

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE PD 98-1392		<input checked="" type="checkbox"/> Special Exception to Deadline Date Policy		FOR NSF USE ONLY	
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) BCS - Biological Anthropology				NSF PROPOSAL NUMBER 1720091	
DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
11/30/2016	1	04040000 BCS	1392	069687242	11/30/2016 4:36pm
EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) 593102112		SHOW PREVIOUS AWARD NO. IF THIS IS <input type="checkbox"/> A RENEWAL <input type="checkbox"/> AN ACCOMPLISHMENT-BASED RENEWAL		IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> IF YES, LIST ACRONYM(S)	
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NAME OF PRIMARY PLACE OF PERF University of South Florida		ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE University of South Florida Kannur University Thalassery Cam Kannur University Thalasse ,67066 ,IN.			
IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)		<input type="checkbox"/> SMALL BUSINESS	<input type="checkbox"/> MINORITY BUSINESS	<input type="checkbox"/> IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE	
		<input type="checkbox"/> FOR-PROFIT ORGANIZATION	<input type="checkbox"/> WOMAN-OWNED BUSINESS		
TITLE OF PROPOSED PROJECT Interviewing mothers of twins in Kerala					
REQUESTED AMOUNT \$	PROPOSED DURATION (1-60 MONTHS) 12 months	REQUESTED STARTING DATE 12/01/16	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE		
THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW					
<input type="checkbox"/> BEGINNING INVESTIGATOR (GPG I.G.2)		<input checked="" type="checkbox"/> HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____ Exemption Subsection _____ or IRB App. Date Pending			
<input type="checkbox"/> DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)		<input checked="" type="checkbox"/> INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j) IN			
<input type="checkbox"/> PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D., II.C.1.d)		<input checked="" type="checkbox"/> COLLABORATIVE STATUS Not a collaborative proposal			
<input type="checkbox"/> HISTORIC PLACES (GPG II.C.2.j)					
<input type="checkbox"/> VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____ PHS Animal Welfare Assurance Number _____					
<input checked="" type="checkbox"/> FUNDING MECHANISM EAGER					
PI/PD DEPARTMENT Department of Anthropology		PI/PD POSTAL ADDRESS 4202 E. Fowler Ave. NULL Tampa, FL 33620 United States			
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CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes

No

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

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By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

- (1) community in which that area is located participates in the national flood insurance program; and
- (2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

- (1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
- (2) for other NSF grants when more than \$25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)

(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds \$5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations. By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:

- (1) has filed all Federal tax returns required during the three years preceding this certification;
- (2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
- (3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

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When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

Certification Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME Mindy Owen		Electronic Signature	Nov 30 2016 4:34PM
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Project summary

Overview

The purpose of this project is to collect genealogies of families in Kodihni in the Southern State of Kerala India, to reconstruct when they started having twin frequencies. Currently, the village as a whole has twin birth rates (TBR) which are out of the normal range of other Indian populations. According to news reports, villagers say that the “twin epidemic” started after the community went through a massive epidemic sometime around the 1930's or 1940's, which suggests a possible bottleneck effect. However, the occurrence of twins in these families across generations has not been documented or reported by any scientific team and remains the stuff of news reports only. Recording, documenting and counting the twin families must be a first step before larger funding is requested.

Intellectual Merit

The intellectual merit of this project is that we are considering multiple reasons for the rise in the twinning birth rate in this town: 1. Pollution with endocrine-like agents, 2. ingestion of phytoestrogens and insulin-like growth hormone in milk, 3. a sudden increase in alleles which favor twinning due to a bottle-neck effect following a massive epidemic. With the substantial sample size of twins, we will be able to also evaluate the presence of gene by environment interaction, as we did in our recent paper (Huang et al. 2015), where we demonstrated that odds of twinning differed by alleles, by a specific environmental insult (in Huang et al, smoking) and by allele*smoking interactions.

Broader Impacts.

The broader impact of this project involves not only human health but also the study of variability of the life history patterns of our species. While it has been well known that non-industrialized human populations will control their fertility with various cultural means such as post-partum taboos and effective breast-feeding patterns, a demonstration that human populations differ significantly in their fertility-related genetic make-up is new. Results of this study will have applicability for fertility-enhancing technologies.

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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Project description.

Introduction.

The purpose of this project is to collect genealogies of families in Kodihni in the Southern State of Kerala India, to reconstruct when they started having a twin birth rate (TBR) out of the normal range of other Indian populations. According to news reports, villagers say that the “twin epidemic” started after the community went through a massive epidemic sometime in the 1930’s-1940’s, which suggests a possible bottleneck effect. However, the occurrence of twins in these families across generations has not been documented or reported by any scientific teams and remains the stuff of news reports only. Recording, documenting and counting the twin families must be a first step before larger funding is requested.

Kodihni, Kerala. India.

The Southern state of Kerala is well-known for its long history of open discourse and exchanges with the West as much as for its progressive policies. Many Malayalans (as the people who live in Kerala call themselves, due to their Dravinian language, Malayali) look with pride to their history: they were always a player in the world scene which allowed them to be a particularly heterogeneous group. Indeed, they had a lively and successful Jewish settlement and many Malayalans are Christian because their ancestors were converted by non-other than St. Thomas. In modern India, Kerala has achieved high levels of female literacy and a drop in fertility rate in stark contrast with those of other states in the subcontinent (Susuman, et al. 2016). The village of Kodihni is a rural small town which still maintains a fairly traditional social organization despite its fair proximity to large cities such as Kozhikode (see figure 1).

As is traditional of most Kerala rural villages, Kodihni cannot be described as a Hindu, Muslim or Christian village, because it includes members of many constituents, each of which may have its own inheritance rules. Moreover, the traditional rules of inheritance, marriage and caste relations are in continuous flux.

For example, until rather recently, the Namboorini, a patrilineal-landed Brahman group which controlled large areas of land, only allowed the first son to marry within their own cast and inherit all of the property. This traditional system, which permitted younger sons to enter non-formal relations with women of lower matrilineal casts was challenged and forced to change by younger Brahmin sons and better-educated-members of lower casts in the last few decades. Another player in the eventual change in the status of this Malayalam Brahman group were the Scheduled and Unscheduled Casts, because they would not be able to receive any spiritual services from the Namboorini (Mencher and Goldberg 1967). Although India is not supposed to have castes anymore, the presence of castes in everyday life is palpable in a recent study in a small rural village in Kerala (Arora and Sanditov 2015). Besides the well-known *Dalits* (or Scheduled Castes), formerly-known as the “untouchable”, there are India’s indigenous tribes or

Adivasi, categorized as Scheduled Castes. These two groups share in common a history of discrimination and exploitation by the other castes, and still to this day they tend to live in the outskirts of towns and cities (Arora and Sanditov 2015). Most of these families are landless-workers, who continue to be reproductively isolated from the other casts. They are both matrilineal and patrilineal (Osella and Osella 1999).

