Strange nativities

bmj.com/podcasts
▶ US virgin births
Authors talk about their paper

A born again Christian

David Isaacs, **Stephen Isaacs**, and **Dominic Fitzgerald** put a modern twist on the nativity story

"Blessèd Herod" grumbled Joseph of Nazareth. "Another senseless census! A 600 furlong hike to Bethlehem to register for another tax increase. You'd think in this modern era of globalisation they could tax the rich to spare the poor. At least it's all motorway. We can't afford a GPS on a carpenter's salary." "Thou art an honest artisan," said Mary. "Yes, but with a dubious family tree and no tertiary qualifications, as your parents keep harping on." "Well, go easy on the wine," said Mary sweetly. "You know how Herod's men breathalyse everyone at Christmas." Joseph stomped out to pack the donkey.

The journey was arduous, with several security checks because of rumoured terrorist activity, but their papyrus passports were in order. In Bethlehem, however, all hotels were fully booked. "So you didn't get a chance to book on lastminute.com then, my angel?" asked Mary. Joseph grunted and shuffled into the nearest hostelry, the Star was Born Inn, Bethlehem. "We can use the barn," he said. "Are you sure that's wise?" asked Mary. "Nothing must befall our unborn child. I read about listeria on the internet." "Our child?" said Joseph. "I'm getting paternity testing as soon as he's born." "I told you not to worry dear," reassured Mary. "Yes, yes, Angel of the Lord . . . a likely story," moaned Joseph. "IVF pregnancy, my ass. Improbable virgin fable, more likely. Anyway, it's a lowly cattle shed or the paddock."

The midwife refused to attend unregistered home deliveries and the local GP didn't visit stables. And Mary bore a healthy boy, unaided, and laid him in a manger. "Hallelujah, a natural delivery," chorused the cherubim and seraphim. "Ding, dong merrily on high," chimed the ring tone on an angel's iPhone. "Nailed it," said Joseph prophetically. "Well?" asked Mary, "Whom does he resemble?" "A chip off the old block," beamed Joseph. "If that cheapskate innkeeper had wireless we could Skype the grandparents in Nazareth."

The first visitors were some shepherds tending their flocks in the fields nearby. Joseph, who knew all about paparazzi, checked their robes for hidden cameras and made them undergo "Working with Children" checks. From afar came the sound of voices raised to heaven, singing:

We are three obstetrical men
On our way to Bethlehem
We won't use tweezers
On Little Jesus
We'll do an ARM.

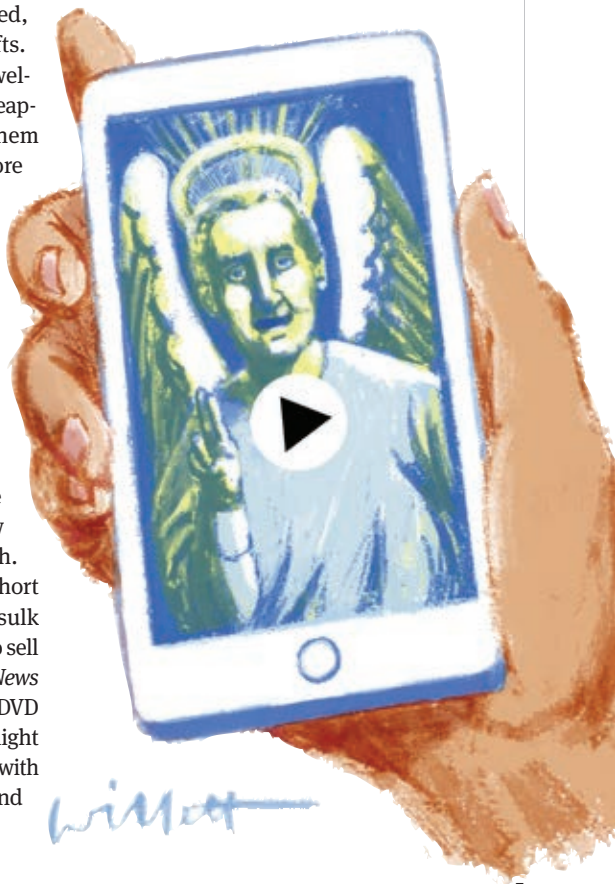
We'll give Mary quite a fright
Monitor her both day and night
Little Jesus
Won't defeat us
We'll make sure His APGAR's right.

Three foreigners from the East appeared, clad in exotic garments and bearing gifts. "God rest ye merry gentlemen," Joseph welcomed them. He frisked them for hidden weapons of Messiah destruction and made them sign a Conflict of Interest declaration before he would allow the infant Jesus to accept their priceless presents of gold, frankincense, and myrrh, whatever that might be. Not even an iPhone. "How embarrassing," said Mary, "We didn't get them anything for Christmas."

