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**Title of Thesis:** Prediction and Measurement of Human Body  
Composition using non-invasive Techniques

## **ABSTRACT**

The study of human body composition has been in use for several decades. The body composition assessment is generally linked to the determination of the relative amount of fat in the body having applications in several fields of study such as medicine, public health, nutrition, health and fitness, and exercise science. The body composition assessment partitions the body into quantifiable components, representing the primary tissue or chemical components of the human body. Body composition analysis is used in preventative, therapeutic and research applications such as nutritional assessment, anti-aging therapy, physical performance assessment, weight management, obesity, fluid and nutritional assessment etc. After a thorough look at the available literature of the various body composition methods, Bioelectrical Impedance Analysis (BIA) technique was identified as the research tool for the current work being the most viable, simple, multi-purpose and non-invasive futuristic body composition technique having a wide range of applications. The preliminary study resulted into identification of the following issues which needed to be addressed for the work of “*Prediction and Measurement of Human Body Composition using non-invasive Techniques*”.

- A deep investigation and understanding of the Cole Impedance model which forms the basis for BIA research.
- Use of multi-frequency BIA method for determination of body composition of healthy Indian adult population of both sexes belonging to different age groups.
- Analysis and comparison of this data with other available body composition data.
- Measurement of BIA phase angles for the above reference population and comparison of the results with other ethnicity based reference values.
- Current developments in clinical and non-clinical applications of BIA
- Any other issues / explanations arising as part of this study.

The body composition results obtained from the current population study confirm the utility of multi-frequency BIA measurements for body composition estimation. It has also shown consistency of the body composition results in comparison to other population studies. However, some extreme differences have been observed in the correlation coefficients between height and ECW/ICW ratio of males and females (0.076 and 0.90 respectively) which could not be explained. A modified BMI (MBI) formula has been suggested using BMI correction factor  $\gamma$  which makes MBI of much more practical utility to the health-care specialists. This proposed correction factor  $\gamma$  has a value between 0 and 1. By using the data from the current study the value of  $\gamma$  has been derived as 0.67. By substituting  $\gamma = 0$  in the above expression, MBI formula gets converted to the original BMI formula.

The 50 kHz phase angle value has proved its importance beyond the body composition prediction equations in estimation of health condition of an individual. Clinically, the most established impedance parameter is the phase angle for the diagnosis of malnutrition and clinical prognosis, both associated with changes in cellular membrane integrity and fluid imbalance. The phase angle values obtained from various population studies including the current one have established that the maturity age for males and females is achieved in the age-group of 20-29 years when their cellular health is at its best. The in-general low phase angle values observed for Indian adults could be linked to malnutrition, lack of exercise and/or unawareness about healthy food habits. Further the comparatively shorter average life span of Indians compared to the US citizens (69 years vs. 78 years) as reported in the World Fact-book could also be traced to the smaller phase angles.

India has the second largest population and is amongst the fastest developing economies of the world but when it comes to the healthcare facilities, a large disparity is observed between the urban elite class and the rural uneducated laborers. The unhygienic living conditions, lack of proper food, the general ignorance about healthy habits, stressful work environment, lack of physical activity etc have created the largest number of cancer, kidney, diabetic, cardiac and AIDS patients in the country. To effectively deal with such a situation, the country needs a simple, inexpensive but effective clinical tool which could help to monitor the general health condition of the people and diagnose the large scale medical problems of the population. BIA is one such technique which has proven its capability to meet such a challenge. The healthcare specialists also need to be made aware about the developments in this upcoming field so that the benefit of this technology could become available to the masses at affordable cost.