A Comparison of Traumatic Injury Patterns Between a Rural and an Urban Population from Medieval Poland

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Introduction

- Medieval rural and urban populations differed in settlement patterns and subsistence methods [1]. In particular, rural populations typically engaged in agriculture, while those living in urban settings specialized in certain crafts. These activity patterns would have differentially impacted the skeleton, especially in terms of traumatic injuries [2].
- Medieval agriculture was a lifestyle consisting of numerous activities, as individuals participated in many different and often dangerous repetitive activities, increasing the potential for injury [3]. Craft specialization, on the other hand, allows for specialized occupations consisting of repetitive activities that are arguably less intensive and less dangerous than that of agriculture [4].
- Both rural agriculture and urban craft specialization were common in medieval Poland. Following the formation of the Polish state and the adoption of Christianity (AD 966), incipient urbanization took place in several strategic locations throughout the country, including what is now the modern city of Poznań [5]. Over time, individuals migrated into such urban centers from surrounding rural areas, abandoning their agricultural pursuits to engage in a particular trade.
- **This study seeks to assess whether levels of traumatic injuries reflect the different activity patterns of medieval populations. It is expected that the rural, agricultural population will have a higher prevalence of accidental and stress fractures than a contemporaneous urban population of craftsmen due to the more laborious nature of agricultural practices compared to craft specialization.**

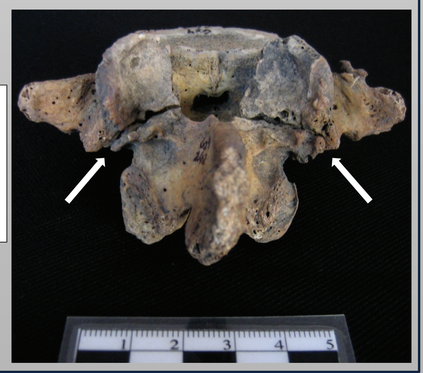

Figure 5a. Spondylolysis of L4 in a 35-45 yr old female from the Giecz sample (G 2/02)

Materials & Methods

Figure 1. Modern map of Poland showing location of Poznań and Giecz

- To test this hypothesis, human skeletal remains from two early medieval (10th-12th century) Polish populations were examined for the presence of traumatic injuries (Figure 1).
- The Giecz (Gz4) sample consists of rural agriculturalists, while the Poznań-Śródka sample consists of urban craft specialists. Giecz was an influential political, economic, and military center surrounded by a massive earthen stronghold. Archaeological evidence suggests the people at Giecz engaged in agricultural activity.
- Poznań, as one of the initial urban centers recognized in a newly established Polish state [6], attracted people with economic prospects of selling goods or services.
- Skeletal remains of 276 adults were examined (Table 1). Sex and age were assessed following standard anthropological protocols.

Table 1. Sample sizes and sex distribution

Sample	Males	Females	Unsexed	Total
Giecz	104	56	20	180
Poznań-Śródka	26	36	34	96

Figure 5b. Compression fracture of T12 in a 45-55 yr old female from the Giecz sample (G 90/01)

- Presence of skeletal elements and evidence of traumatic injuries were documented according to the Global History of Health handbook to ensure maximum comparability [7]. Evidence of traumatic injuries was classified into one of three categories: 1) stress (s) fractures (e.g. vertebral compression fractures, spondylolysis), 2) accidental (a) fractures, and 3) violent fractures.
- The analysis of violent fractures is not reported here, as they are less indicative of general activity patterns. The prevalence of each fracture type was calculated for individuals by body region (e.g. upper limb, lower limb, trunk) and by skeletal element (e.g. femur, humerus, etc.).
- Comparisons of the sites were performed for all adults, as well as for males and females separately. Nonparametric tests of significance (Fisher's exact) were used to determine whether differences in fracture frequency existed between the two skeletal samples. Confidence level was 95%.

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Results

Table 2. Fracture frequencies by body region and element. P-values are the result of tests of significance (Fisher's exact) between fracture frequencies in total samples and by sex. Highlighted p-values are statistically significant (α=0.05).