"I still prefer the name Noel," sulked Joseph. "We agreed it would be Jesus if it was a boy and Samantha if it was a girl," said the mother mild. "He will go on Facebook and cure the sins of the youth of the world. No more vices." "No vices? But how will I hold my wood still?" asked Joseph. "Sometimes you can be as thick as two short planks," sighed Mary. Joseph went off to sulk and to message Rupert again, still hoping to sell the rights for the first virgin birth to the *New News of the Old World*. It would be a miracle if the DVD didn't go viral. Joseph took a photo by the light of the haloes and uploaded it on Instagram, with the caption, "The Son of God is born: He and His mother are in a stable condition."

A rumour was circulating that Herod had got wind of the birth of a future rival and was planning ethnic cleansing of all first born sons. So Joseph decided they should flee to Egypt, before the Arab Spring. They had to go by foot because Virgin Airways would not take the donkey despite its widely trumpeted policy of putting more asses on seats. Before fleeing they registered with the representative of the United Nations High Commissioner for Refugees in Bethlehem. Egypt had refused any asylum seekers ever since Moses arrived as a boat person and then drowned half the Egyptian army in the Red Sea. "What work will I find in Egypt?" Joseph ruminated. "Pyramid selling? Perhaps become a Cairopracter?" Only time would tell.

Competing interests: None declared.
Provenance and peer review: Not commissioned; not externally peer reviewed.
Cite this as: *BMJ* 2013;347:f7006



David Isaacs infectious diseases physician, and clinical professor, Department of Infectious Diseases and Microbiology, Children's Hospital at Westmead, Sydney, NSW 2145, Australia and Discipline of Child Health, Sydney Medical School, University of Sydney, NSW, Australia
david.isaacs@health.nsw.gov.au
Stephen Isaacs retired child psychiatrist, London, UK
Dominic A Fitzgerald paediatric respiratory and sleep physician, and clinical professor, Department of Respiratory Medicine, Children's Hospital at Westmead, Sydney and Discipline of Child Health, Sydney Medical School, University of Sydney, NSW, Australia

Like a virgin (mother): analysis of data from a longitudinal, US population representative sample survey

Amy H Herring,[1 2] Samantha M Attard,[2 3] Penny Gordon-Larsen,[2 3] William H Joyner,[4] Carolyn T Halpern[2 5]

OBJECTIVE
To estimate the incidence of self report of pregnancy without sexual intercourse (virgin pregnancy) and factors related to such reporting, in a population representative group of US adolescents and young adults.

DESIGN
Longitudinal, population representative sample survey.

SETTING
Nationally representative, multiethnic National Longitudinal Study of Adolescent Health, U.S.

PARTICIPANTS
7870 women enrolled at wave I (1995) and completing the most recent wave of data collection (wave IV; 2008-09).

MAIN OUTCOME MEASURES
Self reports of pregnancy and birth without sexual intercourse.

RESULTS
45 women (0.5%) reported at least one virgin pregnancy unrelated to the use of assisted reproductive technology. Although it was rare for dates of sexual initiation and pregnancy consistent with virgin pregnancy to be reported, it was more common among women who signed chastity pledges or whose parents indicated lower levels of communication with their children about sex and birth control.

CONCLUSIONS
Around 0.5% of women consistently affirmed their status as virgins and did not use assisted reproductive technology, yet reported virgin births. Even with numerous enhancements and safeguards to optimize reporting accuracy, researchers may still face challenges in the collection and analysis of self reported data on potentially sensitive topics.

[1]Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, CB 7420, Chapel Hill, NC 27599, USA
[2]Carolina Population Center, Chapel Hill, NC, USA
[3]Department of Nutrition, Gillings School of Global Public Health and School of Medicine, NC, USA
[4]The Chapel of the Cross, Chapel Hill, NC, USA
[5]Department of Maternal and Child Health, Gillings School of Global Public Health, NC, USA
Correspondence to: A H Herring **amy_herring@unc.edu**

Introduction

Virgin births in non-humans are generally by asexual reproduction, or parthenogenesis, where development of the embryo occurs without fertilization. Births without a human father are seen as distinct from asexual reproduction, and involve a non-mortal father—for example, in the gospel of Matthew, Mary was found to be "with child" from the Holy Spirit, and numerous Greek demigods, were reportedly born of mortal women[3] (or in the case of Dionysus, his immortal father, Zeus[4]).

