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**Title:**

Are tall people at higher risk of low back pain surgery? Discussion on results of the Gazel cohort.

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## **Introduction**

Low back pain (LBP) is a major public health problem because of its high prevalence and its economic burden. Lifetime prevalence in developed countries is estimated up to 84% in the general population<sup>1</sup>. If most cases improve with medical treatment, some require surgery. Although many studies have investigated individual risk factors for LBP, little is known about specific determinants of surgery for LBP.

One particular discussed risk factor is height. Studies considering association between height and LBP or sciatica report both positive and negative results<sup>2</sup>. We aimed to investigate if height was associated with LBP and surgery, taking into account personal and socio-economic risk factors, in a general population.

## **Population and Methods**

We used data of the Gazel cohort<sup>3</sup>, a multipurpose cohort followed since 1989. This cohort included at baseline 15010 (75%) men and 5614 (25%) women born between 1939 and 1953 and working in the French national electricity and gas company (EDF-GDF). Data on low back pain and surgery interventions in the whole life were collected in 2001 through a self-administered questionnaire. Three outcomes were compared: no LBP (reference group, participants who declared they never had LBP), LBP without surgery (participants who ever had LBP but without surgery) and back surgery (ever had surgery for LBP). The three groups were first compared using bivariate analyses (chi-square test, t-test), in respect to the following determinants: gender, age class, educational level, marital status, height (cm) declared at baseline and body mass index (BMI) calculated on height and weight declared at baseline. Comparisons were made globally for the three groups, and for each group compared to each of the other ones. Then, statistically significant risk factors were included in a multinomial logistic regression model. Analyses were conducted separately for men and

women. Data were analysed using the SAS statistical software (SAS Institute Inc., Cary, NC) version 9.1.

## **Results**

Among the 19901 volunteers who were sent the self-administered questionnaire in 2001, 27% did not return the questionnaire and 4% did not fill the part on LBP. The LBP questionnaire was filled by 13680 subjects (69%). Subjects who benefited from back surgery before the age of 40, those who didn't mention whether they had surgery or the year of their operation were excluded. The final sample included 4596 (34.6%) participants in the reference group, 8272 (62.3%) in the LBP group and 414 (3.1%) in the back surgery group. The distribution of height was different between the three groups (fig.1). Mean height was significantly higher in men in the back surgery group (175.3, SD 6.0) than in the reference group (173.2, SD 6.1) and the LBP group (174.1, SD 6.0). The same tendency was observed in women limit for significance, which might be due to smaller sample size. The proportion of surgically-treated LBP was 4.2% in people  $\geq$  4<sup>th</sup> quartile (178 cm for men and 166 cm for women) against 2.7% for those with height  $<$  4<sup>th</sup> quartile ( $p < 0.0001$ ).

Other variables significantly associated with the outcome in bivariate analyses were age, educational level, and BMI. Gender was not a significant factor ( $p = 0.09$ ). When adjusted on all these variables, being in the highest quartile for height was still a strong risk factor for surgery (ORa = 2.01, 95% confidence interval 1.61 to 2.51) whereas it increased only slightly the risk of LBP without surgery (ORa = 1.29, 1.18 to 1.40). The test comparing these two ORs was significant ( $p < 0.0001$ ).

## **Discussion**

These results suggest that height is more closely associated with surgery than with LBP without surgery, taking into account socio-economic factors and BMI. The fact that height and surgery were self-assessed could not explain this association. Height was declared at

baseline, independently of episodes of back surgery. A study on Gazel subjects showed that men and women tended to overestimate their height but this overestimation was limited (0.38 cm for men and 0.46 for women) and unrelated to health problems<sup>4</sup>.

Here, 31% of the population did not fill the LBP questionnaire. The effect on the results is expected to be minimal despite of slight differences between participants and no participants in the Gazel cohort in general<sup>5</sup>. In addition, we checked that those who did not fill the part on LBP in the questionnaire were similar, especially for height.

Back surgery may be an indicator of severe low back pain. A hospital-based study found that mean stature was taller in the patients who required radical treatment for disc-related sciatica, but this relationship was not significant in the multivariate analysis<sup>6</sup>. A recent case-control study report a positive association between being tall and low back pain referred for magnetic resonance imaging (ORa=1.6, 1.1 to 2.2)<sup>7</sup>. Results were adjusted on mental health, smoking status, somatising tendency, propensity to consult for low back pain and occupational risk factors. However, when restricted to severe cases (Roland-Morris score >10) this association was no more significant (ORa=1.4, 0.9 to 2.3). The disability score used however may be an indicator of severity less sensitive than back surgery.

A mechanism possibly involved in the lumbar pathology is the role of lumbar disc height. Natarajan suggests that taller people have more potential for instability under external loading, because of higher discs exposed to much higher risk of failure<sup>8</sup>. An anthropometric study found that alterations of facet joints in patients with lumbar disc hernia were more evident in the taller patients<sup>9</sup>. Tall people might also be more exposed to strains that lead to injury or disease, due to unfitted environment. A study on aid posture among female Japanese cooks showed that the improvement of subjective discomfort through a standing aid was more effective for taller subjects<sup>10</sup>.

In this study, no detail was available about the type of back surgery, and the reason for surgery. Low back pain can have various sources. However, primary causative mechanisms of low back pain remain largely undetermined and prevention guidelines focus on low back pain as a whole<sup>11</sup>.

Our results suggest that being tall is a predictor for back surgery; however the mechanisms involved remain unclear and should be more investigated. As back surgery may be an indicator of severe low back pain, this could have major implications in public health policies for specific prevention towards tall populations. However, indications for LBP surgery depend on many factors and the indications could differ between countries. For that reason, it should be interesting to replicate this analysis in other countries.

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Fig. 1. Proportion of participants in each study group (reference group, LBP group and back surgery group) in men and women, according to height.

