

Dangerous Balls?

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In the results subsection of the abstract:

- 1 A.What is the comparison the authors make with fractures in children?
B. What is an appropriate test for the information provided?

Abstract section continued:

- 2 A.State the test hypothesis.
B.Check their results of the comparison within children age 11 or less.
C.What is the general reason in this study for choosing a two-sided test as opposed to a one-sided test?

Method and results:

3.What prerequisite information about ball usage distribution is not addressed, in order for their inferences to be valid? (Hint: In a related news article [attached], it is mentioned that size 3 and 4 usage advice is largely ignored!)

- 4 A.The authors report ``injuries occurred on the right side in 14 patients and on the left in 15 patients.'' Is this result important in the study?
B.Calculate a 95% Confidence Interval for the age 11 or less group.
C.How might the four patients with injuries from balls of unknown size affect the study?

Discussion section:

- 5.Are you convinced a smaller ball is safer to play with?

Dangerous Balls? answers

1 A. They compare the proportion of fractures that occur due to adult-sized balls (size 5) to junior-size (size 3 and 4).

B. One sample proportion ^zt-test. -For the purposes of this exercise, disregard that they use a Yate's correction; it simply adds a -.5 to the numerator of the test statistic.

2 A. $H_0: p_5 = 0.5$ $H_a: p_5 > 0.5$ $p_5 < 0.5$

(adults)

B. $p_5 = 12/15 \dots 0.8$

$Z = 0.8 - 0.5 / \sqrt{(.5)(.5)/15} \dots 2.32$

They use a two-sided test, so the p-value doubles

$df = 14 \dots P = 2 \times .019 = .038$ -close to their value

C. Bigger balls are not necessarily more dangerous than smaller balls. It could be just the opposite, contrary to the belief of soccer officials.

3. We do not know how many children in the population sampled are actually using junior-sized balls. If 90 percent of the sampled population use adult-sized balls, by chance alone we are more likely to find higher distal injuries with the big balls.

4. A. The distribution of left and right injuries is even -close to what one might expect.

B. $0.8 \pm 2.15(\sqrt{(.8)(.2)/15}) \dots (.58, 1.00)$ -so big!

C. If the injuries from unknown balls are in fact due to junior-sized balls, then the proportion could change to a level of not being significant.

5. No. I would be more convinced if the authors qualified their study by giving the proportion of soccer players that currently use junior-sized balls. Furthermore, in the discussion, the authors make their case for smaller balls by calculating force of impact. I suspect some distal fractures are due to falling, rather than direct impact with the ball, when ``saving the ball.''

①

Dangerous Balls - Comments on Answers

1A OK They make separate analysis for younger and older children.

1B To me, as you allude to later, this SHOULD be a comparison of injury RATES, ~~in these~~ while playing with adult & junior footballs.

If we know the percentage of playtime with adult and junior balls (say $A\%$ and $J\% = 100 - A\%$ respectively), then the null expectation for the distribution of injuries would be $A\% : J\%$. There is nothing to allow us to assume that $A\% = 50\%$! As you say $A\%$ is more likely 80 or 90%.