Some supporters of the doctrine of the perpetual virginity of Mary believe that Mary dedicated herself and her virginity to God, and that her husband Joseph was guardian of that virginity—perhaps a precursor of present day pledges of chastity. Chastity pledges may be signed by those who plan to remain chaste until marriage and by non-virgins who pledge to abstain from further intercourse until marriage ("born again" virgins)[5]; this concept of the reconstitution of virginity has also appeared in pop culture.[6]

Using data from a nationally representative, multiethnic longitudinal study, we examined the incidence of virgin pregnancy and birth based on self report of pregnancy and sexual debut. We hypothesized that individual and contextual factors may influence reporting.

Parents of virgins who reported pregnancy were more likely to indicate inadequate knowledge to discuss sex/birth control than the parents of the other virgins

Methods

The National Longitudinal Study of Adolescent Health (Add Health) began in 1994-95 as a representative sample of the US school aged population (grades 7-12, typically ages 12-18). A stratified sample of 132 schools was selected with probability of selection proportional to size. Add Health includes interviews at home and school and with parents and school administrators, providing a wealth of sociodemographic, contextual, behavioral, and biological data.[7] The in-home survey included 20 745 youth in wave I (1994-95; mean age 15.7 years). All eligible school aged respondents were followed (including dropouts) in wave II (1996; mean age 16.2); all eligible wave

Possible role model

Table 1 | Characteristics of women according to status of their virginity, from National Longitudinal Study of Adolescent Health. Values are numbers (percentages) unless stated otherwise

	Virgins		Non-virgins	
Characteristics	**No pregnancy**	**Pregnancy**	**No pregnancy**	**Pregnancy**
Women	146 (2.5)	45 (0.5)	2319 (30.7)	5116 (63.8)
Mean (SE) age at wave I	14.9 (0.5)	14.4 (0.4)	14.4 (0.1)	14.8 (0.1)
Importance of religion at wave I***:				
Very important	91 (49.0)	24 (53.3)	1017 (43.4)	2330 (42.7)
Somewhat important	30 (19.5)	11 (22.7)	800 (33.5)	1750 (35.5)
Somewhat unimportant	5 (2.6)	— (7.9)	163 (7.7)	257 (5.4)
Very unimportant	3 (8.4)	— (<0.1)	69 (3.0)	114 (2.4)
Refused/don't know	17 (20.5)	7 (16.2)	270 (12.4)	665 (14.0)
Sex education offered in school:				
No	25 (11.6)	8 (21.4)	321 (12.6)	806 (16.2)
Yes	114 (84.6)	35 (73.9)	1869 (79.8)	4089 (78.0)
Missing	7 (3.8)	2 (4.6)	129 (7.6)	221 (5.8)
Took pledge to remain virgin until married, wave I***:				
No	100 (72.4)	31 (66.4)	1888 (82.5)	4256 (83.7)
Yes	40 (21.2)	12 (30.5)	410 (16.4)	801 (15.0)
Missing/refused	6 (6.4)	2 (3.1)	21 (1.1)	59 (1.3)
Respondent beliefs				
Knows how to use a condom correctly, wave I***:				
Strongly agree	22 (14.3)	10 (16.1)	686 (29.1)	2103 (41.3)
Agree	43 (15.9)	19 (51.7)	902 (37.6)	1996 (38.3)
Neither agree nor disagree	26 (15.1)	5 (8.2)	313 (12.7)	426 (8.5)
Disagree	22 (18.2)	5 (16.0)	228 (9.8)	321 (5.9)
Strongly disagree	13 (5.7)	3 (0.6)	113 (5.1)	145 (2.9)
Don't know/refused	20 (30.8)	3 (7.3)	77 (5.8)	125 (3.1)
Knows how to use rhythm method of contraception, wave I***:				
Strongly agree	13 (6.5)	6 (14.4)	329 (13.9)	1007 (19.0)
Agree	38 (13.6)	16 (39.6)	760 (31.3)	1927 (37.3)
Neither agree nor disagree	34 (19.2)	7 (16.5)	478 (20.0)	938 (19.3)
Disagree	27 (17.7)	10 (19.6)	478 (20.6)	788 (15.1)
Strongly disagree	14 (7.2)	3 (2.5)	163 (6.6)	276 (5.1)
Don't know/refused	20 (35.7)	3 (7.3)	111 (7.4)	180 (4.2)
Knows how to use withdrawal method of contraception, wave I***:				
Strongly agree	14 (8.6)	7 (12.3)	356 (15.1)	1077 (20.5)
Agree	29 (12.7)	19 (43.1)	869 (35.3)	2271 (44.1)
Neither agree nor disagree	41 (23.3)	9 (22.8)	468 (20.2)	843 (16.8)
Disagree	29 (14.1)	5 (8.6)	377 (16.1)	583 (11.1)
Strongly disagree	11 (6.1)	— (6.0)	125 (5.3)	158 (3.2)
Don't know/refused	22 (35.3)	— (7.3)	124 (8.1)	184 (4.3)

Percentages calculated using survey weights to allow population representative inference. Dash indicates cell size was too small to be displayed. Data from 244 "born again virgins" who reported sex in an early wave but later recanted are not shown.
***P<0.001 using analysis of variance for continuous variables and Fisher's exact test for categorical variables.

