

# The Brazilian Twin Registry

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The Brazilian Twin Registry (BTR) was established in 2013 and has impelled twin research in South America. The main aim of the initiative was to create a resource that would be accessible to the Brazilian scientific community as well as international researchers interested in the investigation of the contribution of genetic and environmental factors in the development of common diseases, phenotypes, and human behavior traits. The BTR is a joint effort between academic and governmental institutions from Brazil and Australia. The collaboration includes the Federal University of Minas Gerais (UFMG) in Brazil, the University of Sydney and University of Melbourne in Australia, the Australian Twin Registry, as well as the research foundations CNPq and CAPES in Brazil. The BTR is a member of the International Network of Twin Registries. Recruitment strategies used to register twins have been through participation in a longitudinal study investigating genetic and environmental factors for low back pain occurrence, and from a variety of sources including media campaigns and social networking. Currently, 291 twins are registered in the BTR, with data on demographics, zygosity, anthropometrics, and health history having been collected from 151 twins using a standardized self-reported questionnaire. Future BTR plans include the registration of thousands of Brazilian twins identified from different sources and collaborate nationally and internationally with other research groups interested on twin studies.

■ **Keywords:** twin registry, Brazil, twin studies, health promotion, disease prevention

The Brazilian Twin Registry (BTR) was established in 2013 as the first twin registry in Brazil and for that matter a decisive undertaking for twin research in South America. The main aim of the initiative was to create a resource that would be accessible to the Brazilian scientific community as well as international researchers interested in the investigation of the contribution of genetic and environmental factors in the development of common diseases, phenotypes, and human behavior traits (Hopper, 1992). Being the first twin registry in South America, the BTR was set up to be a unique source of information on health and disease, providing the genetic and environmental profile of a region still under-represented and under-explored.

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as well as the research foundations CNPq and CAPES in Brazil. Although Brazil does not have a long-standing tradition in twin research there are isolated groups of researchers who have conducted twin research previously, and we envisage that the BTR will be the central coordinator of other twin studies in the country.

## A Brief History of the BTR

The BTR ([www.gemeosbrasil.org](http://www.gemeosbrasil.org)) was born as a result of the interest of Brazilian researchers undertaking twin re-

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search in Australia, mainly in the field of musculoskeletal pain (Dario et al., 2016; Ferreira et al., 2011; Ferreira et al., 2013; Ferreira et al., 2016; Junqueira et al., 2014; Oliveira et al., 2015; Pinheiro et al., 2015). Since its inception, the BTR has been fully supported by the Australian Twin Registry and could be regarded as its co-twin registry. To our knowledge, the BTR is the only established active twin registry in South America, and the lack of a previous twin registry in the region led us to establish the registry through the implementation of a research project focused on risk factors for low back pain in the state of Minas Gerais, Brazil. The aim is to expand the research activities through the integration of other twin research groups in Brazil and broaden the scope of research co-ordinated by the BTR.

The BTR became a member of the International Network of Twin Registries in 2015 (Buchwald et al., 2014). Currently, 291 twins have consented to be registered in the BTR, with baseline and demographic data available from 151 twins. One of the strengths of our implementation design is the availability of health and lifestyle data from the register-entry questionnaire. The current twin sample is younger than in most twin registries (mean age = 30; range = 18–83), and characteristics of the 151 twins include 64 pairs of monozygotic and 12 pairs of dizygotic twins (Table 1).

### Funding of the BTR

The BTR is funded by an enabling grant from the Brazilian agency CNPq, a people support scheme provided by the Brazilian agency CAPES, and an international research and research training fund from the University of Melbourne, Australia.

### Recruitment

We are recruiting twins from a variety of sources, including media campaigns, social networking (e.g., Facebook), the BTR website, media appearances (e.g., TV, radio, national newspapers), multiple birth associations (e.g., Vizinhos de Utero), personal referrals, as well as healthcare providers and governmental databases.

#### Recruitment Through a Study of Low Back Pain

One of the main recruitment strategies we are using to register twins is through the invitation to participate in a longitudinal study investigating genetic and environmental factors for low back pain occurrence. This is the Brazilian arm of a large consortium study, with data also being collected in Australia. This study has been approved by the Local Human Research Ethics Committee at UFMG (protocol number 507231) and has received funding from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brazil (project number A009\_2013).

### Study Population and Setting

All Brazilian twins aged  $\geq 18$  years old who comprehend Portuguese are eligible and are being invited to participate in the study. A number of separate invitation strategies are being adopted: (1) media campaigns in Brazilian universities, faculties, and other locals of interest, (2) media campaigns using social networking (e.g., Facebook), (3) media campaigns using the developed website of the project, and (4) local publicity and word-of-mouth. We expect a convenient sample of 300 Brazilian twin pairs ( $n = 600$  individuals) to be recruited for the low back pain study, with twins being automatically registered with the BTR.

Twins who fulfill the inclusion criteria and agree to participate in the study are contacted by a study researcher to collect relevant data. Prior to the data collection, the researchers double-check the inclusion criteria and explain the nature of the study to the participant.