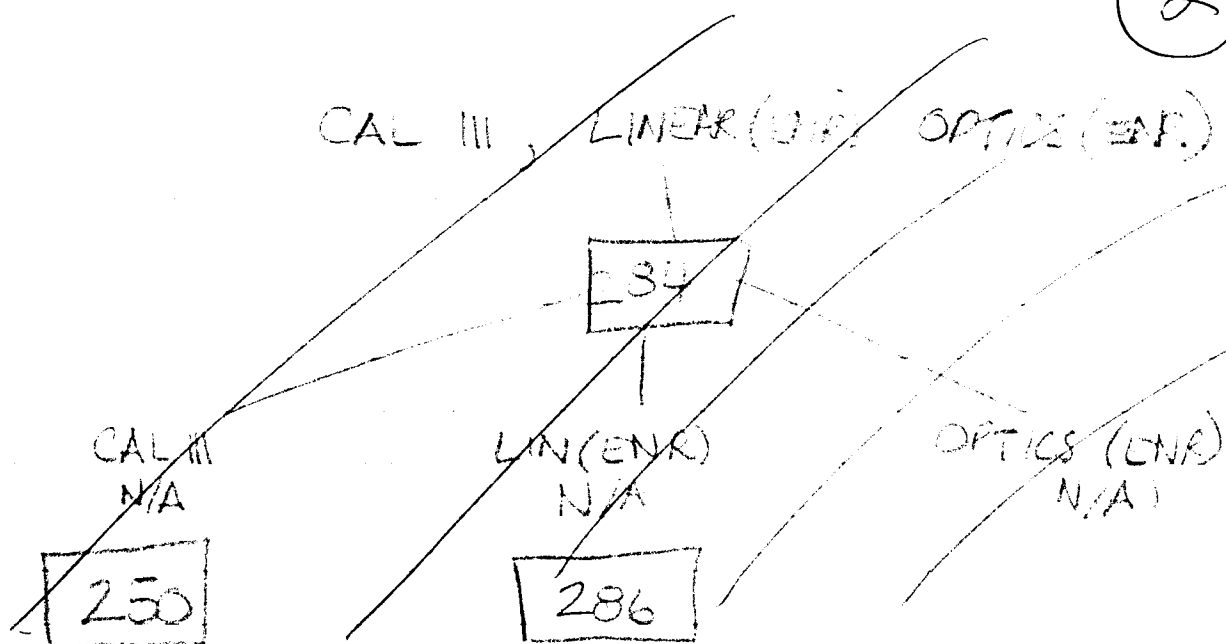
But, OK, for sake of ~~the~~ replicating what we ~~think~~ the authors did, we go with the 50:50 null expectation.

2A Yes this is what authors assumed/used.

B You could ask students to reconstruct the chi-square.

The observed frequencies are, as you say, 12 and 3. The expected frequencies, under 50:50, are 7.5 and 7.5. The discrepancies, $O-E$, are ~~5~~ 4.5 and 4.5. So, without the correction for continuity (as an OS.7 would say, for the discontinuity) the chi-square value is 4.5^2 divided by 7.5 plus the same again, i.e. $(20.25/7.5) + (20.25/7.5) = 40.5/7.5 = 5.4$, which is ~~exactly~~ exactly the square of your ~~z~~ $Z = 2.32$.

2



With the continuity correction, the chi-square statistic is 4 squared divided by 7.5 plus the same again, i.e. $\frac{32}{7.5} = 4.27$. The chi-square table puts this between the 0.05 and 0.02 ~~points~~ points of the ~~chi-square~~ chi-square distribution with 1 df. so 0.039 would make sense. To get the actual p value corresponding to 4.27, you can take the square root, 2.06, and determine that $P(|Z| > 2.06)$ is 2×0.0197 or 0.0394, just as the authors reported.

Without the correction, the p value corresponds to ~~$\chi^2 = 7.5$~~ , or $\rightarrow$ to $\chi^2 = 5.4$ or $Z = 2.32$ is 2×0.0132 . ~~I'm~~ I'm not sure how you use the 14 df. With Z there are no (or, rather infinite) degrees of freedom.

A 'cleaner' way to ~~calculate~~ calculate the p-value, in this case where the ~~n~~ is small (15) is via the Binomial ($n=15, p=0.05$) distribution which is Tabulated in Table C of the text or given by the BINOMDIST function in Excel. From Table C, we have $P(12/15) = 0.0139$; $P(13) = 0.0032$; $P(14) = 0.0005$; $P(15) = 0$ so $P(\geq 12/15) = 0.0175$, or ~~2P~~ $P(\leq 3) + P(\geq 12) = 0.0$

2 C I agree, although most ^{likely} would probably be more on the bigger ball doing more damage.
~~It should be~~

3 Excellent answer. Instead of the use is indeed 90% , then ~~numbers~~ ~~large~~ splits such as 15.0, all the way to say 11.4 are plausible (See Table C with $n=15$ ~~and~~ ~~become~~ and $p=0.10$ become the table doesn't mean $p=0.90$, you can use 10% junior balls instead). (All this is a bit like the best place to shoot on Patrick Roy, or the ~~distribution~~ mix of planes involved in crashes ~~is~~, or the fact that 90% of accidents happen close to home.)

