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### RESEARCH ARTICLE

## FUNCTIONAL IMPACT OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION IN THE MANAGEMENT OF POST STROKE HEMIPLAGIA IN BAFOUSSAM REGIONAL HOSPITAL, CAMEROON

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### Abstract

**Introduction:** Hemiplegia is the first cause of physical and mental handicap in adults with an incidence of 1.5 per 1000. Death arises principally during the first six months; the mortality rate is estimated at 25% for the first month. There are many rehabilitative methods for this handicap but this research was focused on the Proprioceptive Neuromuscular Facilitation (PNF). This PNF aims at improving motor responses but it is not yet effectively implemented in the rehabilitative protocol of post stroke hemiplegic patients in the Bafoussam Regional Hospital. The main objective was to evaluate the impact of PNF in the rehabilitation of post stroke hemiplegic persons.

**Methods:** This study was an interventional study which took place at the Regional Hospital of Bafoussam. We included in this study post stroke hemiplegic persons undergoing rehabilitation in the physiotherapy unit and who consented to participate. We had 2 groups: the case group which received PNF and the control group which received only the classical protocol of the hospital.

**Results:** The results of this study show that both PNF and classical therapy improved muscular strength, range of motion, equilibrium and functional independence but, the PNF+ group generally had better scores especially at the level of functional independence with a statistically significant difference (p-value=0.0194).

**Conclusion:** PNF in this study seems to be more efficient in the management of post stroke hemiplegia in this context and should be recommended in the Physiotherapy unit of the above hospital. There is also need for similar studies to be implemented in other hospital contexts in the country and with larger sample sizes to better appreciate this efficiency.

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### Introduction:-

Stroke constitutes one of the deadly and paralyzing pathologies of the central nervous system. According to the World Health Organization, it is one of the major public health problems (1). Actually in developing countries

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stroke holds the third position of mortality rate behind heart disease and cancers. Though absent in the past, cardiovascular diseases (stroke inclusive) are now emerging in Sub Saharan Africa and by 2020 will become one of the most severe public health problems in the region (2). Its morbidity and mortality has become higher in African patients (3). In Cameroon stroke is a real public health problem killing even more than road accidents. In a long term it cause neurological handicap and presently is the second cause of mortality after infectious diseases in Cameroon. Stroke occurs every 5 hours in the country with a mortality rate of 25% within the first month and of 60% within 5 years (4).

Hemiplegia is usually linked to neurological disorders notably stroke and generally come with a good number of manifestations which could be cognitive, gestural, postural or movement problems (5,6). It is the first cause of physical and mental handicap in adults with an estimated prevalence of 5-8 in 1000 (2). Neurological problems linked to hemiplegia like problems of balance and movement are responsible of the limitation of displacement and partial or total dependence in routine day-to-day activities. They lead to the physical handicap that cause falls and fractures thus one of the major causes of hospitalization and increases expenditures to the family (2). Rehabilitation post stroke to mobilize the motor function of the nervous system can be done using several methods (7). Handicap International recommends physical treatment giving more weight to global management like the PNF method (2). This method also known the KABAT method intervenes on both the voluntary and automatic motor reflexes. It is a manual muscle reinforcement method realized following a tridimensional scheme with aim to facilitate movements, limit pathological movements and modulate muscular tonus (8,9).

It should be noted this method is not used in the Physiotherapy unit of the Regional Hospital of Bafoussam. Here the personnel available use only the classical method which constitutes electro-stimulation of the weak muscles, thermotherapy, massage, stretching, ergotherapy etc. This study was thus implemented to find out the impact of PNF in functional rehabilitation of post stroke hemiplegia. The hypothesis was that PNF will be more beneficial to the patients thus providing suggestion or not for it to be integrated in the treatment protocol of the Physiotherapy unit of the Regional Hospital of Bafoussam. More specifically this study tried to demonstrate the feasibility and efficacy of the PNF in the management of hemiplegia in the context of post stroke patients visiting the Physiotherapy unit of the Regional Hospital of Bafoussam for rehabilitation.