A family's religion may affect the type of home or compound it builds. Through rural Kerala, Christians prefer to purchase land plots close to the roadside, while Hindus prefer to buy them close to the village's center to be close to the temples and the homes of the wealthy. With increasing upward mobility, some of the Scheduled and Unscheduled Castes are been able to purchase land, and they are trying to build according to the Hindu family tradition of a large household compound, which embodies permanence, stability and reputation (Osella and Osella 1999)

Background. The human twin rate.

Human population differences in frequencies of twinning have long been recognized. There is wide variation in the frequency of twin pregnancies across different human populations, yet the Kodihni population is a clear outlier. Broadly speaking, populations of African descent have a high twin birth rate (40-50 per thousand), populations of European and Middle-Eastern descent have a medium TBR (10-20 per thousand), and populations of Asian descent have a low TBR (about 10 per thousand) (Madrigal 1994; Madrigal 1995a; Rao, et al. 1983). The TBR in different areas of India has been reported to be 10.5 (Choudhury, et al. 1985), 8.7, 9 (Thirumalaikolundusubramanian, et al. 1986) and 12.44 (Sengupta and Boruah 1996) per thousand. There is one report of a relatively high twinning birth rate in India in a Muslim group in West Bengal, whose TBR was 20.5 per thousand-while the TBR in the Hindu sample from the same area was 10.6 per thousand- (Das Chaudhuri, et al. 1993).

In all of these studies, it is assumed that DZ twinning is responsible for such geographical variation because the frequency of monozygotic twinning (MZ) is (for all intents and purposes) a teratogenic event and therefore the same across populations (Hoekstra, et al. 2008).

Spontaneous dizygotic (DZ) twinning is a phenomenon related with the release and fertilization of two oocytes. A genetic component to it has long been recognized but no clear inheritance pattern has been identified. Several groups, including ours have endeavored to unravel which genomic areas are involved in human population differences in twinning. We showed with a data-mining approach that mothers of twins and mothers of singletons differ significantly in genes which are also enriched in Brazil's famed "twin town" (Tagliani-Ribeiro, et al. 2012) and that environmental factors such as smoking may influence the expression of these genes (Huang, et al. 2015). A GWAS study which considered 2 000 mothers of DZ twins and 13 000 controls (Mbarek, et al. 2016) based on four populations detected more loci implicated in twinning. We have resubmitted a paper to the European Journal of Human Genetics (Susca, et al. 2016) in which we have demonstrated evidence for selection of twinning genes previously noted by earlier research (Huang, et al. 2015; Mbarek, et al. 2016).

The literature on whether twinning is advantageous from a Darwinian fitness perspective in humans is mixed. It is well known that twin pregnancies are associated with preterm and

premature labor, higher risk of pre-eclampsia and pregnancy-induced hypertension and gestational diabetes, and other maternal and fetal/neo-natal complications (Wennerholm 2009). However, mothers of twins under two different socio-cultural and ecological conditions have been reported to achieve higher selective fitness than mothers of singletons, suggesting that at least in some environments, the genetic propensity for twinning may be favored (Madrigal 1995b; Sear, et al. 2001).

What may be the cause of the high twinning rate in Kodinhi?

There are three possible causes for population differences in polyovulation, which may be the cause of Kodinhi's high TBR:

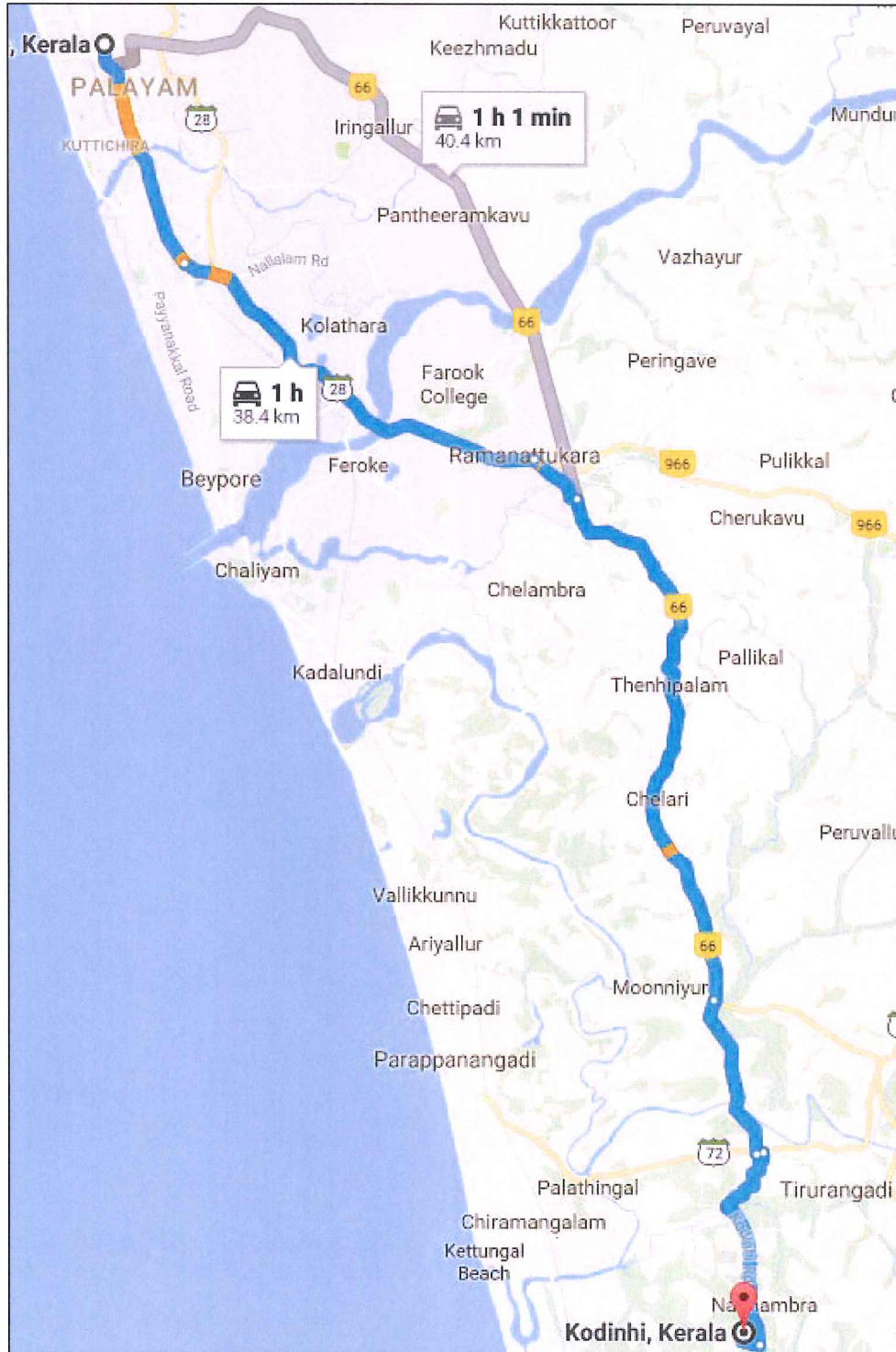
1. Dietary ingestion of phytoestrogens and/or insulin-like growth factors (IGF) which cause polyovulation.
2. Exposure to endocrine disrupting chemicals (EDC) such as polychlorinated biphenyls (PCBs) and Bisphenol A (BPA).
3. The population may have high frequencies of genetic variants involved in the steroid metabolic pathway which may influence levels of circulating steroid hormones, such as those demonstrated previously (Huang, et al. 2015; Mbarek, et al. 2016; Susca, et al. 2016)