They ~~might~~ ^{might} be the "hype" around on the breach than in the observations in the article itself -- but

(4)

You could build a nice q around this [and indeed if you are going to write to the Editor, use it] by asking what % use of adult ball ^(AND NO INCREASED RISK) use is this observed rate of 12/15 compatible with. The answer can be obtained directly from the ^{Table of} Binomial Confidence Intervals I put on the web page 0.52 to 0.96, or 52% to 96%.

4A

Important? Unless you mean not being able to write for a few weeks, ~~and~~ or ~~generally being more hesitant~~ and the like, I don't see what it has by way of importance. Maybe if the preponderance were to the right hand, we should ~~have~~ ^{give} the right glove more padding!

As you say, you can't get any closer to 50% than ~~12/15~~ a 14:15 split! In fact, the p value for a 2 sided test is, unless you use a mid-value, GREATER than

1 -- An EMBARASSING FOR Statisticians who insist on counting in the tail area the full probability of the observed outcome (see my notes re "mid- p " values!)

4 B ... Could also ~~why not use~~ the binomial.

(S)

You say 0.8 or 80%, but the split is 14:15, close to 50%. Where did you get the 80% from? (12/15?). I'm not sure it is relevant. Here is one instance where I (and the other soccer players in my home) were unsure which "side" to bet on. ~~The~~ on the one hand ... on the other hand, as many 2-handed statisticians ~~are known as~~ often fall back on!

~~4 B~~ For part B, are you back to the Adult vs Junior balls in Under 11's (maybe indeed that's where your CI comes from -- compare it with mine (52% to 96%). Whenever you get an ~~interval~~ interval limit that goes above 100%, you know the Normal ("Gaussian") approximation isn't accurate. The tables I mention above are better in such cases.

4 C ~~See~~ See my comments above, also. ~~without the missing data, a wide range~~

(P6)

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(6)

5. Indeed! It would take
so little to get a rough
estimate of the division of
the "study base" into ADULT
and JUNIOR. Just drive around
At the same time as the
clinic (or even other times) and
"see for themselves" -- a bit of
shoe-leather epidemiology wouldn't
hurt! (with your permission!)

→ I would like to put this article, your Q & A, and my comment on the web site.

OVERALL COMMENTS (besides 'excellent choice')

I think you should write a letter
to Editor -- we have another injury/sports
epidemiologist in our PhD program -- Brent
Hagel -- he wrote to ~~an American~~ a Sports
Medicine Journal (North America I think) last
year concerning a less glaring error involving
snowboard injuries and use of ~~test~~ wrist guards.

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December 11, 2001

Risks and Remedies: Soccer Found Safer With Smaller Balls

By ERIC NAGOURNEY

Young goalkeepers who play soccer with adult-size balls instead of smaller ones increase their risk of breaking their hands or wrists, a new study has found.

A full-size ball weighs less than a pound, but its potential for causing injury increases because of its speed, which can reach as much as 50 miles an hour when kicked by a skilled adult. Even at slower speeds, the result can be the same as a bad fall, the researchers said.

The study appeared in a recent British Journal of Sports Medicine and was prepared by doctors at two British hospitals. They found that although soccer officials there had recommended since 1993 that children use smaller balls, Sizes 3 and 4, the advice was widely ignored. (An adult ball is Size 5.)

In the United States, smaller balls are commonly used, said David Brown, a spokesman for the American Youth Soccer Organization.

"First of all," Mr. Brown said, "the kids are simply smaller, so they manipulate it a little easier." But beyond that, he said, "a heavier ball is just harder on the human frame."

The British researchers followed soccer injuries at a clinic for 17 months and found 29 cases in which young goalkeepers broke bones trying to make saves.

In children under 11, 12 of the 15 fractures involved adult soccer balls.

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the authors reported. In children 12 to 15, 9 of 10 injuries involved adult soccer balls, they said. In the other four cases, the ball size was not known.

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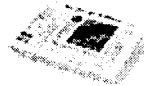
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