# Sacral Preauricular Extensions/Notches and Dorsal Pubic Pitting as Indicators of Parity

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## Introduction

The use of pelvic changes to infer parity from skeletonized remains has been studied and debated for over 100 years, with the preauricular sulcus first being associated with the softening of ligaments during pregnancy in ancient Egyptians in 1909 (Maas & Friedling, 2014). Angel (1969) suggested that pitting around the pubic symphysis was produced by pregnancy, while Houghton (1975) provided more evidence of “parturition scarring” and dorsal pitting from studies on the Hamman-Todd Collection. While most parity indicators have proved unreliable, recently studied osseous markers including the sacral preauricular extension (SPE) and sacral preauricular notch (SPN) have been useful in potentially identifying parous females in a Bronze Age sample (Pany-Kucera et al. 2019). The SPE is a thin, ventrally directed osseous extension at the ventrosuperior margin of the ala ossis sacri at the level of the terminal line (Figure 1), while the SPN is described as a notch at this same location that suggests a loss of convexity (Figure 2). Pany-Kucera et al. (2019) found that females exhibited SPE and SPN 9.6-14.7% of the time while neither feature was observed in males. Pany-Kucera et al. (2021) further observed SPE only in parous females who had had two or more children, SPN in multiparous females, and none in males. This study examines the presence of SPE, SPN, and dorsal pubic pitting (DPP) in parous and non-parous assigned females at birth (AFABs) and assigned males at birth (AMABs) in a modern donated skeletal collection.

## Materials and Methods

A randomly selected sample of 150 AFABs with a recorded obstetric history of childbirth (31-95 years) and 97 AFABs who had self-reported as being nulliparous (19-97 years), as well as 150 AMABs (21-96 years), were examined from the University of Tennessee, Knoxville’s, Donated Skeletal Collection. All sacra were scored for SPN and SPE following Pany-Kucera et al. DPP was scored as present or absent. Chi-squared tests were performed to determine the statistical relationships between the skeletal markers observed and factors such as parity status, age, sex assigned at birth, and number of births. When comparing the number of births, AFABs were split into groups of those who had only had one child and those who were multiparous. AFABs were also split into groups of those who were younger than 50 years and those who were 50 years or older. An interobserver error test was performed by a colleague using a sample of 10% of the total sample (n=40).

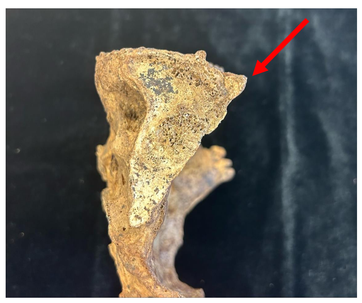

**Figure 1. SPE.**

**Figure 2. SPN. Scale in cm.**

## Results

Frequencies of the SPE, SPN, and DPP for parous AFABs, AFABs with one birth, multiparous AFABs, AFABs < 50 years, AFABs ≥ 50 years, nulliparous AFABs, and AMABs are presented in Table 1. Additionally, fusion of the sacroiliac joint was not observed in any of the parous AFABs, but in 4.1% of nulliparous AFABs and 2.7% of AMABs.

When observing the relationship between sex assigned at birth and these markers, it was determined that there is a statistically significant relationship between SPE ($\chi^2(1) = 92.72$, $p = <.001$) and DPP ($\chi^2(1) = 59.89$, $p = <.001$); however, not with SPN ($p = .421$): AFABs more frequently exhibited SPE and DPP compared to males. In AFABs, there was a statistically significant difference between parity status and SPE ($\chi^2(1) = 248$, $p = <.001$), SPN ($\chi^2(1) = 18.79$, $p = <.001$), and DPP ($\chi^2(1) = 15.35$, $p = <.001$). When comparing AFABs who had given birth once and those who were multiparous, there was a statistically significant relationship between births and SPE ($\chi^2(1) = 9.33$, $p = .002$), SPN ($\chi^2(1) = 20.73$, $p = <.001$), and DPP ($\chi^2(1) = 4.19$, $p = .04$). AFABs who were younger than 50 and those who were 50 and over at death demonstrated a statistically significant relationship between age and SPE ($\chi^2(1) = 4.19$, $p = .04$) and DPP ($\chi^2(4) = 161$, $p = <.001$); however, not with SPN ($p = .151$). Probabilities of assigned sex at birth, parous versus nulliparous AFABs, and single versus multiparous AFABs are presented in Tables 2-4.

Interobserver error testing was conducted by a colleague who was acquainted with the method, using a sample of 10% of the data gathered. Cohen’s Kappa analyses were performed and there was a fair agreement between SPE analyses (k = 0.22, $p = .16$), a moderate agreement between analyses of SPN (k = 0.4, $p = 0.109$), and a slight agreement between DPP analyses (k = 0.08, $p = 0.743$).