These three possibilities are discussed here briefly: 1. My colleagues at the Department of Anthropology at the University of Kannur, who have done work in the local area dismiss increased consumption of phytoestrogens in the diet, as they have not witnessed a change in the diet. They are unaware of the use of IGF in the dairy industry, however. A survey of dairy and food practices is needed to test this hypothesis 2. Although India is much polluted, Kodinhi is still in a very rural area. A comprehensive environmental pollution survey is required. 3. The villagers' accounts indicate that this could be a case of gene drift by the bottle neck effect, following a massive epidemic. However, since there are reports of other such "twin villages" in India, we wonder if the environmental explanations may be correct after all. In the case of the Brazilian "twin village", it was determined that some of the genes found enriched by authors cited above were also found there, indicating that at least in Brazil the high TBR was due to genetic drift and inbreeding (Tagliani-Ribeiro, et al. 2012).

Objectives: The objectives of this EAGER study are:

1. Confirm the number of twin pairs.
2. Confirm the ages of the twin pairs to establish when they were born.
3. Obtain exhaustive family trees of the twin families to determine when the twin birth started occurring
4. Determine if these families share an occupation, a geographical region or a religion in common.

Figure 1. Map showing the distance from Kozhikode (major closest airport) to Kodihni).



Rational and scope

This project is a necessary first step before we collect biological and environmental data which will require a budget in the millions of dollars, a commitment of numerous scientists and an extended presence in the field. It is necessary to document in a scientific publication the number of twins, since when they started occurring, and in which families. Otherwise, the reports of twins in this village remain nothing more than reports.

My colleagues at Kannur University have already met with the council of elders (the Panchayat) and have obtained permission to do this preliminary field visit and others following. The elders are pleased that our team includes people who speak their language and even a student who is from their own region (the student's father introduced my colleagues to the elders).

The cooperating institutions are: Kannur University, the local major University and the Panchayat, (the local council of elders), which has granted us permission to do this preliminary project). We see the Panchayat and the participants as collaborators, not as subjects.

Research Management Plan

Sampling strategy:

We will interview the mothers of all twins within the village. We will coordinate our schedule with the Panchayat's secretary, with whom my collaborator in India already spoke. Although there are 250-300 pairs of twins reported in the town, it does not mean that there are 250-300 mothers to be interviewed, because several of these twins have been born to the same mother, and several of these twins are grand or great-grand-children to the same woman. Since many of these households are multi-generational, and because women get married relatively early, it will be possible to find households with a mother, a grand and a great-grandmother, living in the same compound, which will facilitate the interview process and support the reliability of the participants' answers.

Protocols:

Interviews will be conducted in Malayam by a female anthropologist born and raised in Kerala. The interview will start by explaining the project and by obtaining informed consent. Participant will not be asked to sign the form because they are most likely not to be literate. Instead, the PI will sign affirming that the participants fully understand the consent form.

The interview will consist of questions about the participant herself (age, occupation, diet, possible exposure to contaminants) and about her reproductive history. Then we will ask her to reconstruct to the best of her knowledge her mother's, father's, father-in-law's and her mother-in-law's reproductive history, unless her mother and mother-in-law are available to do so.

Data analysis, interpretation and dissemination.

With the support of the NSF, we are going to buy a laptop computer and install in it the program Progeny, which we have used in the past for constructing complex lineages. As my

colleague interviews each participant, I will be entering the data into the program, and creating each family tree.

Data analysis: Families will be divided by decade, and mean number of children by decade will be calculated as well as the frequency of twin births. Families will also be divided by religion, occupation, and by region within the village, to determine if the frequency of twinning is correlated with any of these variables. Data analysis will be done using SAS 9.4.

We will hope to publish in as high of an impact journal as we can. We think that given the interest of the topic to population geneticists, anthropologists, assisted reproductive medicine, we are likely to be able to publish in a broad science journal

Available facilities:

We have already made contact with the local council of elders, who have approved our project. The fact that our student assistant is from the region has proven to be very beneficial. Our student assistant's father introduced my colleagues to the council, and he is going to be setting up our living arrangements.

Progress to date:

We have preliminary data indicating that human populations differ in "twinning genes" (Susca, et al. 2016). In our own work, we have shown that there is strong environment*genetic interaction which affects twinning odds (Huang, et al. 2015), and members of our team have shown that pollutants may behave as endocrine modifiers (Baerwald, et al. 2012).

Project schedule:

- December 5-6: Travel to India.
- December 6-9: Meet with colleagues at Kannur University and with administrators.
- December 10-15: Work on interview transcription.
- December 16-25. Work in Kodihni.
- December 2. Leave for Kozhikode
- December 26: Depart to the USA.

Immediate results:

1. Determine when these families started having twins.
2. Determine if the families which have twins have something in common, such as occupation, religion, marriage type, diet, area of town, etc.

Anticipated future results:

This project will allow us to submit a multi-year proposal to study the causes of the high twinning rate in Kodihni. In this project we will be able to obtain DNA and test the hypotheses shown in table 1. We will also be able to fund several graduate students at several institutions, including Kannur University.

Contributions to education and human resources.

With a large NSF grant, I plan on hiring several graduate students from the USA, and to hire one graduate student from the Thalassery Campus of Kannur University, where my colleagues are based. Both my colleagues and I are looking forward to signing a formal agreement between both Universities which will allow us to more easily exchange students and scholars (for example via the Nehru Fulbright Fellowship). The Nehru Fulbright Fellowship would allow me to travel to Kannur University to teach and to visit the field site on an intermittent basis. Dr. S. Gregory is particularly excited about this prospect because the Thalassery campus has recently opened a new allied-health department, and my Anthropology Department has a joint degree with Public Health; I myself conduct research with members of the School of Medicine at my University. Therefore, Dr. S. Gregory (who was the former director of his campus, analogous to our President or Chancellor), is looking forward to a stronger relation between both Universities. From the perspective of the University Of South Florida Department Of Anthropology, we have an applied anthropology program with a strong emphasis on biomedical applications. We have created a biomedical minor and we are recruiting many pre-med students who are switching majors or double-majoring. I am currently doing research with three undergraduate students who are going to go to medical school. For these students, as well as for my graduate students, to have the possibility to go to the field in India, is a fantastic opportunity.