### **Methodology:-**

This was an interventional study conducted in the Regional Hospital of Bafoussam upon authorization from the National Ethics Committee for Human Health Research (N° 2016/02/717/CE/CNERSH/SP) in addition to the Administrative Authorization from the Director of the Regional Hospital of Bafoussam. This Hospital is the reference in the West Region of Cameroon having a very functional Physiotherapy unit amongst other units. Included in this study were post stroke hemiplegia patients in the rehabilitation phase and conscious enough to give their consent to participate in the study. Here the first 20 patients who consented to participate were recruited and divided into case (PNF+) and control (PNF-) groups. The participants were received 5 times per weeks for 6 weeks; the control group receiving the normal classical method of rehabilitation meanwhile the case group was rehabilitated using the classical method above followed by rehabilitation in according to the PNF method. The data was collected using some functional parameters of their rehabilitation and was analyzed using the software Epi Info v7 as well as results graphically presented using the software GraphPad Prism v6. From the data, frequencies and means were calculated where appropriate. This was followed by comparison of the mean degree of amelioration of both groups after intervention, this done using the test of student with significance set at 5%.

### **Results:-**

In total 20 participants were included in this study, age ranging from 36 years to 74 years and with a mean age of 60.15 years ( $\pm 11.63$ ). This study population was dominated by male participants (60%) and most of them were civil servants or traders (21.0% for each). These participants constituting more than 80% of Christians and came from towns like Bafoussam (73.7%), Foumban (10.5%), Douala (10.5%) and Dschang (5.3%). Only 10.5% of them were illiterates with 21.1% reaching higher education and also 72.2% of them being married. All these participants had done a scan showing they had stroke (ischemic; 52.2%, hemorrhagic; 36.8% and transitory ischemic accident; 10.5%). About 44.4% of these participants had stroke dating about a month, 5.6% dating between 1-2 months and 27.8% dating more than 3 months. Also from their medical history, 93.3% of these participants were suffering from high blood pressure and 6.7% from diabetes. Amongst the problems faced by these participants, the most frequent ones were facial paralysis, aphasia, urinary incontinence and hemiparesia.

When the muscular force of the inferior limb was evaluated, results showed a net amelioration from the mean muscular force of 2.8 ( $\mu=0.7$ ) before intervention to 3.7 ( $\mu=0.7$ ) after intervention in the PNF+ group. In the PNF- group, the same trend was noted with mean muscular force changing from 2.7 ( $\mu=1.3$ ) to 3.4 ( $\mu=4.1$ ). The mean degree of amelioration (as show in figure 1 below) was thus in favor of the PNF+ group with 0.9 as compared to 0.7 in the PNF- group though this difference was not statistically significant ( $p$ -value=0.7874).

#### Keywords

PNF + : Case group (classical method + PNF method)

PNF - : Control group (classical method only)



: Before Intervention



: After Intervention

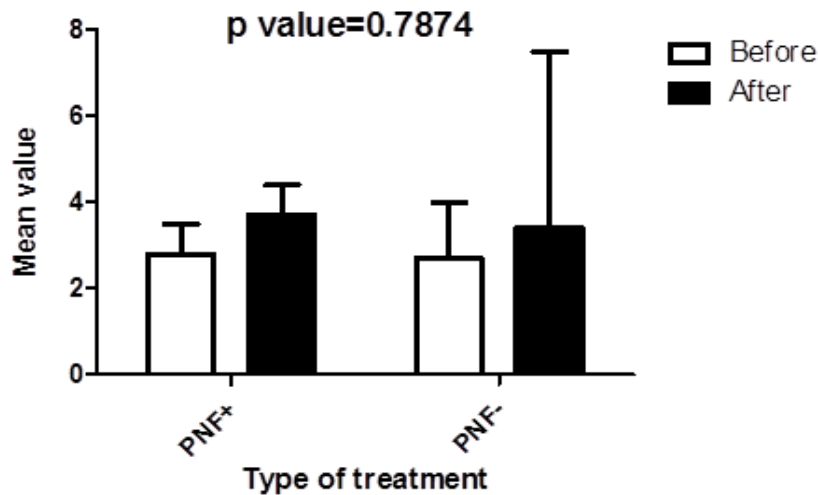


Figure 1:- Inferior limb Muscular Force of participants

Spasticity was evaluated on a total of 5 points (0 being good and 5 being bad) and a slight aggravation of spasticity was noted in the PNF+ group (with degree of amelioration of -0.3) while spasticity in the PNF- group remained constant. As shown on figure 2 below, this difference also was not statistically significant ( $p$ -value=0.647).

