INSTRUCTION MANUAL
BAFRIC PROTOCOL

ASSESSMENT BATTERY FOR INTEGRATED RISK FACTORS FOR BREAST CANCER

Estélio Henrique Martin Dantas; Heriberto Alves dos Anjos; Vicente Clemente Suarez; Guilherme Eustáquio Furtado; Rodrigo Cerqueira Simão; Millena Angel Silva Rodrigues

ABOUT THE PROTOCOL

The BaFRIC (Integrated Cancer Risk Factors Assessment Battery) was developed and validated through a methodological, quantitative, exploratory, and descriptive study.

Its objective is to comprehensively assess cancer risk factors—such as environment, diet, epigenetics, physical activity, and mental health—in adults. The instrument demonstrated high internal consistency, with a Cronbach's alpha coefficient of ≥ 0.8, confirming its reliability.

BaFRIC is a product of the Cancer and Exercise Research and Working Group (GTP) at the Laboratory of Human Motor Biosciences (LABIMH).

I. About the Instrument (BAFRIC)

Definition

The Integrated Cancer Risk Factors Assessment Battery (BaFRIC) is a comprehensive, integrated assessment tool developed to quantify cancer risk. The instrument synthesizes complex interactions among biological, environmental, and behavioral factors into a single cancer risk score.

Context

The development of BAFRIC is justified by the need for an accurate assessment of the epigenetic and mutational risks associated with cancer in order to provide personalized and effective care. The literature review indicated that existing assessment tools did not sufficiently integrate these factors, leaving a significant gap in clinical practice and scientific research.

An integrated assessment is crucial, as cancer development occurs through mutagenic factors (agents that cause DNA mutations, such as ionizing radiation and chemicals) and epigenetic modifications (which can be influenced by lifestyle and environmental factors). Understanding these factors is essential for providing an integrated and accurate assessment of patients, leading to effective treatment and continuous improvement in care. BAFRIC aims to fill this gap by offering a systematic and validated method for identifying and quantifying these risks.

Battery Structure

BAFRIC was designed to provide an integrated assessment of multiple cancer risk factors. The dimensions of cancer risk, based on a literature review and the brainstorming technique, are:

1. **Nutrition** (Diet).
2. **Epigenetics.**
3. **Physical Exercise.**
4. **Environmental Ecology (Environment).**
5. **Mental Health.**

In addition to the questionnaire's dimensions, the battery assesses dermatoglyphics (arch-type pattern) as an epigenetic marker for identifying epigenetic predispositions in cancer patients.

Target Audience

The target population for the study that validated BaFRIC consists of adults aged 18 and older who are volunteers diagnosed with primary cancer, including those currently undergoing treatment and cancer survivors.

Validity and Reliability

The development of the BaFRIC followed a quantitative, exploratory, and descriptive methodological design, carried out in four distinct stages, including the Determination of Scientific Validity (Face and Content Validity) and the Assessment of Reliability and Objectivity.

The instrument demonstrated high internal consistency, with a Cronbach's alpha coefficient of ≥ 0.8.

The results confirmed the validity, reliability, and objectivity of the BAFRIC:

- Content and Face Validity: Content and face validity were demonstrated using the Delphi method. The Content Validity Index (CVI) was high for all criteria, such as a CVI of 0.93 for Construct (content) and 1.0 for Objectivity.
- Reliability (Intra-Rater Error): Intra-rater reliability, measured by the Intraclass Correlation Coefficient (ICC), ranged from 0.975 to 1.000 for the dimensions, classifying it as Excellent.
- Objectivity (Inter-Rater Reliability): Inter-rater reliability was also rated as Excellent, with ICC values ranging from 0.996 to 1.000.

BAFRIC Components and Application Procedures

BAFRIC, which was developed and validated in a methodological, quantitative, exploratory, and descriptive study, consists of data collection through medical history and questionnaires, as well as the evaluation of dermatoglyphics.

