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Hormonal correlates of human paternal interactions: A hospital-based investigation in urban Jamaica

P.B. Gray [a,*], J.C. Parkin [a], M.E. Samms-Vaughan [b]

[a] Department of Anthropology and Ethnic Studies, 4505 Maryland Parkway #5003, University of Nevada, Las Vegas, Las Vegas, NV, USA
[b] Section of Child Health, University of the West Indies, Mona, Jamaica

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Abstract

To expand our understanding of the neuroendocrine mechanisms underlying human fatherhood, including its cross-cultural expression, we investigated the hormonal correlates of fatherhood in the greater Kingston, Jamaica area. We recruited 43 men, aged 18–38, to participate: 15 single men; 16 "coresidential" fathers (men who live with their adult female partner and youngest child); and 12 "visiting" fathers (men who live apart from their adult female partner and youngest child). The research protocol entailed biological sampling before and after a 20-min behavioral session during which single men sat alone and fathers interacted with their partner and youngest child. Hormone measures relied upon minimally invasive techniques (salivary testosterone and cortisol, finger prick blood spot prolactin, urinary oxytocin and vasopressin). Results revealed significant group differences in average male testosterone levels ($p=0.006$), with post hoc contrasts indicating that visiting fathers had significantly ($p<0.05$) lower testosterone levels than single men. Prolactin profiles also differed significantly across groups ($p=0.010$) whereby post hoc contrasts showed that prolactin levels of single men declined significantly compared with the flat levels of visiting fathers ($p<0.05$). No group differences in cortisol, oxytocin or vasopressin levels were observed. However, among fathers, vasopressin levels were significantly and negatively ($r=-.431$, $p=0.022$) correlated with the age of a man's youngest child. These results thus implicate lower testosterone levels as well as prolactin and vasopressin in human fatherhood. These findings also highlight the importance of sociocultural context in human fatherhood while exhibiting parallels with existing data on the non-human vertebrate hormonal bases of paternal care.

Keywords: Paternal care; Caribbean; Cross-cultural; Testosterone; Prolactin; Vasopressin

Introduction

Humans are among the approximately 5% of mammalian species that provide paternal care (Clutton-Brock, 1991; Kleiman, 1977; Reichard and Boesch, 2003; Whitten, 1987). Evolutionary models recognize that human paternal care appears linked to pair bonds between mates and long periods of offspring dependency in complex multi-male, multi-female groups (Flinn, 2006; Hrdy, 1999; Kaplan and Lancaster, 2003). Most evolutionary models suggest that human paternal care arose among our *Homo* ancestors within approximately the past 2.5 million years (Dixson, 1998; Geary and Flinn, 2001; Hewlett, 1992; Lancaster and Lancaster, 1987; McHenry, 1996). However, evolutionary models differ in the degree to which they emphasize the importance of direct (e.g., holding, carrying) care compared with indirect (e.g., food provisioning) care. Human paternal care also exhibits cross-cultural and historical variation (Barry and Paxson, 1971; Eibl-Eibsfeldt, 1989; Hewlett, 1992; Marlowe, 2000). Variation in human paternal care is responsive to a host of variables (Geary, 2000) including the mode of subsistence (Hewlett, 2004; Marlowe, 2000) and the nature of a man's relationship to a child's mother (Parke, 1996; Whiting and Whiting, 1975).

Here, we build on this evolutionary and cross-cultural background to investigate human fatherhood in an African Caribbean context. In African Caribbean countries, children are commonly born into dynamic family structures characterized by a variable paternal role and important maternal kin assistance (Barrow, 1996; Madrigal, 2006; Roopnarine et al., 2005; Smith, 1996). Births commonly take place during so-called visiting relationships, in

* Corresponding author.
E-mail address: peter.gray@unlv.edu (P.B. Gray).

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which a man living separately visits a woman to engage in social and sexual activity. Visiting relationships may yield to common-law marriages between the parents, and these in turn may be followed by formal marriage. Consequently, a higher proportion (about 70%) of children born out of marriage occurs in the Caribbean than any other region of the world (Roopnarine, 2004; United Nations, 2000). Recent Jamaican data reveal that 49.0% of children are born into visiting unions, 36.4% common-law unions, and 14.5% married unions (Population Census, 2001, Jamaica; Samms-Vaughan, 2006). Religious affiliation and socioeconomic status are both positively associated with couples marrying, and particularly for children being born within households of already-married couples. The quality of a man's relationship to a coresidential mate also helps predict his paternal involvement (Brown et al., 1997).

In this project, we sought to link the Jamaican context of fatherhood with a complementary body of research on the neuoroendocrine underpinnings of vertebrate paternal care. We draw upon both nonhuman and human data to derive predictions because mechanisms of human paternal care are likely to exhibit homologous features with other species, and ethical and logistical constraints limit the kinds of experimental research feasible with humans.

