value</i>
Incidence rates by year				
<i>2018</i>	1.08	0.01	1.07–1.09	< 0.001
Incidence rates by sex				
<i>Female</i>	1.11	0.01	1.09–1.13	< 0.001
Incidence rates by age				
<i>45–64</i>	6.71	0.11	6.49–6.95	< 0.001
<i>65–74</i>	5.89	0.13	5.65–6.14	< 0.001
<i>> 75</i>	1.65	0.06	1.54–1.77	< 0.001
Incidence rates by health care system				
<i>Private</i>	3.42	0.44	2.66–4.39	< 0.001
<i>Private-adjusted*</i>	4.83	0.26	4.33–5.39	< 0.001

Negative binomial regression was used for the analysis. (*) Age and sex adjusted analysis.

The age ranges with the highest incidence of surgeries were the 45–64- and 65–74-year-old groups, with an overall rate of 61.6 and 53.2 per 10⁵, respectively (compared to 8 per 10⁵ in the group under 25 years and 14 per 10⁵ in the group over 75 years) (Fig. 3, Table 1).

During the observed period, 19,564 surgeries were performed on patients enrolled in the public healthcare system and 15,886 in the private system. However, when comparing the global rates according to the healthcare system (Fig. 4), the public system corresponds to 21.3 per 10⁵ and the private system to 72 per 10⁵, the latter being 3.4-times higher (95% CI 2.7–4.4; $p < 0.001$) (Table 1). In 2008, RCS rates in the private health system were 5.01 times higher than the public system. By 2018 this difference decreased to 2.34.

Discussion

The main finding of this study is the increase in the rates of RCS in Chile during 2008–2018, in accordance with the literature published internationally, being the first national report on RCS rates.

During the 10-year study period, the calculated rate of RCS was 32.36 procedures for every 100,000 Chilean inhabitants over 25 years old; below than the rate reported for European countries (Italy, 62.1 per 10⁵ [2001–2014] [9], Finland, 44 to 131 per 10⁵ [1998–2011] [14]); the United States (41 to 98 per 10⁵ [1996–2006] [11]), and Asia (Korea, 13.15 to 116.04 per 10⁵ [2007–2015] [13]). Compared with RCS rates for Brazil (0.83 to 2.81 per 10⁵ [2003–2015] [16]), we found a higher rate in a similar period. The causes of these differences were not evaluated in this study, but they are likely related to socioeconomic factors and the gross domestic product that are believed to influence access to surgery and its costs [13].

RCS rates present statistically significant differences according to the variables analyzed. In Chile, there is a higher rate of surgery observed in women (male:female ratio 0.84:1) throughout the period, in contrast with the higher rates in men in other countries. In Finland, the male to female ratio is 1.7:1 [14], while in Korea and Italy is 1.02:1 [9, 13].

However, there are similarities in the age range, with the highest rate of RCS between 45 and 65 years [9]. In Korea, the mean age of patients who received RCS was 55.4 years (SD \pm 10.8) [13]. The mean patient age at the time of operation in Finland increased from 55 (SD 9) years in 1998 to 56 (SD 10) years in 2011 [14]. In the US, it is precisely this age group (45–65 years) that presents the greatest increase in RCS, mainly with arthroscopic technique (2 to 10 per 10⁵ to 21 to 146 per 10⁵) [11].

The main difference with respect to international reports is in relation to the healthcare system. In 2014, 97.33% of RCSs were performed in Italian public hospitals and 2.67% in the private healthcare system [9]. In 1998, 91% of rotator cuff repairs were performed in Finnish public hospitals and 9% in private

hospitals, but in 2011, the corresponding percentages were 53% and 47% [14]. In Chile, the rate in the private healthcare system is triple the rate in the public healthcare system for RCS. This difference is probably related to the patient's capability to assume costs and access compared with the public healthcare system. The lower rates of RCS in the public sector could be explained by its shortage in coverage in terms of number of healthcare professionals per patient and concordantly the long waiting lists associated to this fact. Moreover, seek care in the private system without a proper coverage comes with a high out of pocket cost which limits public to private transfer of patients.

Nonetheless, the public system RCS rates increased at a higher pace than private RCS rates, observing a decrease in the difference at the end of the studied period (2018). In an attempt to explain this finding, we hypothesize that this may be due to: 1) an improvement in the public healthcare system surgical capacity, 2) an increase in the state budget for the health sector, and/or 3) the implementation of new OOPS to access for RCS in the public health system.