A. Medical History (Preliminary Information)

- Objective: To collect personal and contact information, as well as specific details regarding the diagnosis and treatment of cancer patients, in order to understand each individual’s medical history and specific needs.
- Content: The medical history should include the following information:
  - Personal and Contact Information: Full name, age, gender, phone number or email address, education level, place of residence, and marital status.
  - Diagnosis Information: Type of cancer, location, and stage.
  - Treatment and Side Effects: Details about treatments received or currently undergoing (such as chemotherapy and radiation), as well as side effects experienced during and after these treatments.
- Scoring/Scale: Not applicable. The medical history serves to gather qualitative and contextual data to personalize and inform patient care.

B. Dimension: Food

- **Content:** The questions focus on dietary habits that affect cancer prevention. The topics covered include:
  - **Consumption of Ultra-Processed Foods and Fast Food:** Examining products high in sodium, sugars, saturated fats, and chemical additives.
  - **Consumption of Processed Meats:** Such as bacon and sausages, given their proven association with an increased risk of cancer.
  - **Preventive Dietary Practices:** The importance of including antioxidant-rich foods, fruits, vegetables, and whole grains, which protect against cellular damage.
  - **Organic Foods:** Questions regarding the consumption of organic foods to reduce exposure to pesticides and potentially harmful chemical compounds.
  - **Professional Guidance:** Seeking guidance from healthcare professionals on the relationship between diet and disease prevention.
- Score/Scale: This dimension is standardized on a common scale from 0 to 10, where higher scores indicate a higher risk of cancer.

C. Dimension: Epigenetics

- Content: The questions examine factors related to cancer risk, taking into account genetic, environmental, and behavioral aspects. The items include:
- Hereditary Predispositions: Family history of genetic mutations and genetic testing.
- Exposures/Interventions: The influence of medical exposures and interventions—such as chemotherapy, radiation, pollution, smoking, and exposure to chemicals—that may impact the expression of cancer-associated genes.
  - Epigenetic Expression (Dermatoglyphics): In addition to the questionnaire, dermatoglyphic patterns (such as arches (A), loops (L), whorls (W), the number of deltas (D10), and the total sum of lines (SQTL)) are evaluated to identify epigenetic predispositions.
- Score/Scale (Questionnaire): The Epigenetic dimension (questionnaire) is standardized on a common scale from 0 to 10, where higher scores indicate greater risk.

- Score/Scale (Dermatoglyphics): Dermatoglyphics (specifically the “Arch” pattern) is a variable that contributes to the overall index and is standardized on a scale from 0 to 10. Evidence suggests that a higher number of “Arches” corresponds to a higher cancer risk.

D. Dimension: Physical Activity

- **Content:** The questions explore the relationship between an active lifestyle and disease prevention, examining different types and intensities of physical activity, including:
  - **Light, Moderate, and Vigorous Activities:** Such as walking, water aerobics, high-intensity interval training (HIIT), and high-impact aerobics (e.g., jump, step, Zumba).
  - Sedentary Lifestyle: An individual's level of awareness regarding the risks of a sedentary lifestyle and its negative impact on health, given the strong correlation with an increased risk of cancer.
  - Intention to Remain Active: The intention to maintain a regular exercise routine to prevent disease and promote long-term health.
- Scoring/Scale: This dimension is standardized on a common scale from 0 to 10. It is the only variable whose scale is inversely scaled; that is, higher values indicate lower risk. To correct for this when calculating the BaFRIC Index, the expression (10 − Fiscal Year) is used.

E. **Dimension: Environmental Ecology**

- **Content:** The questions assess personal and environmental risk factors that may contribute to the development of cancer. They include:
  - Personal/Family History: Family history of cancer (indicating genetic predispositions), presence of chronic stress or chronic inflammatory diseases (such as arthritis or inflammatory bowel disease) that affect the immune system.
  - Health Habits: Sleep quality and quantity, excessive alcohol consumption, and smoking.
  - Exposure to Toxic Substances: Exposure to toxic substances (such as asbestos, pesticides, and chemicals) and heavy metals (lead and mercury).
  - Medical Care: Access to resources for ongoing health monitoring and regular medical checkups.
  - Environmental Policies: An assessment of the importance of effective environmental policies in preventing exposure to carcinogens.
- Scoring/Scale: This dimension is standardized on a common scale from 0 to 10, where higher scores indicate greater risk.