**Table 1. Frequencies of SPE, SPN, and DPP.**

| | % SPE L | % SPE R | % Bilateral SPE | % SPN L | % SPN R | % Bilateral SPN | % DPP L | % DPP R | % Bilateral DPP |
|---|---|---|---|---|---|---|---|---|---|
| **Parous AFABs** | 9.3 (n=150) | 8.7 (n=150) | 9.3 (n=150) | 9.3 (n=150) | 6.7 (n=150) | 1.3 (n=150) | 2.7 (n=150) | 6.0 (n=150) | 32.0 (n=150) |
| **AFABs with single birth** | 7.3 (n=55) | 5.4 (n=55) | 3.6 (n=55) | 5.4 (n=55) | 7.4 (n=55) | 1.8 (n=55) | 1.8 (n=55) | 0 (n=0) | 14.5 (n=55) |
| **Multiparous AFABs** | 10.5 (n=95) | 10.5 (n=95) | 11.6 (n=95) | 11.6 (n=95) | 6.3 (n=95) | 2.1 (n=95) | 3.1 (n=95) | 10.5 (n=95) | 41 (n=95) |
| **AFABs < 50 years** | 11.8 (n=17) | 11.8 (n=17) | 17.6 (n=17) | 5.9 (n=17) | 0.0 (n=0) | 0.0 (n=0) | 0.0 (n=0) | 11.8 (n=17) | 17.6 (n=17) |
| **AFABs > 50 years** | 11.3 (n=133) | 16.5 (n=133) | 9.8 (n=133) | 13.5 (n=133) | 10.5 (n=133) | 1.5 (n=133) | 3.0 (n=133) | 11.3 (n=133) | 40.6 (n=133) |
| **Nulliparous AFABs** | 4.1 (n=97) | 11.3 (n =97) | 5.2 (n=97) | 5.2 (n=97 | 4.1 (n=97) | 0.0 (n=0) | 0.0 (n=0) | 7.2 (n=97) | 9.3 (n=97) |
| **AMABs** | 3.3 (n=150 ) | 5.3 (n=150) | 2.7 (n=150) | 6.7 (n=150 | 6.0 (n=150) | 0.7 (n=150) | 0.0 (n=0) | 0.0 (n=0) | 0.0 (n=0) |

**Table 2. Probabilities of sex assigned at birth based on univariate analyses.**

| | SPE | SPN | DPP |
|---|---|---|---|
| **AMAB Probability** | 31.5% | 55.9% | 0.0% |
| **AFAB Probability** | 68.5% | 44.1% | 100% |

**Table 3. Probabilities of parity if AFAB based on univariate analyses.**

| | SPE | SPN | DPP |
|---|---|---|---|
| **Nulliparous AFAB Probability** | 43.0% | 34.8% | 29.8% |
| **Parous AFAB Probability** | 57.0% | 65.2% | 70.2% |

**Table 4. Probabilities of single versus multiple births based on univariate analyses.**

| | SPE | SPN | DPP |
|---|---|---|---|
| **Single Birth AFAB Probability** | 64.1% | 80.1% | 42.9% |
| **Multiparous AFAB Probability** | 35.9% | 19.9% | 57.1% |

## Discussion and Conclusions

Pany-Kucera et al. (2021) observed SPE only in parous AFABs who had had two or more children. This was not demonstrated in the current study, as SPE was observed in both nulliparous AFABs and AMABs. Pany-Kucera et al. (2021) also only observed SPN in multiparous AFABs and not in AMABs. Pany-Kucera et al. (2021) did not find age to be a factor in the frequency of markers as there was no indication that the SPE was more frequent in those 40 years of age or older, which contradicts the current study that suggests SPE and DPP are statistically significant in regard to age.

These results indicate that there is a statistical significance between parity status, sex, number of births, and age-at-death and the SPE, SPN, and DPP. However, the presence of these markers in both nulliparous AFABs and AMABs complicate the use of these markers as a tool for identifying parity in skeletal remains. However, univariate probabilities can help predict if an individual is likely AFAB or AMAB, nulliparous or parous AFAB, and single or multiparous AFABs (Tables 2-4 ). Additionally, the SPE, SPN, and DPP could be used as an indicator of life histories in contexts of bioarchaeological investigations. For example, this information could work to link AFAB reproductive and social status in various societies using this skeletal data (Pany-Kucera et al., 2019). The practice of comparing bioarchaeological contexts with osteological data allows information to be gathered related to the social status of AFAB in societies and how motherhood was viewed (Rebay-Salisbury et al., 2018).
DPP also served as a statistically significant indicator of parity status, sex, number of births, and age at death. As there were nulliparous AFABs with DPP and parous AFABs without this pitting, this marking should not serve as a positive identifier for parity status. However, there were no AMABs with DPP which highlights the possibility of DPP as an indicator of sex assigned at birth.

Caution is warranted in scoring the traits as there is slight to fair interobserver agreement. In particular, the DPP, if used, should be better defined in terms of variation in presentation and scoring. More research should be done to relate sex assigned at birth and these markers as well as the biomechanical factors that could affect its presentation.

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## References