Chilean citizens had a high level of OOPS and segmentation of private and public insurance schemes. The OOPS as a share of total health expenditure is 33% which is one of the highest among OECD countries (OECD average of 20%). The new OOPS payment or "Payment Associated to Diagnosis" (PAD) allows patients to pay an affordable, known and fix amount to access to pre-established medical benefits depending on each diagnosis. This amount corresponds to 50% of the total amount received by the private institution that will provide health care (in this case RCS). The other 50% is covered by the state and is transferred directly to a private institution that must be affiliated to this system. As the amount paid per patient is fix, there are no subsequent modifications allowed in the total price independently from the number of implants used, bed days, medications, exams, and other supplies needed to carry out the procedure [17].

One of the main strengths of this study is the use of a large sample size based on a nationwide database of public information that must be compulsorily recorded in all surgeries of public and private institutions. Because the information is collected from all regions of Chile, the data are expected to be representative of the country. To our knowledge, this is the first study in Chile that reports RCS rates and analyzes its associated factors and differences with previously reported data from other countries.

One of the main limitations is the retrospective design, which can influence the recording and coding of the information. By including three different codes, it is expected to cover the greatest number of accurate diagnoses. However, we recognize that subjects may be excluded or incorrectly included we are unable to evaluate potential inaccuracies in the coding of the diagnoses. Nonetheless, we believe that our results highlight important trends in RCS.

Conclusions

RCS rates are increasing in Chile specially for patients between 45 and 65 years old concordantly with previous reports of other western countries. The most important factor associated with RCS rate found was the patients' healthcare system, with higher rates observed for the private sector. The rate breach

between public and private sector is diminishing over the observation period. Future studies may elucidate the associated factors that explain this difference and its trend over time.

List Of Abbreviations

RCS: Rotator cuff surgery

RCR: Rotator cuff repair

OECD: Organisation for Economic Co-operation and Development

OOPS: Out of pocket spending

DEIS: Database of Hospital Discharges of the Department of Statistics

MINSAL: Chilean Ministry of Health

INE: National Statistics Institute

PAD: Payment Associated to Diagnosis

Declarations

Ethics approval and consent to participate

This project was approved by the scientific ethics committee of the Faculty of Medicine of the Pontificia Universidad Católica de Chile (ID: 16-196).

Consent for publication

Not applicable

Availability of data and materials

The datasets analysed during the current study were derived from the following public domain resources: <https://deis.minsal.cl/>

Competing interests

None author, their immediate family, and any research foundation with which they are affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

Funding

The authors received no specific funding for this work.

Authors' contributions

CV, MJL, RL and RdM conceived of the study and initiated the study design. CV and MJL provided statistical expertise and conducted the data acquisition and statistical analysis. RL, RdM and JC interpreted the data. JC have drafted the work and All authors contributed to refinement of the final manuscript.

Acknowledgements

To our families for their unconditional support.

References

1. Djade CD, Porgo TV, Zomahoun HTV, Perrault-Sullivan G, Dionne CE. Incidence of shoulder pain in 40 years old and over and associated factors: A systematic review. *Eur J Pain*. 2020;24(1):39-50.
2. Narvy SJ, Didinger TC, Lehoang D, Vangsness CT Jr, Tibone JE, Hatch GF 3rd, Omid R, Osorno F, Gamradt SC. Direct Cost Analysis of Outpatient Arthroscopic Rotator Cuff Repair in Medicare and Non-Medicare Populations. *Orthop J Sports Med*. 2016;4(10):2325967116668829.
3. Karjalainen TV, Jain NB, Heikkinen J, Johnston RV, Page CM, Buchbinder R. Surgery for rotator cuff tears. *Cochrane Database Syst Rev*. 2019;12(12):CD013502.
4. Contreras J, Liendo R, Díaz C, Díaz M, Osorio M, Guzmán R, Soza F, Beltrán M, Palomo H, Córdova C, Manosalvas D, Lecaros J, Torres R, Grau G, Silva P, Parada C, Cibie D, Martínez R, Pérez I. Effectiveness of a self-administered rehabilitation program for shoulder pain syndrome in primary health care. *Rev Med Chil*. 2018;146(9):959-67.
5. Mather RC 3rd, Koenig L, Acevedo D, Dall TM, Gallo P, Romeo A, Tongue J, Williams G Jr. The societal and economic value of rotator cuff repair. *J Bone Joint Surg Am*. 2013;95(22):1993-2000.
6. Jain NB, Higgins LD, Losina E, Collins J, Blazar PE, Katz JN. Epidemiology of musculoskeletal upper extremity ambulatory surgery in the United States. *BMC Musculoskelet Disord*. 2014;15:4.
7. Judge A, Murphy RJ, Maxwell R, Arden NK, Carr AJ. Temporal trends and geographical variation in the use of subacromial decompression and rotator cuff repair of the shoulder in England. *Bone Joint J*. 2014;96-B(1):70-4.
8. Svendsen SW, Frost P, Jensen LD. Time trends in surgery for non-traumatic shoulder disorders and postoperative risk of permanent work disability: a nationwide cohort study. *Scand J Rheumatol*. 2012;41(1):59-65.
9. Longo UG, Salvatore G, Rizzello G, Berton A, Ciuffreda M, Candela V, Denaro V. The burden of rotator cuff surgery in Italy: a nationwide registry study. *Arch Orthop Trauma Surg*. 2017;137(2):217-24.
10. Ensor KL, Kwon YW, Dibeneditto MR, Zuckerman JD, Rokito AS. The rising incidence of rotator cuff repairs. *J Shoulder Elbow Surg*. 2013;22(12):1628-32.