### Data Collection at Baseline and Follow-Ups

The experience of the participants of low back pain and potential risk factors are investigated using our baseline questionnaire (Table 2). Participants may choose to answer the questionnaire in person, over the telephone, or electronically. At baseline, demographics, zygosity, anthropometrics, and health history of the participants are collected using standard self-reported questionnaires. Portuguese versions of the standard self-reported questionnaires are used. Data on health variables include the following: health-related quality of life, physical workload and physical activity level, lifestyle (e.g., smoking) and psychosocial (e.g., levels of social isolation) factors, and occurrence of health problems (e.g., low back pain).

The questionnaire used at baseline was developed by the study researchers and was based on the script used by other established registries (i.e., Australian Twin Registry and Spanish Murcia Twin Registry) in order to maintain consistency and future comparisons among populations. Factors collected have been previously reported in twin studies as being associated with low back pain (Ferreira et al., 2013; Hartvigsen & Christensen, 2007; Hartvigsen et al., 2006; Hestbaek et al., 2008). Variables collected are assessed, as described below.

#### Demographics, Anthropometrics, and Social Variables

Demographics such as age, sex, and ethnicity are assessed by self-reported questions. Self-reported questions also assess anthropometrics (e.g., weight and height) and social variables (e.g., marital status, familiar income, educational level, and occupation).

#### Health History

Health-related quality of life is assessed using the EQ-5D (Rabin & de Charro, 2001). Participants are asked to

**TABLE 1**  
**Characteristics of 151 Twins With Baseline Data in the Brazilian Twin Registry (151 out of 291 Registered Twins)**

Characteristics	Number (Percentage or SD)
Total number of twins with baseline data	151
Monozygotic twins	127 (84%)
Male–male	46
Female–female	81
Dizygotic twins	24 (16%)
Male–male	2
Female–female	1
Opposite-sex	21
Age, mean	30.0 (12 SD)
Educational level	
Completed under-graduate or post-graduate degree	55 (36%)
Completed high school	88 (58%)
Completed fundamental school	4 (3%)
Did not complete fundamental school	4 (3%)
Occupation	
Employed	96 (64%)
Unemployed	12 (7%)
Student	43 (29%)
Ethnicity	
White	89 (59%)
Black	2 (1%)
Brown	57 (38%)
Mulatto	3 (2%)
Weight (kg), mean	65.0 (19 SD)
Height (cm), mean	166.0 (17 SD)
Smoking history	25 (17%)
Alcohol consumption history	107 (71%)
Physical active	106 (70%)
Report sleep quality problems	43 (29%)
Self-reported quality of life	85.0 (11 SD)
Reported health problems	
Related to mobility, <i>n</i> (%)	4 (3%)
Related to personal care, <i>n</i> (%)	2 (1%)
Related to usual activities, <i>n</i> (%)	6 (4%)
Related to pain and discomfort, <i>n</i> (%)	71 (47%)
Related to anxiety and depression, <i>n</i> (%)	55 (36%)
Diagnosed with health conditions	
Cancer	9 (6%)
Neurologic disorders	75 (50%)
Allergic disorders	74 (49%)
Skin disorders	13 (9%)
Gastrointestinal disorders	35 (23%)
Cardiorespiratory disorders	36 (24%)
Endocrine disorders	21 (14%)
Musculoskeletal disorders	48 (32%)
Rheumatic/autoimmune disorders	7 (5%)
Congenital disorders	8 (5%)
Disabling low back pain in the last 4 weeks	26 (17%)
Medication consumption in the last 4 weeks	113 (75%)

describe their own health according to five dimensions (i.e., mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) and also provide a self-rating on a visual analogue scale with endpoints of ‘best imaginable health state’ set at 100 and ‘worst imaginable health state’ at zero. Twins’ physical workload and physical activity level are assessed using, respectively, the Physical Workload Index (Hollmann et al., 1999) and the Active Australia Survey (Brown et al., 2004). Self-reported questions assess lifestyle factors, including smoking, alcohol, and illicit drugs consumption. Sleep quality is assessed using the Pittsburgh Sleep Quality Index (Bertolazi et al., 2011). Anxiety and depression is assessed using the Center for Epidemiological Studies–Depression Scale (CES-D; Batistoni et al., 2007),

and participants’ perceived levels of social isolation is assessed using the Friendship Scale (Hawthorne et al., 2013). Occurrence of health problems (e.g., cardiovascular, neurologic, respiratory, oncologic, mental, and musculoskeletal health disorders) and use of medication are assessed using self-reported questions.