Table 2 | Parental attitudes and guidance according to respondent's virginity status and gravidity, from National Longitudinal Study of Adolescent Health, wave I. Values are numbers (percentages)

	Virgins		Non-virgins	
Variables	**No pregnancy**	**Pregnancy**	**No pregnancy**	**Pregnancy**
Women	146 (2.5)	45 (0.5)	2319 (30.7)	5116 (63.8)
Parent feels (s)he does not know enough to discuss sex/birth control with child***:				
Strongly agree	3 (0.5)	4 (11.9)	35 (1.1)	104 (2.1)
Agree	4 (1.2)	5 (11.3)	79 (2.8)	195 (3.1)
Neither agree nor disagree	6 (5.6)	5 (9.7)	78 (3.3)	197 (3.7)
Disagree	41 (43.4)	14 (23.8)	721 (32.0)	1605 (31.5)
Strongly disagree	76 (43.2)	10 (26.9)	1136 (51.7)	2239 (46.0)
Don't know/refused/missing	16 (6.0)	7(16.4)	270 (9.1)	776 (13.6)
Parent would find it difficult to discuss sex/birth control with child*:				
Strongly agree	— (<0.1)	5 (12.2)	27 (1.0)	73 (1.4)
Agree	8 (9.1)	— (5.5)	129 (7.2)	246 (4.2)
Neither agree nor disagree	— (4.0)	— (4.8)	91 (4.2)	172 (3.1)
Disagree	58 (42.0)	16 (25.8)	870 (37.8)	1859 (37.1)
Strongly disagree	60 (38.3)	12 (35.3)	934 (40.9)	1985 (40.6)
Don't know/refused/missing	17 (6.5)	7 (16.4)	268 (9.0)	781 (13.7)
Parent feels child would be embarrassed if parent discussed sex/birth control with them***:				
Strongly agree	3 (2.4)	5 (11.5)	53 (2.5)	120 (2.3)
Agree	19 (27.8)	3 (5.8)	334 (14.7)	566 (11.1)
Neither agree nor disagree	8 (6.1)	3 (10.7)	200 (9.6)	322 (6.7)
Disagree	54 (32.3)	16 (28.2)	809 (34.9)	1703 (33.0)
Strongly disagree	45 (25.1)	11 (27.5)	656 (29.3)	1622 (33.1)
Don't know/refused/missing	17 (6.3)	7 (16.4)	267 (9.0)	783 (13.7)
How much has the parent talked with the child about sex?***:				
Not at all	11 (11.2)	5 (15.5)	134 (6.6)	248 (4.9)
Somewhat	36 (23.1)	7 (15.0)	512 (24.4)	752 (14.5)
A moderate amount	50 (33.0)	12 (16.3)	775 (32.9)	1366 (27.7)
A great deal	32 (26.5)	14 (36.7)	613 (26.3)	1933 (38.3)
Don't know/refused/missing	17 (6.1)	7 (16.4)	285 (9.8)	817 (14.5)

Percentages calculated using survey weights to allow population representative inference. Dash indicates cell size was too small to be displayed. Data from 244 "born again virgins" who reported sex in an early wave but later recanted are not shown.
*P<0.05.
***P<0.001 using ANOVA for continuous variables and Fisher's exact test for categorical variables.

I respondents were followed in waves III (2001; mean age 22.0) and wave IV (2007; mean age 28.5, response rate 80.3%). State of the art technology (audio computer assisted self interview and computer assisted self interview) was used to enhance the candor of the respondents. We used sampling weights to account for the study design and dropout rate for generalizability of the results to the US population.

We included women who completed interviews at waves I and IV (n=7870, see figure on bmj.com).

Variable measurement and definition of dependent and independent variables

At every wave, participants reported their history of vaginal intercourse and women reported their pregnancy history. We used these longitudinal data to classify women by their virginity status at the time of reported pregnancy. We defined virginity as consistent reporting of no history of vaginal intercourse. Women were classified as having virgin pregnancies if they reported a pregnancy before sexual debut. We classified the other women as non-virgins.

Respondent reported variables included age, importance of religion, and presence of a chastity pledge. Respondents indicated how much they agreed with statements about contraception (see table 1). Parents of respondents reported how much they had talked with their child about sex or birth control and indicated their level of agreement with several statements (see table 2). School administrators reported whether sex education was offered in the respondent's school.