A wealth of avian data suggest two primary endocrine correlates of paternal care: lower testosterone and elevated prolactin levels (Ball, 1991; Buntin, 1996; Ketterson and Nolan, 1999; Schradin and Anzenberger, 1999; Wingfield et al., 1999, 1990; Ziegler, 2000). Among non-primate mammals, similar findings have been observed for many, but not all, species in which males provide paternal care (Becker et al., 2002; Brown, 1985; Dixson, 1998; Nelson, 2005; Wynne-Edwards, 2001). Among primates, paternal care was first linked with elevated prolactin levels in common marmosets (Dixson and George, 1982) and has since been observed in other non-human primates as well (e.g., tufted ear marmosets: Nunes et al., 2000). Other hormones such as oxytocin, vasopressin and cortisol may also have roles in paternal care (Bales et al., 2004; Carter, 1998; Odendaal and Meintjes, 2003; Young and Wang, 2004; Ziegler, 2000), although endocrine interventions have had variable effects (e.g., Ketterson and Nolan, 1999; Wynne-Edwards and Timonin, 2007).

The few available studies, all published since 2000, suggest some of these same hormones may be associated with human paternal care. Three different studies of Canadian fathers observed lower testosterone levels associated with paternal care (Berg and Wynne-Edwards, 2001; Fleming et al., 2002; Storey et al., 2000), findings that complement research observing lower testosterone levels among pair bonded North American men (reviewed in Van Anders and Gray, in review). Outside of North America, Beijing, Chinese fathers had lower testosterone levels than married non-fathers and unmarried men (Gray et al., 2006). Two different Canadian studies linked elevated prolactin levels to paternal responses (Fleming et al., 2002; Storey et al., 2000), and in another fathers had lower cortisol levels than controls (Berg and Wynne-Edwards, 2001).

Based on the background above, we hypothesize that Jamaican fathers will have higher oxytocin and prolactin levels but lower testosterone, vasopressin and cortisol levels compared with non-father controls. Given the cultural salience of visiting relationships as a context in which Jamaican fatherhood occurs, we also hypothesize that fathers in these visiting relationships will have hormone levels intermediate between fathers in coresidential relationships with their biological children and control, non-father males. To test these hypotheses, we examine hormone concentrations of Jamaican men falling into one of three relationship groups: single men; biological fathers engaged in visiting relationships; and biological fathers coresiding with their youngest child. We test these hypotheses with both baseline hormone concentrations across groups of men as well as with respect to hormone changes occurring during 20 min behavioral interactions with a partner and child (discussed below).

Methods

Study population

To test our hypotheses, healthy men were recruited between the ages of 18 and 40 in Jamaica. Men needed to fall within one of three groups: 1) single men who were not currently involved in a committed, romantic relationship for longer than 3 months and who had not previously fathered children; 2) fathers who were living with a biological child aged 4 years or younger as well as this child's mother; and 3) fathers involved in a visiting relationship with a biological child aged 4 years or younger as well as this child's mother. Potential subjects were excluded if they were taking exogenous steroids.

Jamaican men were recruited for this study from the University Hospital of the West Indies community and immediate environs. The University Hospital of the West Indies is located in Mona, Jamaica, on the edge of greater Kingston, a city with a population of approximately 800,000 inhabitants. Fathers were recruited primarily from the Hospital well-baby clinic. Control single men as well as other fathers were recruited from the Hospital cafeteria, on-campus facilities (e.g., security office) and nearby enterprises (e.g., grocery stores, daycare facilities). Subjects were remunerated $2000 Jamaican (approximately $30 U.S.) to cover costs of transportation and missed work.

Ethical approval for the study was given by the University of the West Indies Faculty of Medical Sciences/University Hospital Ethical Committee and University of Nevada, Las Vegas institutional review board.

Study procedures

Single subjects were asked to report to the Pediatrics Ward at the University Hospital alone; fathers were asked to report with both their female partner and youngest child. After signing the informed consent, men were subject to a 20-min "cool down" phase during which they were seated alone and given a newspaper to read. This "cool down" phase was designed to standardize sample collection and stabilize hormone levels after travel to the Hospital.

Subjects then had a set of baseline samples and measures taken. Each subject provided a finger prick blood sample (Worthman and Stallings, 1997). Finger pricks entailed wiping a fingertip with an alcohol wipe, pricking the finger with a lancet (Fisher #02-675-165 high flow safety lancet), wiping away the initial drop of blood, then collecting 4 to 5 blood spots dropped onto filter paper (Whatman Protein Saver #903 card). A saliva sample of approximately 1.0 ml was collected in a 1.8 ml cryovial tube by passive drool after requesting the subject rinse out his mouth with bottled water provided to him. Blood pressure was taken twice, with the measures averaged, using a portable, automated blood pressure reader (Omron HEM-773AC). Height and weight were taken from which body mass index (BMI) was subsequently calculated (kg/m^2).

Subjects then engaged in a 20-min behavioral interaction session (fathers) or remained alone (single men). The partner and child who had reported with the father were brought into the room to spend this 20-min session interacting with the father. No specific instructions were given to the couple regarding how to spend this interaction period. Single men remained in the same room where samples had been taken and were instructed to continue reading the newspaper and relax for another 20 min.