#### Assessment of Low Back Pain

Twins’ experience of low back pain is assessed based on a recent consensus on the standardization of low back pain definitions for observational studies (Dionne et al., 2008). The self-report of low back pain is the primary outcome for this study and is investigated by asking participants if they have experienced low back pain. Twins who state they have

**TABLE 2**  
**Assessed Phenotypes in the Brazilian Twin Registry**

Sociodemographic and anthropometrics
Self-reported questions
Age, sex, ethnicity, marital status, educational level, occupation, family income, eye color, natural hair color, laterality, weight, height, waist, and hip circumferences
Portuguese versions of standardized self-reported questionnaires
Zygoty (Peas-in-a-Pod questionnaire; Ooki & Asaka, 2004)
Health history
Self-reported questions
Lifestyle (i.e., smoking, alcohol, coffee, tea, and illicit drugs consumption), occurrence of health conditions (i.e., cardiorespiratory, neurologic, oncologic, mental, musculoskeletal, and others), medication consumption
Portuguese versions of standardized self-reported questionnaires
Health-related quality of life (EuroQol-5D-3L; Rabin & de Charro, 2001)
Physical workload (Physical Workload Index; Hollmann et al., 1999)
Physical activity level (Active Australia Survey; Brown et al., 2004)
Sleep quality (Pittsburgh Sleep Quality Index; Bertolazi et al., 2011)
Anxiety and depression (CES-D Scale; Batistoni et al., 2007)
Perceived social isolation (Friendship Scale; Hawthorne et al., 2013)
Disability related to low back pain (Roland Morris Disability Questionnaire; Costa et al., 2007)
Pain intensity related to low back pain (Visual Analogue Scale; Scrimshaw & Maher, 2001)

Note: Peas-in-a-Pod questionnaire: For twins under 18 years old, score ranges from 3 to 10, with scores up to 6 indicating monozygotic twins. For adults, both twins have to complete the questionnaire and their scores are added together to have a final score ranging from 6 to 20, with a score from 6 to 13 indicating monozygotic twins. EuroQol-5D-3L: Assess health-related quality of life in five dimensions (i.e., mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) and a visual analogue scale with endpoints of 'best imaginable health state' set at 100 and 'worst imaginable health state' at 0 to assess self-reported quality of life. Physical Workload Index: 19 items assess how often individuals stay in different work situations. Active Australia Survey: Assesses physical activity level over the last 7 days. Pittsburgh Sleep Quality Index: Score ranges from 0 to 21, with greater scores indicating worse sleep quality. CES-D Scale (Center for Epidemiological Studies-Depression Scale): Score ranges from 0 to 20, with greater scores indicating higher depressive symptoms. Friendship Scale: Score ranges from 0 to 24, with smaller scores indicating more isolation. Roland Morris Disability Questionnaire: Score ranges from 0 to 24, with greater scores indicating more disability related to low back pain. Visual Analogue Scale: Score ranges from 0 to 10, with greater scores indicating higher low back pain intensity.

experienced low back pain also provide the duration of the episode, number of episodes in their lifetime, and previous treatments. If participants report low back pain at baseline, their low back pain related disability and level of symptoms are assessed using the Roland Morris Disability Questionnaire (RMDQ; Costa et al., 2007) and the Visual Analogue Scale (VAS; Scrimshaw & Maher, 2001), respectively.

Twins are followed for 1 year with information on experience of low back pain and its associated levels of symptoms collected 3, 6, 9, and 12 months after baseline. At baseline, participants are presented with a 12-month calendar and they are asked to report days with low back pain and its associated level of symptoms using the VAS (Scrimshaw & Maher, 2001) to facilitate recall of low back pain. Follow-ups are collected by study researchers in person, over the telephone, or electronically.

### Zygoty Assessment in the BTR

Twins' zygoty is assessed by the Portuguese version of the Peas-in-a-Pod questionnaire. The three-question questionnaire was developed and validated to assess zygoty through twins' or twins' parents or guardians' self-reports, obtaining around 95% accuracy (Ooki & Asaka, 2004). It has been used previously in other studies and is currently used by the Australian Twin Registry (Ooki & Asaka, 2004; Rietveld et al., 2000). For adults, both twins have to complete the questionnaire, and their scores are added together to have a final score ranging from 6 to 20 with a score from 6 to 13 indicating monozygoty.

### Access to the BTR

Twins are coded and their protected data are stored at the BTR database. The BTR research team and collaborators may access stored data to investigate the contribution of genetic and environmental factors in the development of common diseases, phenotypes, and human behavior traits. The Brazilian scientific community and international researchers may access stored data using a standardized form or propose research projects to collect further information from twins in the BTR. In this case, research projects have to be approved by the BTR research team and the ethics committee of the host institution.

### Future Development and Plans

The BTR is in its development stage with a promising future. The BTR has organized the first national twin festival (The first Brazilian Twins' Festival at UFMG, Minas Gerais, in 2016) and has supported other festivals of twins in Brazil (e.g., the first Twins' Festival at Rio Grande do Norte). Approximately 200 twins attended these festivals. As a result of our campaigns and collaborations, the BTR has identified thousands of twins who are being currently contacted to be registered. The BTR research team is acting in collaboration with twin research groups in São Paulo (São Paulo University), Rio Grande do Norte (Federal University of Rio Grande do Norte), and Santa Catarina (Federal University of Santa Catarina). Through this process and the quality of the data being collected, we expect to significantly contribute to improving the health of all Brazilians and

establish a rich platform for Brazilian and international researchers.

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