11. Colvin AC, Egorova N, Harrison AK, Moskowitz A, Flatow EL. National trends in rotator cuff repair. *J Bone Joint Surg Am.* 2012;94(3):227-33.
12. Thorpe A, Hurworth M, O'Sullivan P, Mitchell T, Smith A. Rising trends in surgery for rotator cuff disease in Western Australia. *ANZ J Surg.* 2016;86(10):801-4.
13. Jo YH, Lee KH, Kim SJ, Kim J, Lee BG. National Trends in Surgery for Rotator Cuff Disease in Korea. *J Korean Med Sci.* 2017;32(2):357-64.
14. Paloneva J, Lepola V, Äärilä V, Joukainen A, Ylinen J, Mattila VM. Increasing incidence of rotator cuff repairs—A nationwide registry study in Finland. *BMC Musculoskelet Disord.* 2015;16:189.
15. Salvatore G, Longo UG, Candela V, Berton A, Migliorini F, Petrillo S, Ambrogioni LR, Denaro V. Epidemiology of rotator cuff surgery in Italy: regional variation in access to health care. Results from a 14-year nationwide registry. *Musculoskelet Surg.* 2020;104(3):329-35.
16. Malavolta EA, Assunção JH, Beraldo RA, Pinto GMR, Gracitelli MEC, Ferreira Neto AA. Rotator cuff repair in the Brazilian Unified Health System: Brazilian trends from 2003 to 2015. *Rev Bras Ortop.* 2017;52(4):501-5.
17. Zuniga-Jara S, Guede J. Costos de prestaciones de Pago Asociado de Diagnóstico (PAD) en un hospital provincial chileno. *Cuadernos de Contabilidad* 2013;14(35):463-80.