	Gz: Female		P-S: Female			Gz: Male		P-S: Male			Gz: Total		P-S: Total		
Element	n/N	%	n/N	%	P-value	n/N	%	n/N	%	P-value	n/N	%	n/N	%	P- value
Upper Limb (a)	2/22	9.09	0/12	0	0.529	7/40	17.5	1/10	10.0	1.0	9/65	13.85	1/24	4.17	0.2763
Lower Limb (a)	1/49	2.04	0/23	0	1.0	5/77	6.49	0/14	0	1.0	6/134	4.48	1/50	2.0	0.676
Trunk (s)	9/44	20.45	1/30	3.33	0.0417	22/59	37.29	0/22	0	0.0004	31/110	28.18	1/72	1.39	<0.0001
Trunk (a)	2/37	5.41	0/29	0	0.4998	10/47	21.28	1/23	4.35	0.0874	12/91	13.19	1/72	1.39	0.0068
*rib (a)	5/49	10.2	0/26	0	0.1567	27/86	31.4	1/20	5.0	0.0216	32/142	22.54	1/57	1.75	0.0001
*vert (s)	14/47	29.79	1/27	3.7	0.0069	39/78	50.0	0/17	0	<0.0001	53/126	42.06	1/60	1.67	<0.0001

Gz= Giecz, P-S= Poznań-Śródka. (a)= accidental fracture, (s)= stress fracture, n= # of individuals that sustained a fracture, N= # of individuals. *Rib and vertebrae categories are sub-samples of the trunk.

- Results are summarized in Table 2.
- No significant differences exist in the frequency of accidental or stress fractures in the extremities between the samples (Figure 3). However, individuals from Giecz, including when separated by sex, consistently sustained more injuries to these regions than those from Poznań-Śródka.
- For the entire trunk region, Giecz had significantly more stress fractures *and* accidental fractures in the combined sex sample ($p \leq 0.05$). When divided by sex, Giecz males and females had significantly more stress fractures than those from Poznań-Śródka.
- For the ribs, Giecz had significantly more accidental fractures (Figure 4) for the males and the combined sex sample.
- Vertebrae exhibited significantly more stress fractures in Giecz (Figures 5a,b) than Poznań-Śródka for the combined sex sample as well as both male and female samples.

Figure 3. Healed fractures to an ulna and radius in a 40-50 yr old male from the Poznań-Śródka sample (B. 54)

Figure 4. Ante-mortem healed (h) and incompletely-healed (i) rib fractures in a 30-45 yr old male from the Giecz sample (G. 2/03)

Discussion

- Results support the hypothesis that an agricultural lifestyle was more laborious, leading to chronic injuries and fractures from accidents. The lack of significant difference in prevalence of injuries in the extremities suggests that agricultural activities were especially stressful in the trunk region.
- Males in medieval agricultural communities were more involved in working in the fields and with animals than were females, putting them at high risk for falls [3]. In this scenario, a sexual division of labor in Giecz could explain the difference in rib fracture frequencies. Dangerous activities such as fieldwork might also explain the high incidence of rib fractures in the Giecz sample, especially in males, compared to the less dangerous activities of the Poznań-Śródka sample (Figure 6).
- Vertebral collapse is common in osteoporotic individuals, but osteoporosis is uncommon in physically active populations [8]. Therefore, at Giecz, it is likely that the vertebral fractures observed in this sample were the result of repetitive heavy compressive loads to the vertebral bodies causing failure as opposed to significant bone loss. Additionally, vertebral fractures have been documented in cases where a load is placed on outstretched arms [9], which would not be unexpected in the rigorous lifestyle of agriculturalists.
- Furthermore, if osteoporotic fractures were contributing to trauma in medieval Poland, it was more likely affecting the Poznań-Śródka population where female vertebral fractures outnumber the males. At Giecz, males were more affected by vertebral stress fractures than females (Figure 6), reducing the likelihood of osteoporosis.
- **The differences in fracture frequencies described here provides evidence that medieval agricultural activities were more physically rigorous with negative effects than a lifestyle specifically associated with craft specialization in Poland.**

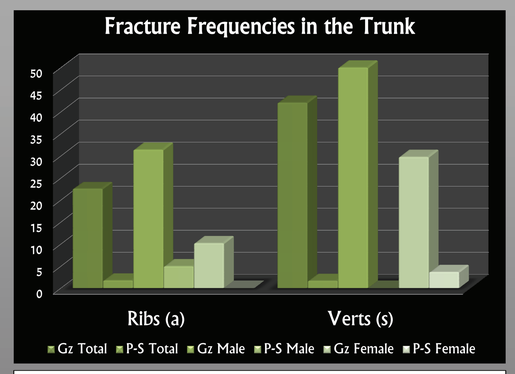

Figure 6. Comparison of fracture frequencies of ribs and vertebrae in Giecz (Gz) and Poznań-Śródka (P-S) samples, and sex specific samples. (a) = accidental fractures, (s) = stress fractures. Frequencies are expressed as percentages (n/N*100), where n= # of individuals that sustained a fracture and N= # of individuals.

- Future research will evaluate bone mass and quality to explore a relationship between fracture frequency and fracture risk. In addition, degenerative joint disease will be assessed to examine patterns of joint involvement due to physical activity. These results will dovetail with those discussed in the current study.

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