How Much would you Rely on Statistical Data? The Power of Statistical Analysis towards Truth as Well as Lie

Petridis AK*
Department of Neurosurgery, Sana Kliniken, Zu den Rehwiesen 9, P.O Box: 47055, Duisburg, Germany

Abstract

**Background:** Statistics is a powerful tool in the hands of an expert but in the hands of a fool it can result in devastating conclusions, since it can fool the whole scientific world.

**Method:** A simulation of 340 patients with growth hormone overexpression and visual disturbance is compared with a control group of normal expressing growth hormone in healthy individuals. Different statistical analyses have been performed.

**Results:** All statistical analyses performed here, show a highly significant correlation of growth hormone overexpression and visual disturbance.

**Conclusion:** Statistically it seems that growth hormone is a cause of visual disturbance. We know that growth hormone by itself is not causing blindness but the disease hidden behind this overexpression, namely macro adenomas does. Would we not be aware of the causative disease we would easily come to the conclusion that growth hormone is strongly associated with visual disturbance. If the knowledge about a pathologic entity is incomplete a statistical analysis alone can mislead the scientific world to very strange conclusions.

Keywords: Confidence interval; Statistical analysis, Statistical testing

Introduction

No observational retrospective or prospective study can convince an investigator without a neat and clean statistical analysis. However, statistics apart of being the investigators best friend can also become a vicious enemy when not used appropriately. It is like a weapon with enormous power in the hands of a child. You never know what the outcome will be. Because of the power statistics have and their representation of truth we rely almost blindly on our analyses. In the present paper it is shown how convincing statistical results can be no matter how far away the outcome can be from the truth.

Methods

The percentage of patients with visual disturbance and growth hormone positive macro adenomas is about 85%. The fact that the group of patients with growth hormone overexpression is patients with macro adenomas will be neglected. The diagnosis macro adenoma will be an unknown factor in the statistical analysis. The percentage of individuals with visual disturbance in the normal population is about 10%. In this simulation a fictive number of two collectives, one with patients with growth hormone overexpression (IGF-1) (N=340) and one without growth hormone overexpression in a healthy population (1022), and the proportion of visual disturbance in both collectives is calculated. A retrospective analysis of a possible correlation of growth hormone overexpression (IGF-1) and visual disturbance has been performed.

Results

Inference for a single proportion in patients with IGF-1 overexpression and visual disturbance compared to a control group of individuals without IGF-1 overexpression

It is observed that 85% of patients with IGF-1 overexpression (N=340), suffer from visual disturbance. In the control collective of 1022 patients admitted to a hospital with diagnoses different than IGF-1 overexpression (i.e. trauma with isolated fractures of extremities and disc hernias of the spine) visual disturbances could be seen in about 10% of individuals. Is the difference in the percentage of visual disturbances in the IGF-1 overexpression group statistically significant compared to the control?

First of all an inference test for a single proportion will be used to evaluate a significant correlation in IGF-1 overexpression and visual disturbance.

Before statistical analysis is performed we have to evaluate if the conditions for our sampling distribution p is being nearly normal (Table 1).

1. Independence: The sample observation is assumed to be independent from each other.

2. There is expected to see at least 10 successes and 10 failures on each collective.

Successes in the IGF-1 overexpression group=np=340 × 0.85=289

|         | Visual Disturbance | Normal Vision | Total  |
|---------|--------------------|---------------|--------|
| IGF-1 (+)| 290                | 50            | 340    |
| IGFnorm | 100                | 922           | 1022   |
|         | 390                | 972           | 1362   |

Table 1: IGF-1 overexpression (IGF-1 (+)) and visual visual disturbance. IGF norm: physiological levels of IGF.

*Corresponding author: Dr. Athanasios K. Petridis, Department of Neurosurgery, Sana Kliniken, Zu den Rehwiesen 9, 47055, Duisburg, Germany, Tel: 492037332425; Fax: 492037330; E-mail: opticdisc@aol.com

Received June 09, 2015; Accepted June 11, 2015; Published June 13, 2015

Citation: Petridis AK (2015) How Much would you Rely on Statistical Data? The Power of Statistical Analysis towards Truth as Well as Lie. J Neurol Disord 3: e116. doi: 10.4172/2329-6895.1000e116

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In each different statistical approach which was done the null hypothesis, that IGF-1 overexpression is not correlated with visual disturbance could be rejected. The alternative hypothesis that IGF-1 expression leads to visual disturbance seems to be right. Statistically IGF-1 overexpression leads surely to visual disturbance. Antagonizing growth hormone would even lead to a regress of visual disturbance. Is IGF-1 a cause for blindness? Or is IGF1 overexpression by itself disturbing vision? This question cannot be answered by our statistical analysis because the study is just observational and not experimental. If it would not be IGF-1 overexpression but a completely new molecule, which we would try to correlate with visual disturbance, the chance to convince the audience that this new molecule causes blindness would be high, because of our statistical analysis and the great z scores. The small but essential detail that the study design by itself is weak probably not even be realized.

Observational studies have to be based on logical assumptions which on their turn are basing on knowledge we already gathered through a number of studies otherwise they can mislead us in a direction completely opposite to the truth. Statistics or numbers do not stand alone and does not need further evaluation. A good statistical analysis on a direction completely opposite to the truth. Statistics or numbers do not even be realized.

The aim of this short paper is not to ban observational studies. The aim is to make clear that an observation alone, based on neat statistical analysis because the study is just observational and not experimental. If it would not be IGF-1 overexpression but a completely new molecule, which we would try to correlate with visual disturbance, the chance to convince the audience that this new molecule causes blindness would be high, because of our statistical analysis and the great z scores. The small but essential detail that the study design by itself is weak probably not even be realized.

The alternative hypothesis is p1–p2 ≠ 0 or in our case p1–p2 > 0. This means our alternative hypothesis states that visually disturbed individuals are likely to overexpress IGF-1. The alternative hypothesis can be rejected.

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