Broader impacts.

This project will have impacts in the health and wellbeing of this community. If the higher rate of twinning is due to pollution, then we can expect to begin to see a rise in reproductive cancers in both males in females within this generation (data obtained in lab by our collaborator, Angela Baerwald, mentioned in discussion). The work of the team in the Brazilian "twin town" and our own shows that the tumor suppressor gene P53 is involved in twinning. In our study we found that a particular SNP in this gene interacted strongly with smoking to raise the probability of twinning. Therefore, it is likely that specific genotypes interact with specific environmental insults to increase odds of twinning and cancer. This is the reason why our questionnaire includes questions about history of cancer and twinning in the family.

If the high rate of twinning in the town is due to high frequencies of "twinning genes" then the local council of elders will have scientific publications which will allow them to request more health services from the central government. At this point, even rural India is grappling with the problems of an increased level of cardiovascular diseases. The twins of this town, likely born premature and low-birth weight are in double jeopardy for developing cardiovascular disease.

Finally, in this initial visit I will be visiting with administrators at Kannur University, to discuss and possibly even draft an exchange program between both Universities. They are very interested in working with my department because of our interaction with the Public Health and Medicine colleges. Their new *Inter University Centre for Bioscience* demonstrates that Kannur University is an intellectual power house in the South of India which is expanding its health research areas. For our future work, it will allow us to analyze biological samples at the

Kannur campus, hiring local students and experts. In addition, setting up an exchange program between the two universities will allow an easier exchange of students and of faculty. For example, I could apply for a Fulbright fellowship to allow me to teach on campus while doing my research at the village. I have also made a commitment to my colleagues that if I get a large federal grant, I will include in the budget funds for an Indian graduate student to be educated at my department and to participate during the summers in the field work. I want to give back to Kerala.

Discussion.

Twinning is a complex process, whose inheritance pattern has been attempted to be uncovered by numerous researchers. We have preliminary data (Huang et al., 2015; Susca et al., under second review) to indicate that twinning is associated with genes which promote a larger cohort of follicles, lower follicle selection and promote multiple implantation. I have assembled a team that includes population geneticists (Guido Barbujani, University of Ferrara; in charge of determining if the allele frequencies are due to genetic drift or natural selection); of reproductive biologists (Katherine Clancy, University of Illinois; in charge of determining the hormonal pathways in which twins may be produced) and Angela Baerwald (her lab has animal models on the interaction of plastics and other endocrine-like products on reproductive outcomes, including twinning. Dr. Baerwald has post-docs who have also worked on water, air and soil pollution and their effect on reproductive outcomes).

The first step before we mobilize this team, which will require a large budget is to document in a scientific publication the number of twins, since when they started occurring, and in which families. Otherwise, the reports of twins in this village remain nothing more than reports.

My colleagues at Kannur University have already met with the council of elders (the Panchayat) and have obtained permission to do this preliminary field visit and others following. The elders are pleased that our team includes people who speak their language and even a student who is from their own region (the student's father introduced my colleagues to the elders).

I am asking the NSF for a very small amount of money to help me complete this preliminary trip, which will allow me to collect the necessary data to submit a large NSF proposal to study a uniquely bio-cultural situation. Human fertility is by definition biocultural, and only anthropology is in a position to study it from a cultural, biological, evolutionary and environmental perspective.

This is a participatory project in which we respect the community's traditional governing structure and in which we will only proceed with their permission. In our data management agreement, we have written that if any of our data are used in a way that results in financial profits, those profits should be shared with the participants and the community.

Arora, S., and B. Sanditov. 2015 Cultures of Caste and Rural Development in the Social Network of a South Indian Village. *Sage Open* 5(3).

Baerwald, A. R., G. P. Adams, and R. A. Pierson. 2012 Ovarian antral folliculogenesis during the human menstrual cycle: a review. *Human Reproduction Update* 18(1):73-91.

Hoekstra, Zhao, Lambalk, Willemsen, Martin, Boomsma and Montgomery. 2008. Dizygotic twinning. *Human Reproduction Update* 14(1):37-47.

Huang, Clancy, Burhance, Zhu and Madrigal 2015) 2015 Women who deliver twins are more likely to smoke and have high frequencies of specific SNPs: Results from a sample of African-American women who delivered preterm, low birth weight babies. *American Journal of Human Biology* 27(5):605-612.

Madrigal, L. 1994 Twinning rates in admixed Costa Rican populations. *American Journal of Human Biology* 6(2):215-218.

— 1995 Differential fertility of mothers of twins and mothers of singletons - study in Limon, Costa-Rica. *Human Biology* 67(5):779-787.

Madrigal, Saenz, Chavez and Dykes. 2001 Frequency of twinning in two Costa Rican ethnic groups: An update. *American Journal of Human Biology* 13(2):220-226.

Mbarek, Steinberg, Nyholt, Gordon, Miller, McRae, Hottenga, Day, Willemsen, de Geus, Davies, Martin, Penninx, Jansen, McAloney, Vink, Kaprio, Plomin, Spector, Magnusson, Reversade, Harris, Aagaard, Kristjansson, Olafsson, Eyjolfsson, Sigurdardottir, Iacono, Lambalk, Montgomery, McGue, Ong, Perry, Martin, Stefánsson, Stefánsson and Boomsma. 2016. Identification of Common Genetic Variants Influencing Spontaneous Dizygotic Twinning and Female Fertility. *The American Journal of Human Genetics* 98(5):898-908.

Osella, F., and C. Osella. 1999 From transience to immanence: Consumption, life-cycle and social mobility in Kerala, South India. *Modern Asian Studies* 33:989-1020.

Rao, P. S. S., S. G. Inbaraj, and S. Muthurathnam. 1983 Twinning rates in Tamilnadu. *Journal of Epidemiology and Community Health* 37(2):117-120.

Satija, M. Sharma, S. Soni, R. K. Sachar, R. K. Singh, G. P. I. 2008 Twinning and Its Correlates: Community-Based Study in a Rural Area of India. *Human Biology* 80(6):611-621.

Sear, Shanley, McGregor and Mace 2001. The fitness of twin mothers: evidence from rural Gambia. *Journal of Evolutionary Biology* 14(3):433-443.

Susca, Clancy, Madrigal and Barbujani 2016. Natural selection accounts for differences in dizygotic twinning rates at the worldwide scale. *Europ J Hum Genet Undergoing second review*.

