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Assessing cancer risk factors faced by an Ancestral Puebloan population in the North American Southwest☆

Catrina Banks Whitley[a,b,*], Jeffrey L. Boyer[b]

[a] Principal Investigator, Bioarchaeology Support, Midlothian, TX, United States
[b] Research Associate, Museum of New Mexico, Office of Archaeological Studies, Santa Fe, New Mexico, United States

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ABSTRACT

Ancestral Puebloan people in the North American Southwest suffered high rates of disease, poor health, and early age-at-death. Four individuals with skeletal expressions of cancer were found in a pre-Columbian population in the Taos Valley - Reports of malignant neoplasms in the archaeological record are uncommon and their presence in four of 82 individuals is a high occurrence. This study continues Whitley and Boyer's (2012) research testing whether concentrations of ionizing radiation were sufficiently high to induce cancer and related health issues. Access to a preserved and partly reconstructed subterranean pit structure inhabited between AD 1120 and 1170, allows us to test radon concentrations in a residential dwelling. This study found radon occurring in high levels, 19.4–20.3 pCi/L (717.8–751.1 Bq/m^3) within the structure. Epidemiological reports are inconsistent when linking specific cancers and radon exposure. However, this study can control for many of the confounding factors plaguing other studies, provide unique data that have the potential to initiate dialogue on the etiology of neoplastic disease in the American Southwest, and add new dimensions to the study of the living conditions and health of the Ancestral Puebloans and their descendants.

1. Introduction

Paleopathological studies over the past 100 years have recorded a wide range of disease processes, including cases of cancer (Stodder, 2012). Paleopathologists continue to investigate the etiology of these diseases and the range of factors that influence their prevalence and distribution. Discovery of four individuals with skeletal expressions of cancer among pre-Columbian human burials from Ancestral Pueblo communities in the Taos Valley of north-central New Mexico, ca. AD 1050–1320 (Whitley, 2009), prompted research to examine potential risk factors. Since malignant neoplasms in the archaeological record are uncommonly reported (Roberts and Manchester 1995), the presence of four individuals with neoplastic cancer in an analyzed population of 82 (ratio: 1/4.89) is remarkably high. This research is part of a multi-phase project intended to determine whether exposure to naturally occurring ionizing radiation was sufficient to affect health and contribute to the development of cancer. Earlier tests focused on radon and radon progeny exposure because radon exposure is an ongoing health issue in the Taos area (Whitley and Boyer, 2012) and because exposure to radon progeny increases the risk of lung cancer (Lantz et al., 2013), chromosomal abberations (Druzhinin et al., 2015), and possibly increases the risk of hematopoietic malignancies (Al-Zoughool and Krewski, 2009). This study continues an environmental approach focusing on possible exposure of Ancestral Puebloans to high levels of naturally occurring ionizing radiation known to be present in the Taos Valley.

1.1. Confounding factors in the study of cancer in antiquity

Some scholars have argued that the apparent dearth of cancer in antiquity is linked to pre–modern populations' shorter life spans and generally healthier environments (Binder et al., 2014; David and Zimmerman, 2010). Proponents argue that the disparities in pre-–modern and modern cancer rates are explained by relatively early age at death in pre-modern populations; an aging population has a greater risk of cancer since risk of cell mutation increases with age and there is greater exposure to carcinogens. Doll and Peto (1981) assert that 80 percent of current cancer cases are related to "modern" lifestyle conditions, including increased life expectancy, dietary habits, obesity, and lack of physical activity, or to occupational and environmental pollutants such as tobacco smoke, exposure to radiation, pesticides, dioxins, organic compounds, metals, metalloids, outdoor air pollution (Clapp et al., 2008; Morgan et al., 2002; Zaidi and Vesole 2001; Huang et al.,

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* Corresponding author at: Principal Investigator, Bioarchaeology Support, P.O. Box 122, Midlothian, Texas, United States.
E-mail addresses: catrina_whitley@prodigy.net (C.B. Whitley), papa.j.boyer@gmail.com (J.L. Boyer).