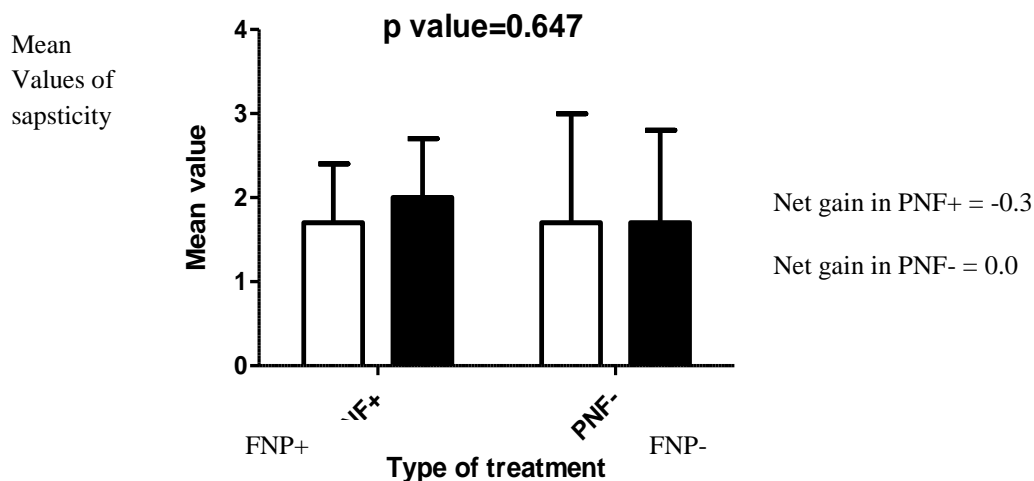
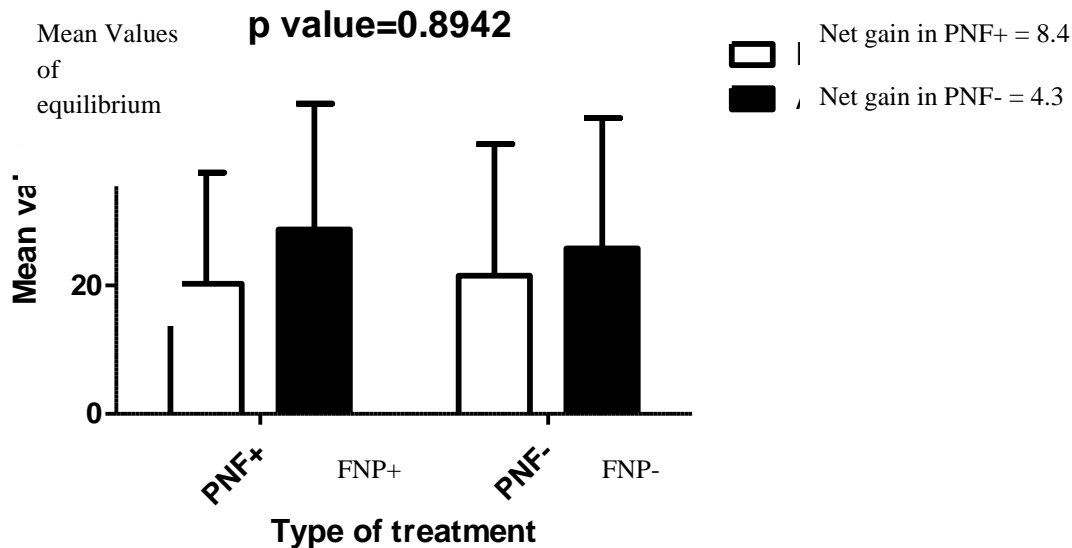