F. Dimension: Mental Health

- Content: The questions address self-care and the psychological impact on physical health. The topics include:
  - Stress and Diagnoses: Frequency of everyday stress and diagnosis of mental disorders.
  - Support and Leisure: The existence of a strong social support network and the maintenance of a balanced lifestyle, including time for leisure.
  - Coping Strategies: Open communication about feelings and emotions, practicing relaxation techniques (such as meditation or yoga), and seeking professional help to maintain mental health.
  - Cancer and Emotions: Seeking Professional Help and Beliefs About the Relationship Between Chronic Negative Emotions (Such as Depression) and Cancer Risk.
- Score/Scale: This dimension is standardized on a common scale from 0 to 10, where higher scores indicate greater risk.

Objective

Dermatoglyphics is included in BaFRIC as a component of the epigenetic assessment. The objective of this section of the protocol is to evaluate dermatoglyphic patterns (epidermal patterns present on the fingers) to identify predispositions to medical conditions, including cancer. The BaFRIC study, in particular, demonstrated that the Arch (A) pattern was more prevalent in the cancer group (CM) (1.50) compared to the control group (1.34), and this finding was statistically significant ($p = 0.043$).

Materials Needed

To collect and analyze fingerprints, the following instruments are required, in accordance with the digitization protocol:

- High-Resolution Digital Scanner.
- Salus® Software.
- Optical Scanner.



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Sample Collection Protocol

Fingerprint collection follows the classic protocol developed by Cummins and Midlo (1961), but is performed electronically to ensure accurate image capture, similar to other dermatoglyphic protocols such as Sports Talent and VOCSPORTS.

The procedure includes the following steps:

1. Finger Placement: The distal phalanx of each finger is placed on the scanner, starting with the left little finger and proceeding sequentially to the right little finger.
2. Rolling: The finger should roll across the scanner in a circular motion, moving from right to left or from left to right, until it reaches the opposite side of the phalanx.
3. Repetition: The procedure is repeated for all fingers on both hands.



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4. Image Processing: The captured images are processed, converted into binary codes, and binarized.
5. Manual Annotation: The evaluator must manually annotate the nucleus and delta points. The Galton Line is defined as a straight line between the center of the nucleus and the delta visible in the image.
6. Quantitative Analysis: The software performs qualitative and quantitative analysis, including the counting of digital lines.

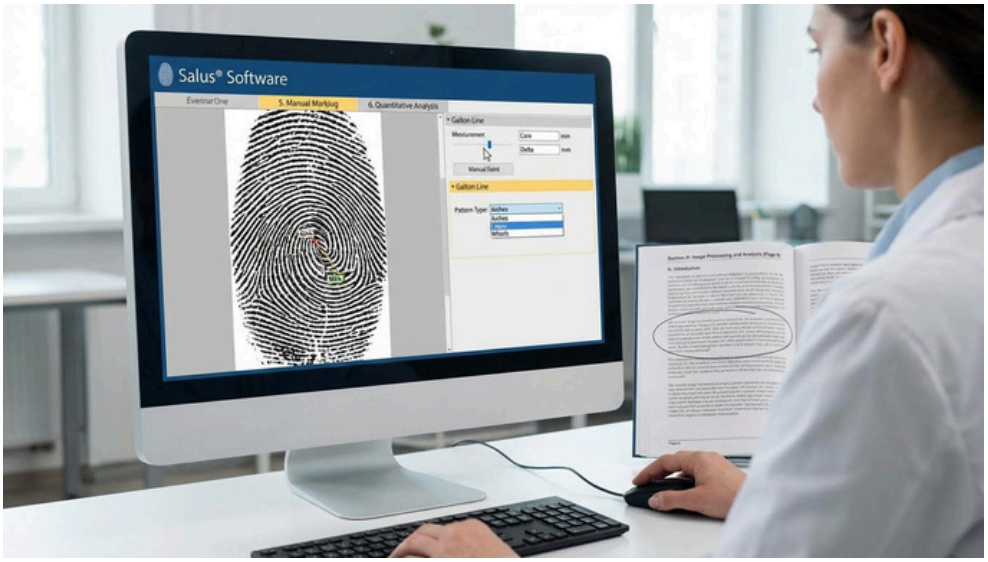


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Measured Variables

The Salus method is used to identify epigenetic predispositions based on the following patterns:

- **Arcs (A).**
- **Loops:** including the Ulnar Loop (LU) and Radial Loop (LR).
- **Whorls:** including the Whorl (W) and Secondary Whorl (WS).
- **Number of Deltas on the 10 fingers (D10).**
- **Total Sum of Lines (SQTL).**

Scoring/Scale (Dermatoglyphics)

The Dermatoglyphics variable (Arch pattern) is one of the dimensions used to calculate the BaFRIC Index.

- All BAFRIC variables are standardized on a common scale from 0 to 10.
- Higher values on this scale indicate a higher cancer risk.
- The inclusion of the Arch (A) pattern is based on evidence of a correlation between Arch-type fingerprint patterns and a predisposition to potentially carcinogenic cellular changes.
- The Dermatoglyphics (Arc) variable is included such that a greater number of arcs corresponds to a higher cancer risk.

IV. Calculation and Classification of the BaFRIC Index

The BAFRIC Index is a weighted average—a mathematically sound method for aggregating the results of various cancer risk tests. It compiles the results of all standardized variables (0 to 10) to provide a single risk score.

General Index Formula

The BAFRIC Index is calculated as the weighted average of the variables, according to the following formula:

$$\text{Índice BAFRIC} = (0,20 \times \text{ALIM}) + (0,20 \times \text{EPIG}) + (0,15 \times (10 - \text{EXER})) + (0,15 \times \text{AMB}) + (0,15 \times \text{SM}) + (0,15 \times \text{DERM})$$

Legends:
ALIM: Diet
EPIG: Epigenetics
EXER: Physical Exercise
AMB: Environment (Environmental Ecology)
SM: Mental Health
DERM: Dermatoglyphics (Arc Pattern)

Weighting

The weights assigned to the variables were based on the theoretical and empirical relevance of each dimension in the literature on cancer development. The total sum of the weights equals 1.0, ensuring proportionality and comparability among the factors.

Dimension	Weight
Diet	0,20
Epigenetics	0,20
Physical Exercise	0,15
Environment (Environmental Ecology)	0,15
Mental Health	0,15
Dermatoglyphics (Arc Pattern)	0,15

Note on Physical Activity: The Physical Activity dimension is the only one whose scale is inverted (higher values indicate lower risk). The expression $\mathbf{(10 − \text{Physical Activity})}$ in the formula represents the inversion of the scale, ensuring that higher levels of physical activity reduce the total risk score while maintaining consistency in the direction of the effects.

Risk Classification

The values derived from the BaFRIC Index are classified into four risk categories, defined based on the quartiles of the sample distribution:

Quartile	Ranking	Interpretation
1th Quartile	High Risk	A marked presence of predisposing factors; a need for immediate intervention and intensive follow-up.
2th Quartile	Moderate Risk	Risk factors that are present but manageable; this requires adjustments and ongoing monitoring.
3th Quartile	Low Risk	Protective behaviors are prevalent; maintaining preventive habits is recommended.
4th Quartile	Minimal Risk	A highly protective profile, with practices that support cancer prevention.