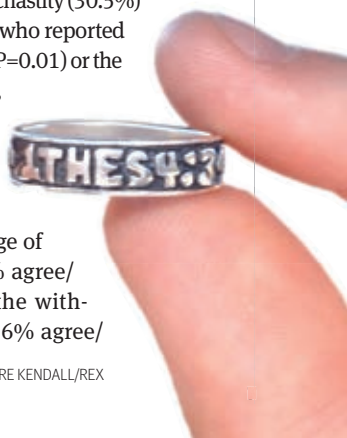
At waves I and IV, interviewers reported the quality of the interview, including number of interruptions, boredom of the respondent, and whether the respondent needed help with the questionnaire.

For details of statistical analysis see bmj.com.

Results

Of 7870 eligible women, 5340 reported a pregnancy, of whom 45 (0.8% of pregnant women) reported a virgin pregnancy (table 1). Perceived importance of religion was associated with virginity but not with virgin pregnancy. The prevalence of abstinence pledges was 15.5%. The virgins who reported pregnancies were more likely to have pledged chastity (30.5%) than the non-virgins who reported pregnancies (15.0%, P=0.01) or the other virgins (21.2%, P=0.007).

The virgins who reported pregnancy were more likely to endorse knowledge of condom use (67.8% agree/strongly agree) or the withdrawal method (53.6% agree/



CLARE KENDALL/REX

strongly agree) than the other virgins (30.2%, P=0.007 and 45.3%, P=0.02, respectively) but were less likely to know how to use condoms than the non-virgins who reported pregnancy (79.6%, P=0.002).

Parental attitudes and guidance were informative (table 2), with the parents of virgins who reported pregnancy more likely to indicate inadequate knowledge to discuss sex/birth control (27.7% agree/strongly agree) than the parents of the other virgins (1.7%, P<0.001) or of the non-virgins with or without pregnancies (5.2% and 3.9%, P<0.001). The parents of virgins who reported pregnancy were more likely to strongly agree it was difficult to discuss sex/birth control with the child (12.2%) than the parents of the virgins not reporting pregnancies (<0.1%, P<0.001) or of the non-virgins (1.4%, P=0.02). The parents of the virgins were more likely to strongly agree that their child would be embarrassed by these discussions (11.5%) than the parents of the non-virgins with or without pregnancies (2.3%, P=0.002 and 2.5%, P=0.004). The frequency of discussions about sex was related to pregnancy but not to virginity.

Differences in the quality of the interviews were apparent (see table 3 on bmj.com) but related to pregnancy rather than to virginity, with the exception of needing help with the questionnaire, which was more common among the virgins (30.2%) than the non-virgins (10.8%, P=0.007).

Discussion

We examined the incidence of self reports consistent with virgin pregnancy in the US nationally representative, multiethnic National Longitudinal Study of Adolescent Health (Add Health). Reporting dates of pregnancy and sexual initiation consistent with virgin pregnancy was associated with cultural mores highly valuing virginity, specifically signing chastity pledges, and with parental endorsement of items indicative of lower levels of communication about sex and birth control.

Errors in data entry are possible. However, among "virgin pregnancies," the median sexual debut reported was 2 (interquartile range 1-6) years after the pregnancy, and numerous women reported virginity at multiple subsequent waves. While Add Health collected information about use of assisted reproductive technologies, all the virgins who reported pregnancies stated that they did not use such methods.

A third group of women (n=244) not included in analysis, "born again virgins," reported a history of sexual intercourse early in the study but later provided a conflicting report indicating virginity. Reports of pregnancy among born again virgins were associated with greater knowledge of contraception methods with higher failure rates (withdrawal and rhythm methods) and lower interview quality (data not shown), and reports from this group may be subject to greater misclassification error.

Numerous important factors can be only feasibly or affordably measured in large samples using self report in surveys, including sexual history, illicit drug use, domestic violence, maltreatment as a child, and diet. Unfortunately this means there is no ideal against which to judge accuracy of self report. Self reported sexual behavior is often "validated" through consistency analyses, wherein respondents' answers to the same questions at multiple time points are compared. Analyses of age at first vaginal sex suggest that 80-90% of respondents report a consistent age, with repeated measures crossing months[11 12] or even years.[13]

Full details including references and competing interests are in the version on bmj.com.

Cite this as: *BMJ* 2013;347:f7102

Does sporting success affect birth rate?