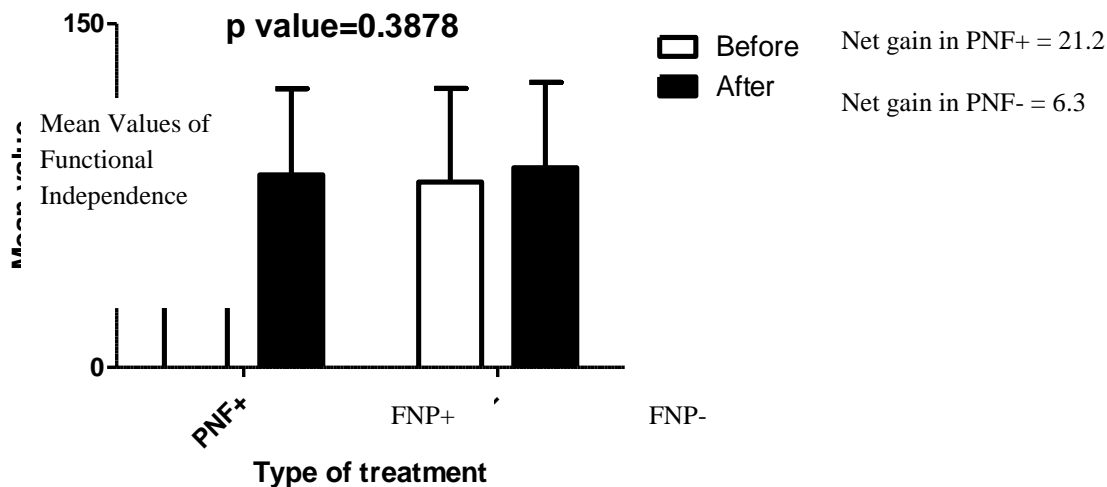
Figure 2:- Mean spasticity of participants

On the 56 points for equilibrium following the scale of Berg (Figure 3 below), the PNF+ group had an amelioration from 20.3 points ( $\mu=17.3$ ) before intervention to 28.7 points ( $\mu=19.6$ ) after intervention as compared to the PNF- group with change from 21.5 points ( $\mu=20.49$ ) to 25.8 points ( $\mu=20.26$ ). Even though the difference between PNF+ and PNF- was about 2 folds greater in favor of the first group, it was still not statistically significant ( $p$ -value=0.8942).



**Figure 3:-** Mean values of equilibrium following the scale of Berg

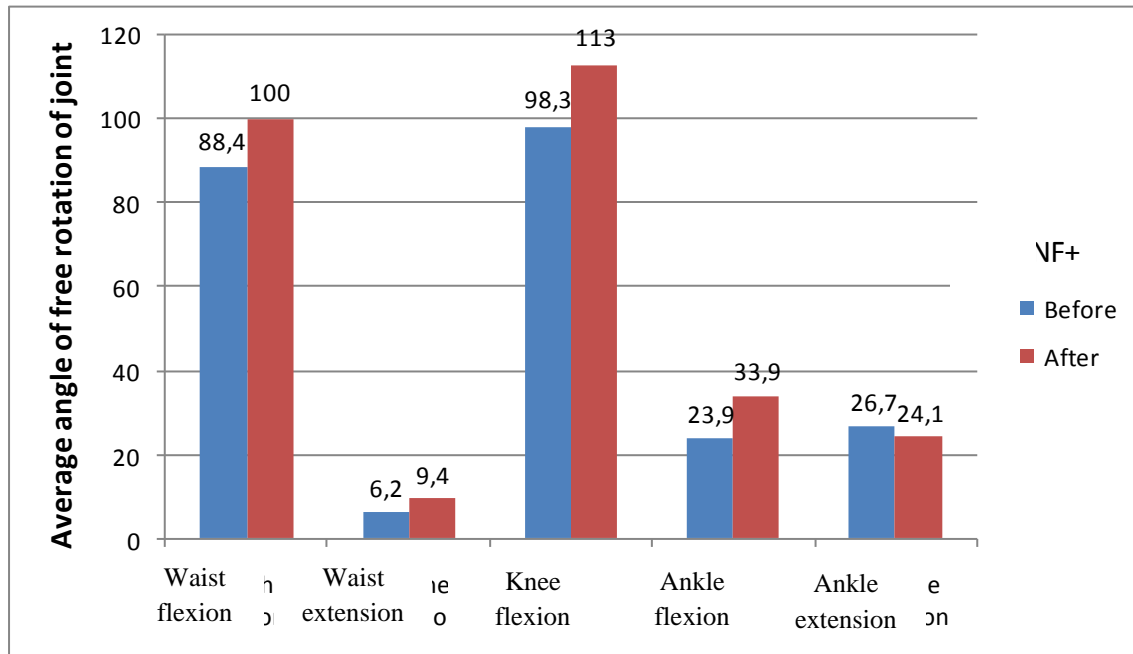
When evaluating the functional independence of the participants, it was noted as shown in figure 4 below that the PNF+ group had net degree of increase of 21.2 points and 6.3 points for the PNF- group. This difference was statistically significant with the net gain in the PNF+ being practically triple the value in the PNF- ( $p$ -value=0.0194).