Susuman, A. S., S. Lougue, and M. Battala. 2016 Female Literacy, Fertility Decline and Life Expectancy in Kerala, India: An Analysis from Census of India 2011. *Journal of Asian and African Studies* 51(1):32-42.

Tagliani-Ribeiro, A; Paskulin, D. D; Oliveira, M.; Zagonel-Oliveira, M.; Longo, D.; Ramallo, V.; Ashton-Prolla, P. ; Saraiva-Pereira, M. L. Fagundes, N. J. R.; Schuler-Faccini, L. and Matte, U. 2012 High twinning rate in Cndido Godi: a new role for p53 in human fertility. Human Reproduction 27(9):2866-2871.

Wennerholm, U. B. 2009 The risks associated with multiple pregnancies. *In* Single Embryo Transfer. J. Gerris, G. Adamson, P.D. Sutter, and C. Racowsky., eds. Pp. 3-16.

BIOGRAPHICAL SKETCH

LORENA MADRIGAL

Professor, Department of Anthropology
University of South Florida, Tampa, FL 33620

PROFESSIONAL PREPARATION

University of Costa Rica	Anthropology		1980-1982
University of Utah	Anthropology	B.S.	1982-1984
University of Cincinnati	Anthropology	M.A.	1984-1985
University of Kansas	Anthropology	Ph.D.	1985-1988

APPOINTMENTS

2015- Present	Graduate Faculty. Florida Agricultural and Mechanical University
2005 – Present	Professor, Department of Anthropology, University of South Florida
1993-2005	Associate Professor, Department of Anthropology. University of South Florida
1990-1993	Assistant Professor, Department of Anthropology. University of South Florida
1988-1990	Visit. Assistant Professor, Dept. of Anthropology. University of South Florida

RELATED PUBLICATIONS

- Susca, RR, Clancy, Kathryn B. H., Madrigal, L. and Barbujani, G. Under second review. 2016. Natural selection accounts for differences in dizygotic twinning rates at the worldwide scale. *European Journal of Human Genetics*.
- H Huang, KBH Clancy, C Burhance, Y Zhu and L Madrigal. 2015. Women who deliver twins are more likely to smoke and have high frequencies of specific SNPs: results from a sample of African-American women who delivered pre-term, low birth weight babies. *American Journal of Human Biology*: 27: 605-612.
- Castrì L. (posthumously), Donata Luiselli, Davide Pettener, Mauricio Melendez-Obando, Ramón Villegas-Palma (posthumously), Ramiro Barrantes, Henrieta Raventos, Reynaldo Pereira, Lorena Madrigal. 2014. A Mitochondrial haplogroup is associated with decreased longevity in a historic New World population. *Human Biology*. Volume: 86 Issue: 4 Pages: 251-259
- Madrigal L., Loredana Castrì (Posthumously), Mauricio Melendez-Obando, Ramon Villegas-Palma, Ramiro Barrantes, Henrieta Raventos, Reynaldo Pereira, Donata Luiselli, Davide Pettener, Guido Barbujani. 2012. High mitochondrial mutation rates estimated from deep-rooting Costa Rican pedigrees. *American Journal of Physical Anthropology*. 148 (3): 327–333.
- Castrì, L., Madrigal, L.; Melendez-Obando, M, Villegas-Palma, R, Barrantes, R, Raventos, H, Pereira, R, Luiselli, D, Pettener, D 2011. Mitochondrial Polymorphisms Associated with differential longevity do not impact lifetime-reproductive success. *American Journal of Human Biology* 23(2): 225-227.

OTHER SIGNIFICANT PUBLICATIONS

- Castrì, L, Mauricio Melendez-Obando, Ramon Villegas-Palma, Ramiro Barrantes, Jetty Raventos, Reynaldo Pereira, Donata Luiselli, Davide Pettener, Lorena Madrigal. 2009. Mitochondrial polymorphisms are associated both with increased and decreased longevity. *Human Heredity*. 67 (3): 147-153.
- Madrigal, L. and Melendez-Obando, M. Grandmothers' longevity negatively affects daughters' fertility. 2008. *American Journal of Physical Anthropology*.
- Castrì, L; Flory Otárola, Mwenza Blell, Ramiro Barrantes, Donata Luiselli, Davide Pettener, Ernesto Ruiz and Lorena Madrigal. 2007b. Indentured migration and differential gender

- gene flow: the origin and evolution of the East-Indian community of Limón, Costa Rica. *American Journal of Physical Anthropology* 109 (2): 330-337 JUN 2007.
- Madrigal, L; Jeffrey Brady, Michelle Raxter, Ernesto Ruiz, Flory Otarola and Mwenza Blell. 2011. Obesity, hypertension and migration: A meta-analysis of populations of the South Asian diaspora. *Human Biology*. 83(1): 71-86.
- Madrigal L. and Kelly W. 2007d. Human skin color sexual dimorphism: A test of the sexual selection hypothesis. *American Journal of Physical Anthropology*.
- Madrigal L and T. Koertvelyessy. 2003a. Epidemic cycles in agricultural populations: A cross-cultural study. *Human Biology*. 75(3):345-354.

SYNERGISTIC ACTIVITIES

Involved in mentoring pre-medical students in active research. In Fall 2016 I am working with three minority women in research projects. Last year I had two minority women working with me, and they both presented their work in professional or semi-professional fora.

Madrigal, L. and González-José. 2016. *Introducción a la Antropología Biológica*. Asociación Latinoamericana de Antropología Biológica. 678 págs. ISBN: 978-987-33-9562-8.

Madrigal, L. 2014-2017. Biological anthropology member of the Executive Board of the American Association of Anthropologists.

Madrigal, L. 2012. Elected as a Fellow of the AAAS.

Madrigal, L. *Statistics for anthropology*. 2012. Second edition. Cambridge University Press.

Madrigal L. *Human Biology of Afro-Caribbean populations*. 2006. Cambridge University Press. Reprinted in 2011.

President, American Association of Physical Anthropologists. 2011-2013.