Nine months after a celebrated goal by FC Barcelona in 2009, the media reported a spike in the Catalan birth rate. **Jesus Montesinos and colleagues** test whether the "Iniesta effect" really existed

OBJECTIVE Nine months after FC Barcelona won 3 major football trophies in the month of May 2009, local and national media reported a 45% spike in the Catalan birth rate, based on anecdotal reports. We decided to formally test whether or not such an increase actually existed.

DESIGN Time-trend ecologic study.

SETTING Catalan counties of Bages and Solsones. Birth data was collected from the Althaia Foundation's referral hospitals, which serve a population of 190 000 inhabitants.

INTERVENTION Observational study. Researchers did not allocate the intervention to any unit.

MAIN OUTCOME MEASURES Number of births over five years (2007-2011).

RESULTS A time series analysis, based on the monthly frequency of births (n=11,000), shows a transitory and significant increase of 16% nine months after a brief series of extraordinary and emotive football victories by a single team. In the following month, this increase remains but decreases to 11%.

CONCLUSIONS Our study confirms a significant and transitory increase in natality nine months after the Barça triumphs of 2009. The design does not allow us to ensure a causal relationship between football success and birth rates, but our results are promising enough to suggest that government may improve natality rates by promoting local sports clubs.

Introduction

On 6 May 2009, Andrés Iniesta scored a last minute goal against Chelsea FC, which put Football Club Barcelona (popularly known as Barça) in the UEFA Champions League final. This single goal was so emotive that the skies over Catalonia reverberated with fireworks, shouts of joy, and the banging of pots and pans. According to some media reports, many fans also celebrated by making other kinds of noise. Nine months after the event, Catalonia's COMRadio broadcast the results of an informal survey of five hospitals, which reported a 45% increase in the number of births.[1-3] The putative cause of this spike in natality was Iniesta's breathtaking goal, and the children born during this boom came to be known popularly as "the Iniesta generation," implying that Iniesta had fathered—through surrogates—hundreds or even thousands of babies (fig 1).

Similar claims made by the media in the past have been disproved under scrutiny.[4-7] For example, the 1965 blackout in the northeast United States affected over 30 million people, including four million homes in New York City. Nine months after this event, the *New York Times* published four consecutive articles reporting a 30% increase in the birth rates of five hospitals in Manhattan.[8] However, in 1970, Menaker et al[6] showed that there had actually been a 20-25% decline in births rather than an increase. Nevertheless, some seasonal and social effects appear to be certain. We hope, for example, that it is not too late for the readers of this issue to bear in mind the "Christmas effect," in which a sharp September spike appears nine months after the December holidays.[9]

We wondered if the Iniesta effect in Catalonia was real, and, if so, whether the exhilaration associated with football or other sporting events can truly have profound demographic repercussions.

Methods

We studied the counties of Solsones and Bages, which have a combined population of

JAVIER GARCIA/BPI/CORBIS

Fig 1 | The genuine article

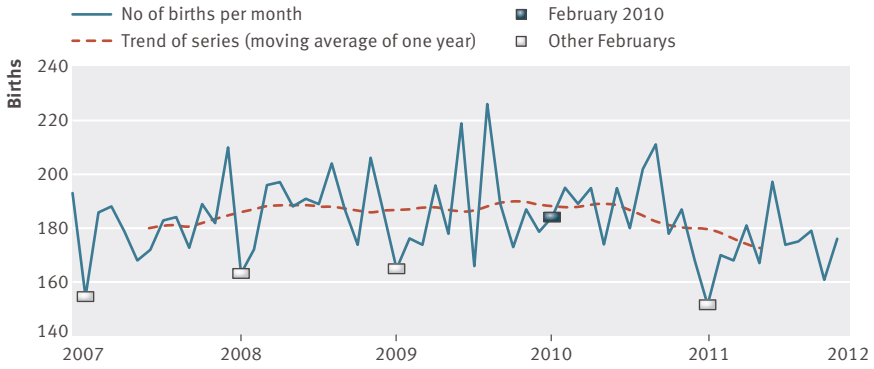


Fig 2 | Number of births per month from January 2007 to December 2011

about 190 000 (16.9% children).[10] This area is located in central Catalonia. Josep Guardiola, FC Barcelona's coach from 2008 to 2012, was born in this region (Santpedor, Bages, Jan 18 1971), so it seemed fair to assume that the population might have a heightened level of enthusiasm for Barça.

We used a time-trend ecological study design. As human pregnancy lasts 269 days,[11] the target period was February 2010. The control period covered January 1 2007 to December 31 2011 (60 months). We looked at the number of births in two of Althaia Foundation's hospitals, located in Manresa, capital of Bages.

We analysed monthly birth data using time-series analyses to determine whether the observed changes in the target period were statistically significant.

For details of statistical analysis see bmj.com.