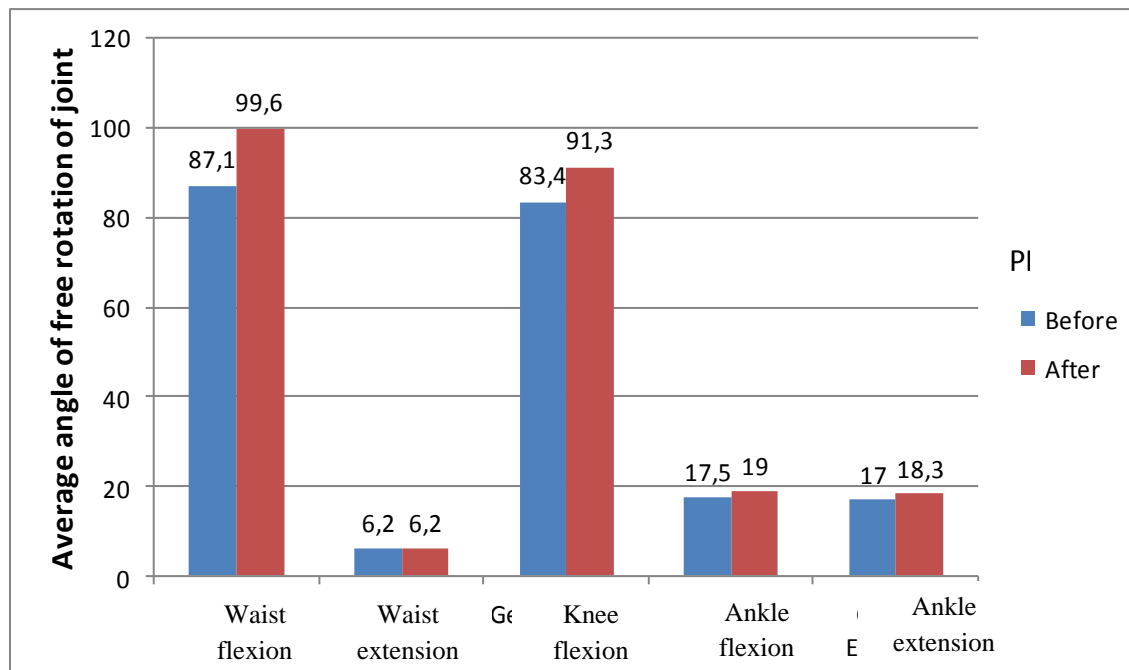
**Figure 4:-** Mean values of functional independence

Also other functional tests were conducted like the evaluation of functional deficiency using the scale of Orgogozo, postural evaluation as well as the degree of paralysis using the modified scale of Rankim. It was noted that in all the tests the degree of amelioration was always in favor of the PNF+ group as compared to the PNF- group with 16 points to 9.5 points, 6.5 points to 4 points and 0.9 points to 0.5 points for all three tests performed above respectively (graphs not shown).

As concerns the assessment of the degree of joint movements (as shown in figure 5 and 6 below), it was noted that the PNF+ group had a mean waist flexion of 88.4° before intervention and 100° after intervention, waist extension of 6.2° before and 9.4° after, knee flexion of 98.3° before and 113° after, ankle flexion of 23.9° before and 33.9° after and finally ankle extension of 26.7° before and 24.1° after. On the other hand the PNF- group had a mean waist flexion of 87.1° before intervention and 99.6° after intervention, waist extension of 6.2° both before and after, knee flexion of 83.4° before and 91.3° after, ankle flexion of 17.5° before and 19° after and finally ankle extension of 17° before and 18.3° after.