Figures

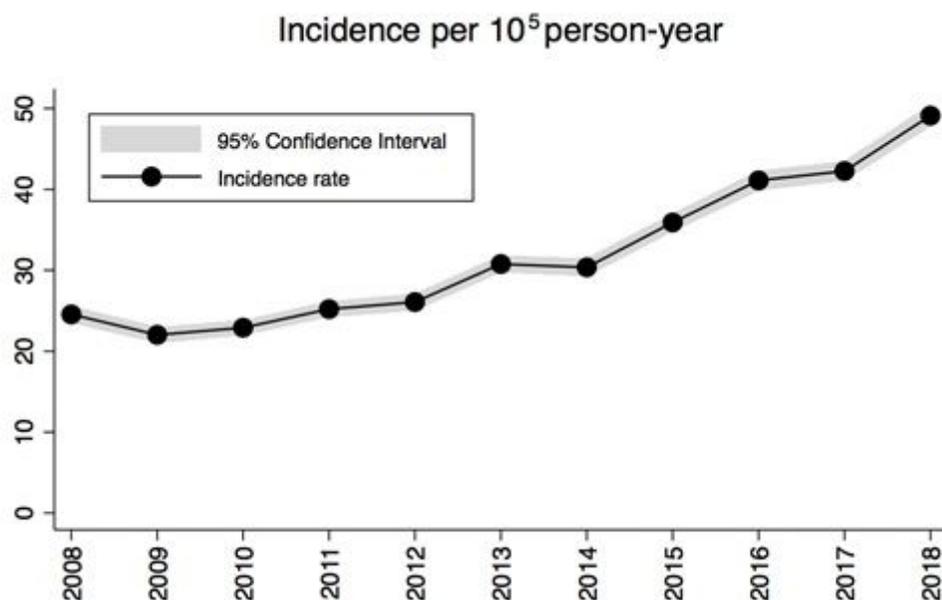


Figure 1

Incidence rate of rotator cuff surgery by year

Incidence per 10⁵ person-year

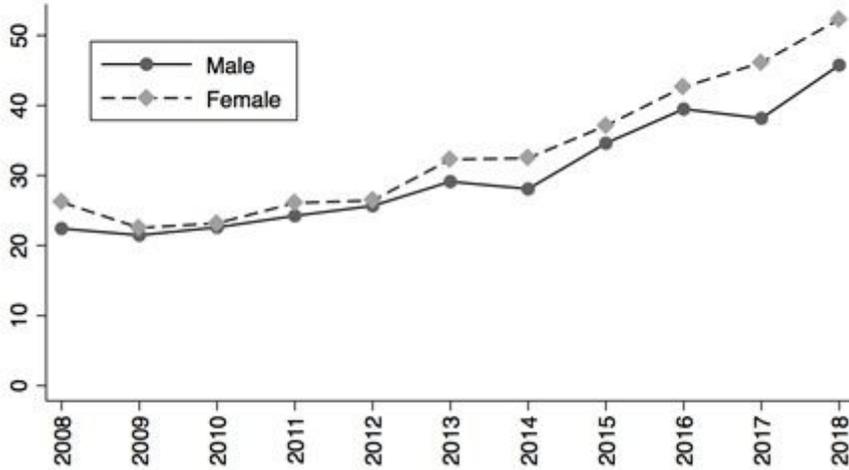


Figure 2

Incidence rate of rotator cuff surgery by sex

Incidence per 10⁵ person-year

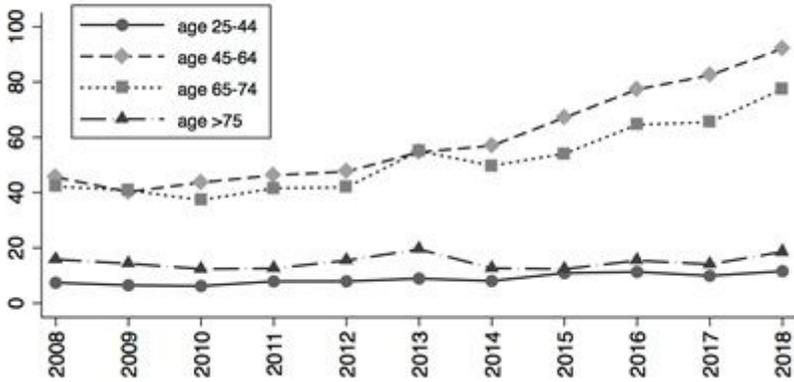


Figure 3

Incidence rate of rotator cuff surgery among patients in different age groups

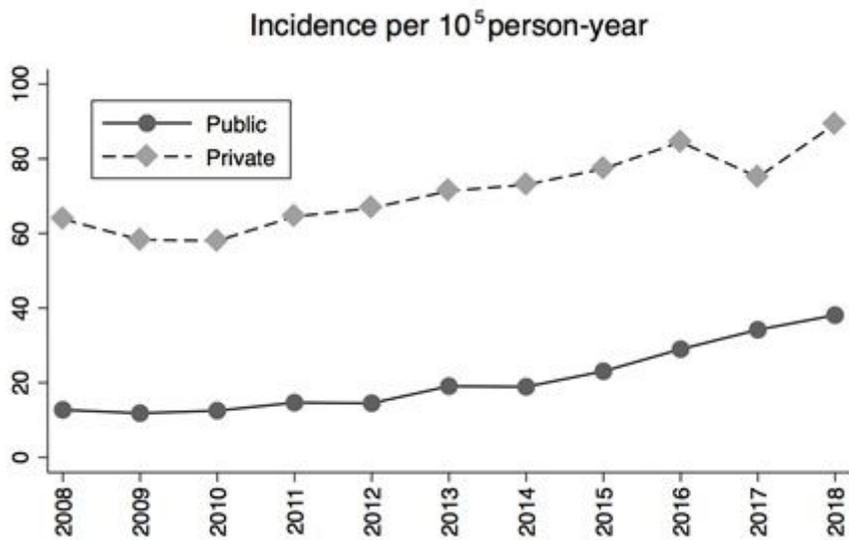


Figure 4

Incidence rate of rotator cuff surgery among patients in public and private health care system