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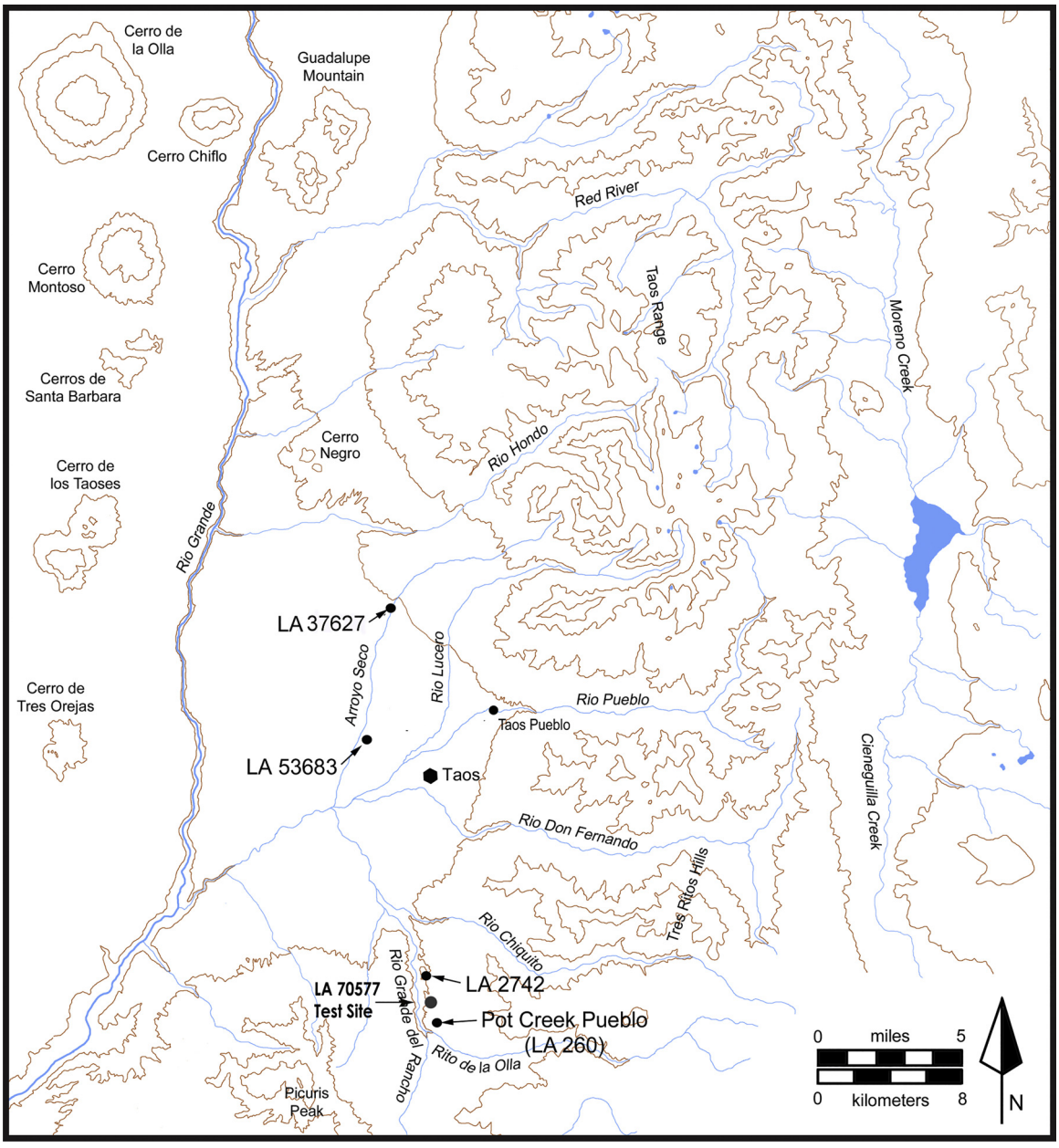

Fig. 1. Map of the Taos Valley showing the LA 70577 test site and pre-Columbian sites with cancerous human remains, and the LA 70577 test site.

2007). Other factors include malnutrition and exposure to infectious agents (Capasso, 2005; ; Baris et al., 2000).

In fact, however, Ancestral Puebloans were exposed to wood–smoke carcinogens from fires in enclosed domestic and ritual spaces (e.g. Matson and Sherman, 2004); naturally occurring ionizing radiation (radon and uranium; Roberts and Manchester, 2007); and tobacco smoke (Vanpool et al., 2006; Hays-Gilpin, 2006; Huckell and Vanpool, 2006). Tobacco was cultivated in the American Southwest and seeds and pipes are regularly found at sites (Adams and Toll, 2000), although we do not know the actual frequency of its use.

1.2. Pathological descriptions of Taos Valley lesions

In the Taos Valley portion of the Northern Rio Grande region in New Mexico, four individuals with expressions of cancer were recorded in an Ancestral Puebloan burial population of 82 individuals recovered from four archaeological sites (Fig. 1; Whitley, 2009). Three cases date to the late Developmental period (Valdez phase, ca. AD 1050–1225), while the fourth is from a Coalition period (Pot Creek and Talpa phases, ca. AD 1225–1320) pueblo site. All data were collected during regular documentation of the skeletal remains, including CT Scans, radiographs, and photographs.

Multiple lytic lesions are present in skeletal remains from LA 37627, a Valdez–phase site. The individual was a male, aged 40–45, found west of a possible domestic/ritual pit structure (Whitley, 2008a). Crater-–shaped lytic lesions are visible on the right frontal, left zygomatic, and the right ilium (Figs. 2–4). Margins of all three lesions are slightly elevated and show new bone formation. New bone formation is also visible inside the zygomatic lesion. Radiographic examination of the remains shows these lesions are circular with sclerotic margins. Several lesions that had not penetrated the surface were also discovered during radiographic analysis. Three additional circular, lytic lesions with sclerotic margins are present in the right ilium (Fig. 4; one not shown is on the auricular surface). Several small lytic lesions without sclerotic margins are on the skull and an ill-defined lytic lesion without a sclerotic margin is on the gonial angle of the mandible (Figs. 5 and 6).