Vice-president and Program Chair. American Association of Physical Anthropologists (2008-2010)

Organizer, "Theories and methods in applied biocultural anthropology". A conference held at the University of South Florida. October 19-20, 2007

SUMMARY YEAR 1
PROPOSAL BUDGET

ORGANIZATION University of South Florida				FOR NSF USE ONLY				
				PROPOSAL NO.		DURATION (months)		AWARD NO.
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Lorena Madrigal				Proposed		Granted		
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months			Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR		
1.		0.00	0.00	0.00				
2.								
3.								
4.								
5.								
6.	(0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00				
7.	(1) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00				
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)								
1.	(0) POST DOCTORAL SCHOLARS	0.00	0.00	0.00				
2.	(0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00				
3.	(0) GRADUATE STUDENTS							
4.	(0) UNDERGRADUATE STUDENTS							
5.	(0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							
6.	(0) OTHER							
TOTAL SALARIES AND WAGES (A + B)								
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)								
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)								
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)								
TOTAL EQUIPMENT								
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)								
2. FOREIGN								
F. PARTICIPANT SUPPORT COSTS								
1.	STIPENDS \$							
2.	TRAVEL							
3.	SUBSISTENCE							
4.	OTHER							
TOTAL NUMBER OF PARTICIPANTS				TOTAL PARTICIPANT COSTS				
G. OTHER DIRECT COSTS								
1. MATERIALS AND SUPPLIES								
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION								
3. CONSULTANT SERVICES								
4. COMPUTER SERVICES								
5. SUBAWARDS								
6. OTHER								
TOTAL OTHER DIRECT COSTS								
H. TOTAL DIRECT COSTS (A THROUGH G)								
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)								
Total direct costs (Rate: 26.0000, Base: 4690)								
TOTAL INDIRECT COSTS (F&A)								
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)								
K. SMALL BUSINESS FEE								
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)								
M. COST SHARING PROPOSED LEVEL \$				AGREED LEVEL IF DIFFERENT \$				
PI/PD NAME Lorena Madrigal				FOR NSF USE ONLY				
ORG. REP. NAME* Mindy Owen				INDIRECT COST RATE VERIFICATION				
Date Checked		Date Of Rate Sheet		Initials - ORG				

SUMMARY PROPOSAL BUDGET Cumulative

ORGANIZATION University of South Florida				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Lorena Madrigal				Proposed		Granted	
				AWARD NO.			
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months			
	CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)		
1.	0.00	0.00	0.00				
2.							
3.							
4.							
5.							
6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00				
7. (0) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00				
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. (0) POST DOCTORAL SCHOLARS	0.00	0.00	0.00				
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00				
3. (0) GRADUATE STUDENTS							
4. (0) UNDERGRADUATE STUDENTS							
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							
6. (0) OTHER							
TOTAL SALARIES AND WAGES (A + B)							
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							
E. TRAVEL							
1. DOMESTIC (INCL. U.S. POSSESSIONS)							
2. FOREIGN							
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ _____							
2. TRAVEL _____							
3. SUBSISTENCE _____							
4. OTHER _____							
TOTAL NUMBER OF PARTICIPANTS _____				TOTAL PARTICIPANT COSTS _____			
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							
3. CONSULTANT SERVICES							
4. COMPUTER SERVICES							
5. SUBAWARDS							
6. OTHER							
TOTAL OTHER DIRECT COSTS							
H. TOTAL DIRECT COSTS (A THROUGH G)							
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
TOTAL INDIRECT COSTS (F&A)							
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							
K. SMALL BUSINESS FEE							
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							
M. COST SHARING PROPOSED LEVEL \$ _____				AGREED LEVEL IF DIFFERENT \$ _____			
PI/PD NAME Lorena Madrigal				FOR NSF USE ONLY			
ORG. REP. NAME* Mindy Owen				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Budget justification

Travel

We are requesting funds for field work necessities, including transportation to and from airport, to and from the Kannur University, and to and from the field site. Driving in India is treacherous, and it is not advisable for foreign drivers to rent cars. In fact, my colleagues say that it is important that we hire a car with a professional chauffer who can handle the roads and likely car failures. We are asking for very modest funds. For example, [REDACTED] per day to cover the PI's stay at the city will include her hotel and three meals, and [REDACTED] per day to cover each person's room and board at the village. We are also requesting funds for one computer which should have a long-lasting battery, since we are not sure that we will have access to electricity, and to purchase a genealogical program. [REDACTED]

Participant costs.

Participant support costs are [REDACTED] per person. This sounds like a meager amount but in this area of India, it is not. Indirect costs are calculated using the out-of-campus rate. [REDACTED]

Other direct costs

Materials and supplies. We are requesting funds for purchasing a laptop with an ample battery and a genealogy software package. [REDACTED]

Total direct costs

[REDACTED]

Total indirect costs:

[REDACTED]

The University of South Florida has negotiated an indirect cost rate of 26% for federal grants when work is to take place outside of campus. www.usf.edu/research-innovation/sr/documents/indirect-rates.pdf

Total direct and indirect costs:

[REDACTED]

Amount of this request:

[REDACTED]

Current and Pending Support

	Other agencies (including NSF) to which this proposal has been/will be submit-		
Investigator: Lorena Madrigal			
Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support			
Project/Proposal Title: Why do some sickle-cell carrier athletes suffer from heat illness?			
Source of Support: NCAA			
Total Award Amount: \$7,500		Total Award Period Covered: 06/2012-0/2016	
Location of Project: Tampa, FL			
Person-Months Per Year Committed to the Project.	Cal:	Acad: 0.1	Sumr:
Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support			
Project/Proposal Title: Funds to send graduate student to Brazil for fieldwork.			
Source of Support: University of South Florida. College of Arts and Sciences.			
Total Award Amount: \$1,400		Total Award Period Covered: 06/2015-06/2016	
Location of Project: Tanzania, Tampa FL.			
Person-Months Per Year Committed to the Project.	Cal:	Acad: 0.05	Sumr: 0
Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support			
Project/Proposal Title: Pregnancy, immune function in Quilombona women in Brazil			
Source of Support: Research & Scholarship, USF.			
Total Award Amount: \$9,500		Total Award Period Covered: 3/9/2016-3/15/2017	
Location of Project: Brazil and USF.			
Person-Months Per Year Committed to the Project.	Cal:	Acad: 0.05	Sumr:
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support			
Project/Proposal Title: Interviewing mothers of twins in Kerala.			
Source of Support: NSF			
Total Award Amount: [REDACTED]		Total Award Period Covered: 12/01/2016-12/01/2017	
Location of Project: Kerala, India			
Person-Months Per Year Committed to the Project.	Cal:	Acad: 0.1	Sumr: 0.5
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support			
Project/Proposal Title:			
Source of Support:			
Total Award Amount: \$		Total Award Period Covered:	
Location of Project:			
Person-Months Per Year Committed to the Project.	Cal:	Acad:	Sumr:



Facilities, Equipment, and Other Resources

1. **Department of Anthropology, USF:** Statistical analysis writing will take place at the Department of Anthropology of the University of South Florida.
 - a. The USF's department of Anthropology is one of the first in the nation to establish a program in applied anthropology. As such, its focus has always been on inter-disciplinary collaboration. Indeed, the department offers a dual-degree program with the College of Public Health, with which it works closely.
 - b. The PI and her graduate students each have access to office space and to computer resources outfitted for statistical analyses. All of our computers have SAS, SPSS, R, and STATA, as well as spreadsheet and word-processing programs. In addition, we have support from USF's IT department for any computing or statistical needs.
 - c. The Department of Anthropology is housed on the first floor and basement of the Social Sciences Building on the USF-Tampa Campus. Department facilities include the main office where the chair and administrative staff reside, two faculty office suites, a graduate student lounge with computer lab and offices, a museum exhibition gallery, and various research and teaching laboratories. Courses offered in the department make use of various media enhanced classrooms, each of which contain a data projector, desktop PC w/Internet access, DVD/CDROM/VCR, document camera, sound system, and various other instructional technologies.
 - d. The Anthropology Exhibit Gallery showcases exhibits on all aspects of anthropology and is designed and curated by students in the Museum Methods class, a unique course that provides undergraduate students with hands-on experience in exhibit design and fabrication. The Gallery serves as an educational experience for the entire university community and general public. Many instructors base class assignments on visits to the gallery, and English-language classes use the captions and labels as a way to teach English. An interactive video kiosk with additional information on anthropology and the exhibits has recently been installed.
 - e. There are five archaeological laboratories in the department, each specializing in different methods or collections. These specializations include archaeological chemistry and materials analysis (primarily for pottery, obsidian, soils, and human and faunal remains), as well as regional archaeological collections from Florida, Mesoamerica, and the Mediterranean. The laboratories are equipped for artifact processing, documentation, and conservation; optical microscopy, photography, illustration, and drawing; physical and chemical analysis of archaeological materials; and preparation of museum exhibits. There is also access to laboratories in other USF departments where there is equipment for remote-sensing using ground penetrating radar; thin-section and metallographic sample preparation and analysis; scanning electron microscopy; x-ray diffraction; and elemental/isotopic analysis by inductively coupled plasma mass spectrometry.

- f. There are three laboratories used principally for research and teaching biological, medical, forensic and nutritional anthropology. The teaching lab includes laboratory tables and benches, anthropometric and osteometric equipment, and two mounted human skeletons. The research laboratory maintains the following: hominid casts; forensic teaching materials; forensic aging and sexing casts for skeletal remains; nutritional assessment equipments including skinfold calipers, electronic weighing scales, stadiometer, bio-electrical impedance body composition analyzer, infant measuring boards and weighing scales, electronic food scales, and food models; osteometric equipment including osteometric boards, digital spreading calipers, micrometers; Leica Microscopes and microscope slides; demonstration models; anatomical charts; blood pressure monitors; osteological research collections; and computer with printer and scanner.
- g. The media laboratory is equipped with a PC loaded with Adobe Premiere digital editing software; an IMAC computer with digital editing capabilities; and an analog editing system, incorporating 2 Panasonic VCR/Monitors, plus an AG-A96-P editing controller, a WJ-MX20 Digital AV mixer, and WJ KB-50 Character generator. The lab also has two digital camcorders, a Super VHS camcorder, and a selection of tripods and microphones.

2. Kannur University.

Kannur University could well be described as an academic powerhouse in the State of Kerala. The University is particularly proud of its focus on interdisciplinary approaches to health, which is why its administrators are eager to collaborate with the University of South Florida's Department of Anthropology.

The Inter University Centre for Bioscience at Kannur University has been established as a part of the mission oriented initiatives of the Higher Education Department, Government of Kerala. The Mission of the proposed Inter University Centre for Bioscience (IUCB), Kannur is to be a global center of excellence for research. Its chosen fields are the studies on herbal and marine metabolites and teaching in the allied sciences. It provides cutting edge technology development in interdisciplinary areas of importance to the country. IUCB functions in conjunction with the Department of Biotechnology and Microbiology, in Kannur University. It is taking shape of a nucleation center for expansion into an institute of significance with autonomy in administration. The Centre is situated in a place with tremendous amount of resource materials, with very rich written and oral knowledge traditions and pioneering stakeholder-institutions. The most important area of expertise of the IUCB is in structural molecular biology. The IUCB with focus on study of secondary metabolites is designed to have divisions for Hermeneutics of Traditional Medical Texts, Plant Metabolic Engineering, Therapeutically Active Principles, Separation and Derivatization Science, Toxicology Studies, Developing New Herbal Products, Biomolecular Structure and Information Science, Instrumentation and Instrument Maintenance Division, Animal and Cell Culture Facilities, Herbal Garden and Repositories and Green House. The IUCB conducts workshops and special training sessions for the students and teachers of tertiary level institutions. It is becoming a hub of frontier level activity related to the research in Bioscience in general and the chosen theme of the center in particular. Now, the Centre

functions as the part of the University with administrative and financial autonomy. The Centre is governed by a Governing Council. The first Governing Council has been constituted by the Department of Higher Education.

1. Types of data, samples, and other materials to be produced in the course of the project.

This project will produce reproductive histories of mothers of twins and family lineages of families which have produced twins. The data are characterized as observational. Data will be collected from interviews. The data are of a sensitive nature.

2. Standards to be used for data and metadata format and content.

These data will be saved in the following formats: excel, Microsoft word and Progeny 6 (a genealogical software). Our metadata will consist of a list of the variables, the purpose of the project, the geographical origin of the sample, and the conditions and terms of use of the data.

3. Methods and policies for providing access and enabling sharing.

Data will be stored on the PI's personal drive at the USF. Ethical and privacy issues including HIPAA and IRB will be addressed by Lorena Madrigal in conjunction with the village elders, who have the last word on this matter. There will be restrictions placed on the data. Restrictions will be placed on the data via a user agreement and access will be granted within a secure virtual network by Lorena Madrigal after consulting with the Panchayath (council of village elders).

4. Provisions for re-use, re-distribution, and the production of derivatives.

Data will be made available on or after the following date 01/01/2018. Foreseeable uses/users of the data are anthropologists and geneticists. Data re-use and re-distribution will not be limited to anyone and will be reviewed by Lorena Madrigal and the USF legal team, which will draft a binding agreement on profit sharing. Access to the data will only be granted after interested parties sign said agreement that any profits which may result from using these data will be shared with the participants, the Panchayat, the Twins and Kin Association (TAKA) and Lorena Madrigal. Findings from the data will be published with Lorena Madrigal Jancy Francis and S. Gregory as co-authors, with an acknowledgement of the participation of the mothers who were interviewed and of the Panchayath (council of village elders).

5. Methods for archiving and preserving access to data and materials.

Data will be permanently archived with the University of South Florida College of Arts and Sciences. The preservation and backup procedures for this facility follow best practices of a research I institution, and will be updated as needed. Access to the data through this resource will be available for an indefinite period of time.



KANNUR UNIVERSITY CAMPUS

Palayad, Thalassery - 670 661, Kerala. Phone: 0490-2346270

DR S GREGORY

**Professor and Former Head
Department of Anthropology**

**Former Director
Kannur University Thalassery Campus**

November 20, 2016

Lorena Madrigal, Ph D
Professor, Department of Anthropology
University of South Florida.
4202 E. Fowler. Tampa, FL. 33620.