**Figure 5:-** Average angle of free rotation of joints in PNF+ group



**Figure 6:-** Average angle of free rotation of joints in PNF- group

**Discussion:-**

Many studies have been implemented in other countries on the effectiveness of PNF notably in USA, Congo, Japan just to name a few (10,2,11). This study involved 20 participants followed up for about 6 weeks (having 5 visits every week). The methodology used in this study is very similar to the experimental study conducted by Mulonsi in 2007 in which he compared the degree of amelioration of muscular force (as well as rotation of joint) before and after the implementation of both PNF and classical treatment methods using the test of student. This study had duration of implementation similar to that of Eun-Kyang et al in 2015 who evaluated the equilibrium of participants using scale of Berg as well as evaluating functional independence. In this study in the PNF+ group, PNF was carried out after classical exercises because its effects become more significant after physical exercise (10).

Results of this study show that the mean age of the participants was around 60 years which goes in accordance to those of the study of Kuate et al. carried out in Cameroon in 2011. Also ischemic stroke was the most frequent while the recorded risk factors in the medical history of the participants were high blood pressure and diabetes (2,12). This is explained by the vulnerability of aged persons to high blood pressure, diabetes and stroke due to their sedentary way of life, and other cardiovascular, metabolic and neurological problems (3,5,13). The male predominance noted in this study is similar to what was observed in the study of Mulonsi and can be justified by a higher vulnerability of men to high blood pressure and stroke than women (2, 14).

In a general perspective we noted better amelioration of muscular force and angle of joint rotation in the PNF+ group than the PNF- group even though most of the differences were not statistically significant. These results go in accordance with other studies like Kayla et al. carried out in USA and Salameh carried out in North Korea both showing the relatively higher efficacy of the PNF in ameliorating amplitude of joint mobility as well as flexibility and physical performance (2, 15). All of these results could become statistically significant given the time factor was longer than the 6 weeks for follow up (16). In the same line, it is worth noting though that the difference at the level of functional independence was statistically significant between the PNF+ and PNF- groups with p-value of 0.0194 which goes in accordance with the results of Eun-Kyang et al. in Japan who in 2015 found a significant result as concerns functional independence between the above groups.

This study had some weaknesses which negatively impacted its outcome. The first setback was the small sample size which is also very much linked to the short period of implementation of the study. We were unable to recruit enough persons to participate in the study due to the relatively low visit rate as well as could not follow up the recruited patients for a longer time. These somehow affected the power of the results obtained and the significance of the differences noted in the various functional tests. A larger scale implementation of this study including other treatment centers in the country will surely bring out the worth of the results obtained above thus permit the generalization of the results to the whole country.

**Conclusion:-**

Despite the fact that the above gotten results can't be generalized to the whole Cameroonian population, it is worth noting that in the context of the Physiotherapy unit of the Regional Hospital of Bafoussam, PNF seems to produce more results in the maintain and amelioration of the degree of mobility, muscular force and most importantly functional independence. PNF can thus be integrated in the routine treatment design of the Physiotherapy unit in this hospital for post stroke hemiplegic patients. Also this KABAT method should be included in the training scheme of kinesitherapy and/or rekindling of the method amongst those who already had the training through seminars. On the other in line with future research, this study can serve as base for other studies of the same kind being carried out in other treatment centers and on a larger scale maybe the results can be generalized thus providing a platform for the general reorganization of the treatment methods used in the various treatment centers nationwide.

**Declarations:-**

**Ethics approval and consent to participate:** This study was conducted upon approval by the National Ethics Committee for Human Health Research (N° 2016/02/717/CE/CNERSH/SP) in addition to the Administrative Authorization from the Director of the Regional Hospital of Bafoussam. Furthermore, each participant provided consent before participating in the study.

**Consent for publication:** N/A

**Availability of data and material:** The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** All the authors (EJFM, JJNN, SNC and AF) actively participated in the implementation of this study. EJFM collected all the data needed for the study as well as participated in the process of analysis, interpretation and drafting of this article. JJNN analyzed and interpreted the collected data as well as participated in the writing and translation of this article. SNC actively participated in the writing and English translation of this article. AF and JMT supervised all the aspects of this research study from planning to implementation and was very crucial in the interpretation, drafting and revision of this article.

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