Results

The average number of births per month was 183.3 (standard deviation 14.9; range 152-226). Figure 2 shows the number of births per month over time. A slight decrease in trend can be seen after mid-2010. September saw the most births and February the least. In 2010, the maximum births increased for both February and March in comparison with other years.

Socioeconomic factors, wars, epidemics, famines, migrations, and cultural and religious events can drive or impede procreation every bit as much as candlelight with Julio Iglesias on the stereo

The coefficient 25.8 (standard error, 8.9) of the covariate I_t leads to a significant increase of 26 births in February 2010 and a slightly lower number in subsequent months. When we readjusted this model by employing logarithms, the percentage increment in births was 16.1% (95% confidence interval 5.8 to 27.4) in February, with another 11.0% increase (4.0 to 18.5) in March.

Discussion

Our results show a transitory and significant 16% increase in births in February 2010, 9 months after FC Barcelona's exciting victories in May 2009—far short of the 45% increase reported by the media. We may infer that—at least among the target population—the heightened euphoria following a victory can cultivate hedonic sensations that result in intimate celebrations, of which unplanned births may be a consequence. Other studies[14 15] have shown, unsurprisingly, that rationality is not always a key factor in conception. One of the most intense emotions that can be experienced is the social component of belonging and the self assertion of a group[16] (also known as *you'll never walk alone*). Thus, the act of coming together can be interpreted on many levels when people feel motivated to share their euphoria with others.

Some authors have shown that circumstances are decisive influences on human conception[17] or other behaviours.[18] Socioeconomic factors, wars, epidemics, famines, migrations, and cultural and religious events can drive or impede procreation every bit as much as candlelight with Julio Iglesias on the stereo, which—depending on the individuals present—could either enhance or reduce desire. Our results also show a decline in births from the second half of 2010, possibly caused by the Spanish economic crisis and presumably related to a decrease in "rational births."[19] Positive emotional experiences appear to offset the pessimism produced by countries in crisis.[20] To state it simply: *bread and circuses* may be a viable remedy for widespread dysphoria.

This study has several limitations, one of which is that the study design does not allow causal inferences. In fact, some of the authors (who happen to be Barça supporters: JM, JC, AA, NM, RS, JB), believe that an intense and brief stimulus (the Barça triumphs in May 2009) was the cause of the increase in births. The remaining authors (who, incidentally, are not Barça

supporters) interpret that the term "Iniesta generation" is a misnomer. Those dissenting authors independently collected data from the Catalan Statistical Institute[10] for the same period, and tested the Barcelona city population under the same hypothesis using the same methodology. But neither the same model nor the model which best fitted the data were able to replicate the effect: there was only a 1.2% increase (95% CI -6.1 to 9.0). However, this does not invalidate the main results of our paper. One can easily argue that the Catalan regions do not belong to the same target population in terms of Barça support. In fact, the number of Barça supporters' groups compared with the number of groups supporting Real Madrid and RCD Español is higher in Bages-Solsones than in Barcelona City (odds ratio 1.21).[21-23]

In summary, our results may have several different interpretations. One is that human emotions on a large scale can profoundly affect demographic swings in populations, that national or regional events can reduce the weight of reason and increase the weight of passion. Validation of our results could contribute to a better understanding of human behaviour, improve healthcare planning, and even aid government policy makers in stimulating or reducing birth rates. Ideally, to bridge the gap between observational and trial data, it would help greatly if Iniesta were willing to replicate his intervention—although the cost of such a study could be prohibitive, not to mention harmful to the reference group (Chelsea).

Full details including references and competing interests are in the version on bmj.com.