Dear Lorena,

We made a visit to the Panchayat today and the following are the developments:
Myself and Jancy, accompanied by a Parent of one of Jancy's students hailing from a nearby place here, and who is familiar with some of the functionaries of the Village Panchayat, Met the Panchayat President. And as required, gave a letter of request for the field work. The content of the letter which is in Malayalam, goes like this:

Dr S Gregory, Professor in Anthropology from Kannur University and Dr Lorena Madrigal, Professor in anthropology in South Florida University, intend to undertake an Anthropological investigation of the phenomenon of twins in Kodhinhi, with the support of the Village Panchayath. The findings will be shared with the Panchayath and with the people. Necessary permission may be granted to interact with the people of kodhinhi and to collect necessary data from them during the period between 10 and 28 December 2016.

- The President granted the approval.
- We also met the Panchayath Secretary (the top executive functionary at the Village Panchayath level), who was again very cooperative.
- We could also meet one of the Ward Members, who is the Standing Committee Chairperson for Health and Education.

The following appealed to the Panchayat:

- Start with reconstructing the **historical timelines** of the place at least for nearly a century, or since the time the phenomenon had taken off, with an increasing speed. Consider:
 - Changing food pattern and nutritional intake over the years
 - Changing eco-environmental setting
- Prepare the **Geneologies** of the concerned Families

I urge the committee which is responsible for approving the human subject approval at your institution to approve your application.

Sincerely

S GREGORY

Residential Address: Teachers Flats (First Floor), Kannur University Thalassery Campus,
Palayad, Thalassery - 670661. Kerala. Phone: 0490-2346253 (R);
09048738988/09400666253 (Mob.)

Interview of mothers of twins.

1. Participant's name

1. Participant's ID number

2. What is your current age? _____

3. Decade. Interviewer: based on the information above, please choose the subject's age:

- a. if the subject is under 20,
- b. 20-29
- c. 30-39
- d. 40-50

4. What is your exact birthday? _____

5. How old were you when you got your first menstruation?

- a. Under 10
- b. 10
- c. 11
- d. 12
- e. 13
- f. 14
- g. 15
- h. 16
- i. 17
- j. older than 17

The following questions are about each of your pregnancies. Please include all pregnancies, even those that resulted in a miscarriage or in a stillbirth

First pregnancy

- 1. your age when you go pregnant _____
- 2. Outcome:
 - a. miscarriage
 - b. baby was born dead
 - c. Single baby born, still alive
 - d. single baby born, died later
 - e. twins born, both still alive
 - f. twins born, one is alive
 - g. twins born, both dead
 - h. triples or higher, all of them dead
 - i. tripples of higher, all of them alive
 - j. tripples or higher, some of them alive.

Repeat this question however many times necessary, inserting more pages as needed.

Please write here:

7. Total number of pregnancies
8. Total number of twin pregnancies
9. total number of children alive a time of interview
10. total number of boys
11. total number of girls.

The following questions are about the history of twinning in our family

12. Do/ Does your mother, sisters or daughters have twins?

A. yes

B. no

11. Do your grandmothers or aunts or nieces have twins?

A. yes

B. no

The following questions are about whether you drink milk and how much. Interviewer: you will need to bring a measuring cup.

12. Does drinking milk make you ill? If so, please skip to question #14

13. If you can drink milk, how many of these cups do you drink ever day?

A. less than 1

b. 1

c. 2

d. 3

E. more than 3

14. Do you eat cheese, yogurt, ice cream ghee and other foods made with milk?

A. yes

B. no

The following questions are about your work outside of home

15. Do you work with cows?

A. yes

B. no

16. Do you work in the agricultural fields?

A. yes

b. No

The following questions are about our family history of certain diseases:

17. Have you been told that you have breast cancer?

a. yes

b. No

18. Have your mother, aunts, grandmothers, sisters or daughters been told he have breast cancer?

a. No

b. Mother only

b. Sister only

c. Daughter only

d. A combination of them.

19. Have our father, brothers, sons, been old ha hey have prostate cancer?

a. Father only

B. Brothers only

c. Sons only

d. A combination of them.



Informed consent for participation in study.

Informed consent for mothers of twins in Kerala.

The following information is being presented to help you decide whether or not you want to be a part of a minimal risk research study. Please read carefully. If you do not understand anything, ask the Person in Charge of the Study, Lorena Madrigal at madrigal@usf.edu or 001-813 974 2138.

Title of Study: Twinning in Kerala.

Principal Investigator: Lorena Madrigal
Study Location(s): Kodinhi, Kerala. India.

You are being asked to participate because you have had at least one pair of twins.

General Information about the Research Study:

The purpose of this study is to interview you and find out the history of your pregnancies, and of your mother, your father, and your husband's family histories. We are trying to reconstruct who has had twins before you, and when.

Interview plan:

We will start by asking simple questions about you, such as your age, where you work, your activities, etc. Then we will ask about each one of your pregnancies. Afterwards we will ask you about your mother's, your father's and your husband's families. If your mother and mother-in-law are still alive, it may be easier for them to remember their families' histories, so we will ask you to refer us to them.

Benefits of Being a Part of this Research Study

If you participate in this study, you will help us determine when the "twin epidemic" started occurring in your town. You will also help us determine if the twins have higher mortality, which is important for local health officials to know.

You will also receive the equivalent of \$3 in Indian rupees as a token of appreciation for your time.

Risks of Being a Part of this Research Study

No significant risks are expected from your participation in this study.

Confidentiality of Your Records

Your privacy and research records will be kept confidential to the extent of the law. Authorized research personnel and the USF Institutional Review Board may inspect the records from this research project.

The results of this study may be published. However, the data obtained from you will be combined with data from other people in the publication. The published results will not include your name or any other information that would in any way personally identify you.

Volunteering to Be Part of this Research Study

You are free to participate in this research study or to withdraw at any time.

If you choose not to participate, or if you withdraw, there will be no penalty or loss of benefits that you are entitled to receive.

Questions and Contacts

If you have any questions about this research study, contact Lorena Madrigal at madrigal@usf.edu or 001 813 974 2138.

If you have questions about your rights as a person who is taking part in a research study, you may contact a member of the Division of Research Compliance of the University of South Florida at 001 813-974-5638.

Your Consent. Please tell me if you agree to be interviewed as I just explained.

Investigator Statement.

Through a translator, I have read to the participant the informed consent form, and I have explained it to her in her own terms. I testify that she understands the benefits and risks of participating, and that she is freely choosing to participate.

Lorena Madrigal
University of South Florida.
Tampa, FL. 33620.
madrigal@usf.edu or 001 813 974 2138.