V. Instrument

Questions - Answers (0) Strongly Disagree (1) Disagree (2) Neutral (3) Agree (4) Strongly Agree (5)

FOOD
Do you eat processed foods and fast food regularly? Answer: [_]
Do you avoid eating too much processed meat (such as bacon, sausages, and deli meats) because of the associated risk of cancer? A: [_]
Do you try to include antioxidant-rich foods, such as berries and leafy greens, in your diet to prevent cancer? A: [_]
Do you believe that a diet rich in fruits, vegetables, and whole grains is essential for cancer prevention? A: [_]
Do you try to eat organic foods to reduce your exposure to pesticides and other chemicals that may be linked to cancer? A: [_]
Are you looking for advice from healthcare professionals on the relationship between diet and cancer prevention? A: [_]
Are you looking for nutritional support to help prevent cancer? A: [_]
EPIGENÉTICA
Do you have a family history of known genetic mutations? A: [_]
Have you ever had genetic testing to check for a predisposition to cancer? A: [_]
Have you ever undergone medical treatments, such as chemotherapy or radiation therapy, that might have influenced epigenetic changes? A: [_]
Have you ever been exposed to environmental factors known to cause epigenetic changes, such as smoking, pollution, or exposure to certain chemicals? A: [_]
Have you ever tried to avoid exposure to harmful chemicals because you know they can cause epigenetic changes associated with cancer? A: [_]
Are you aware that epigenetic changes can be reversed, which may help prevent cancer? A: [_]

VI. Instrument (Continued)

PHYSICAL EXERCISE
Do you engage in light activities such as walking, light gardening, stretching, light housework, climbing stairs, or Pilates? A: [_]
Do you engage in moderate-intensity activities such as ballroom dancing, walking a little faster or jogging, water aerobics, dancing, gardening, cycling on flat terrain, or light swimming? A: [_]
Do you engage in intense activities such as running, sports training, high-impact aerobics, or high-intensity interval training (HIIT)? A: [_]
Do you exercise regularly to help prevent cancer? A: [_]
Do you adjust your exercise routine to make sure you stay active even with a busy lifestyle? A: [_]
Do you avoid a sedentary lifestyle because you know it's linked to a higher risk of cancer? A: [_]
ENVIRONMENT
Do you have access to resources for ongoing health monitoring and regular medical checkups? A: [_]
Do you sleep less than 8 hours a day? A: [_]
Have you ever been exposed to toxic substances at work or at home (e.g., asbestos, pesticides, chemicals)? A: [_]
Do you try to avoid exposure to heavy metals, such as lead and mercury, to protect my health? A: [_]
Do you believe that effective environmental policies are essential for cancer prevention in the general population? A: [_]
Do you try to avoid exposure to environmental pollutants, such as vehicle exhaust and industrial chemicals, to reduce your risk of cancer? A: [_]
MENTAL HEALTH
Do you practice relaxation techniques, such as meditation or yoga, to maintain your mental health and help prevent conditions such as cancer, anxiety, depression, or high blood pressure? A: [_]
Do you believe that treating cancer patients can have a negative impact on your personal or professional life? A. [_]

Do you practice relaxation techniques, such as meditation or yoga, to maintain your mental health and help prevent conditions such as cancer, anxiety, depression, or high blood pressure? A: [_]
Do you talk openly about your feelings and emotions with people you trust to take care of your mental health? A: [_]
Do you have a strong social support network—that is, people close to you whom you can count on during difficult times or to share your joys with? For example, friends who offer emotional support, family members who help out in complicated situations, or coworkers who are willing to pitch in when needed? A: [_]
Do you experience episodes of daily stress, such as moments when you feel pressure, worry, or irritation due to everyday situations—like being stuck in traffic when you're running late, getting scolded at work for something that wasn't your fault, or forgetting an important deadline and having to rush to get everything done at the last minute? Even if these are small things, do they happen often and end up bothering you or making you feel overwhelmed? A: [_]
Have you ever gone to therapy—or are you currently in therapy—to take care of your mental health? A: [_]
Have you ever been diagnosed with a mental health disorder (depression, bipolar disorder, schizophrenia and other psychoses, dementia, intellectual disability, and developmental disorders, including autism)? A: [_]

MEDICAL HISTORY	
Full name	
Age	
Sex	
Phone/Email	
Education	
Place of residence	
Marital status	
Describe your diagnosis. Type of cancer (location).	
Occupation	

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