Cite this as: *BMJ* 2013;347:f7387

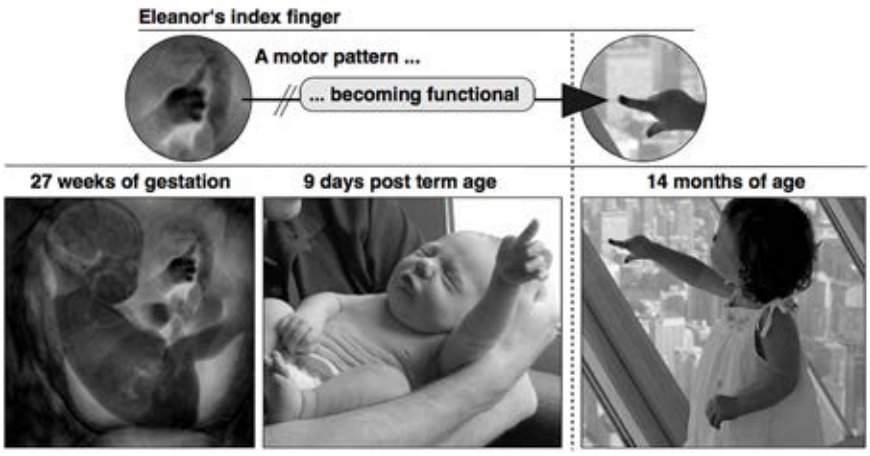
Jesus Montesinos head of research and innovation, Althaia, Xarxa Assistencial Universitaria de Manresa, Barcelona, Spain
jmontesinos@althaia.cat
Jordi Cortes statistical researcher, Department of Statistics and Operations Research, Universitat Politècnica de Catalunya, BarcelonaTech, Spain
Anna Arnau epidemiologist, Althaia, Xarxa Assistencial Universitaria de Manresa, Barcelona, Spain
Josep Anton Sanchez senior statistical lecturer, Department of Statistics and Operations Research, Universitat Politècnica de Catalunya, BarcelonaTech, Spain
Matt Elmore technical writer and editor, Barcelona
Narcis Macia head of medical record service, Althaia, Xarxa Assistencial Universitaria de Manresa, Barcelona, Spain
José Antonio Gonzalez associate statistical professor, Department of Statistics and Operations Research, Universitat Politècnica de Catalunya, BarcelonaTech, Spain
Ramon Santisteve gynecologist , Althaia, Xarxa Assistencial Universitaria de Manresa, Barcelona, Spain
Erik Cobo associate statistical professor, Department of Statistics and Operations Research, Universitat Politècnica de Catalunya, BarcelonaTech, Spain
Joan Bosch director and professor of medicine, A1 Althaia, Xarxa Assistencial Universitaria de Manresa, Barcelona, Spain and Faculty of Medicine, Universitat Internacional de Catalunya, Barcelona

An antecedent of later developing communicative functions: the fetal index finger

Introducing dynamic magnetic resonance imaging (MRI) broke new ground in visualising human fetal behaviour.[1] We use this method for detailed analyses of complex and coordinated fetal motor patterns, to study spontaneous motor activity, and for functional assessments of the young nervous system.[2] While analysing a fetus at 27 weeks of gestation during an uneventful pregnancy, we observed that the fetus repeatedly extended her index finger and "pointed" at the umbilical cord (figure).[3] We first believed our observation was purely incidental, but the reoccurrence left no room for doubt.

Despite being specialised and experienced in motor and socio-communicative development, we found ourselves describing a phenomenon related to both domains, even though socio-communication is far from its initial start-up at this point. We were thrilled to observe this isolated behavioural pattern at such an early age, because it provides new evidence of physiological behavioural patterns as antecedents of behaviours that only become functional at a later age. This is another piece in the puzzle of the evolution of human behaviour disproving assumptions about fetal intentions. And in terms of joint attention and intention to communicate, our fetus obviously was not aware that we were watching her with dynamic MRI.

Still, much remains to be learnt about the transition from intrauterine to extrauterine behaviour and the developmental trajectory from the first appearance of a motor pattern to later functionality of behavioural patterns (figure). In other words: we need to fathom the gap between the fetal ability to extend the index finger and its use in pointing, one of the first ways to interact with the world through communicative gestures.



The extended index finger. A motor pattern becoming functional at 27 weeks of gestation (MRI print of a dynamic, steady state, free precession sequence) and 9 days post term age, and later as a communicative form of joint attention at 14 months of age

Peter B Marschik, associate professor of physiology and neurolinguistics, Institute of Physiology, Research Unit iDN (interdisciplinary Developmental Neuroscience), Center for Physiological Medicine, Medical University of Graz, 8010 Graz, Austria and Center for Genetic Disorders of Cognition and Behavior, Kennedy Krieger Institute, Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, USA
Heinz F R Prechtl, professor emeritus of developmental neurology, Institute of Physiology, Research Unit iDN (interdisciplinary Developmental Neuroscience), Center for Physiological Medicine, Medical University of Graz, 8010 Graz, Austria
Daniela Prayer, professor of neuroradiology, Department of Radiology, Division of Neuroradiology and Musculoskeletal Radiology, Medical University of Vienna, Vienna, Austria
Colleen Peyton, physical therapist, Department of Therapy Services, University of Chicago Medical Center, Chicago, IL, USA
Christa Einspieler, professor of physiology, Institute of Physiology, Research Unit iDN (interdisciplinary Developmental Neuroscience), Center for Physiological Medicine, Medical University of Graz, 8010 Graz, Austria

Correspondence to: P B Marschik
peter.marschik@medunigraz.at

Parental consent obtained.

Full details including references and competing interests are in the version on bmj.com.

Cite this as: *BMJ* 2013;347:f7232