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Original Article

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Effect of Smoking Cessation on Vascular Function by Measurement the Flow-Mediated Dilation: A Comparative Study

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Abstract

Smoking predisposes to endothelial dysfunction; however smoking cessation would have a beneficial effect on cardiovascular risk. The objective of this study was to evaluate the effect of smoking cessation on vascular function.

Methods: This is a comparative, prospective, descriptive, and multicenter study, carried out between March 2018 and April 2021 at two Health Services of the National Gendarmerie and at the Laboratory of Physiology and Functional Explorations of the Faculty of Medicine in Dakar, Senegal. The population included 45 consenting adult men, divided into 3 groups: active smokers, weaned smokers, and non-smokers. We assessed vascular function using the Flow Mediated Dilation (FMD) technique, which consisted of measuring the diameter of the humeral artery at rest and then every 30 seconds after its occlusion.

Results: Non-smokers showed better humeral artery dilation at T1 (30 seconds after occlusion release) with a higher mean FMD than the other 2 groups ($p = 0.0007$). In addition, FMD kinetics showed that control subjects as well as weaned subjects had better arterial compliance ($p < 0.05$) compared to active smokers. FMD1 values were positively correlated with smoking cessation duration ($p = 0.0411$; $R2 = 0.3374$).

Conclusion: Our results showed that stopping smoking improves vascular function and thus constitutes a means of preventing cardiovascular diseases, hence the need to promote smoking cessation in Africa and more particularly in Senegal.

Keywords: Smoking cessation, Vascular function, Flow mediated dilation, FMD cardiovascular risk.

Introduction

Smoking is currently a major public health problem and an important cardiovascular risk factor [1,2] due to its high morbidity and mortality. In 2020, 22.3% of the world's population used tobacco, including 36.7% of men and 7.8% of women[3].

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According to the WHO, 80% of smokers live in low-income countries and more than 10 million deaths per year are attributed to tobacco [4]. In Africa, smoking appears to be the most important risk factor for myocardial infarction in subjects aged under 45 [5,6]. The WHO estimates that 80% of these deaths will occur in low-income countries, particularly on the African continent [7].

In Senegal, the Global Adult Tobacco Survey (GATS) carried out in 2015 by the National Agency for Statistics and Demography (ANSD), found that around half a million (6.0%) of adults are active smokers, i.e. 11.0% of men and 1.2% of women [8].

It is also known that chronic tobacco intoxication is implicated in the occurrence of several pathologies such as cancers and chronic obstructive pulmonary disease (COPD)[9]. Furthermore, it increases the risk of heart attack, stroke, high blood pressure (hypertension), and arteritis [10]. Smoking also leads to impaired vascular function[11]

The mechanisms of tobacco's action on vascular function are not fully elucidated. However, they are probably linked to the presence of carbon monoxide and free radicals which will induce a reduction in the bioavailability and the action of endothelial vasomotor factors but also reduce the anti-fibrinolytic and anti-platelet aggregation effects of NO which can lead to disorders. hemostasis. All these mechanisms will in the long-term lead to an increase in cardiovascular risk [1,11,12].

The consequences of smoking are well recognized and understood, as are the benefits of quitting [9,13–15]. Several studies have reported the beneficial effect of smoking cessation on cardiovascular risk, particularly through the reduction of morbidity and mortality[16,17]. The objective of our study was to compare vascular function by measuring Flow Mediated Dialation in smoking, weaned and non-smoking subjects.

Materials and Methods

This was a multicenter, descriptive, transversal, prospective, and analytical comparative study carried out between March 2018 and April 2021, at the North Garrison Medical Center of Saint Louis, of the Health Service of the National Gendarmerie of the Caserne Samba Diéry Diallo of Dakar and the Laboratory of Physiology and Functional Explorations of the Faculty of Medicine, Pharmacy and Odontology of the Cheikh Anta Diop University of Dakar (FMPO/UCAD).

Population

The study population consisted of 45 adult male volunteers, aged over 18, and active military personnel. They were divided into 3 groups of 15, the smokers (G1), the weaned (G2) and the non-smoking controls (G3). Any subject with a medical-surgical pathology that could influence the results and those who had followed irregular cessation or who had suffered from passive smoking were not included in the study. Participants were informed of the procedures and objectives of the study and provided written consent to participate in the present study.

Protocol

A complete clinical analysis comprising 2 parts was carried out, firstly an interrogation to collect, among other things, socio-demographic data, and medical history (diabetes, hypertension, dyslipidemia, etc.). The interview also allowed us to determine the notions of active smoking and the number of pack-years (P/A), smoking cessation and the duration of withdrawal as well as the absence of regular active and passive smoking. Secondly, a physical examination was employed to measure anthropometric (age, height, and body weight); and cardiovascular (systolic and diastolic blood pressure) parameters. Blood samples were realized for biological (lipid and glycemic profile) parameters.

The body mass index (BMI) of the subjects was calculated using Quetelet equation, BMI (kg / m^2). The systolic and diastolic arterial pressures (SAP/DAP) measured for every participant on both arms, with an electronic sphygmomanometer, after a 10-minute rest in a seated or lying position on a horizontal plane and the mean arterial pressures (MAP) was evaluated by MAP = (SAP + 2 DAP) / 3. Arterial hypertension was defined according to the New York Heart Association: systolic blood pressure greater than 140 mm Hg and/or diastolic blood pressure greater than 90 mm Hg. Mean SAP, DAP and MAP for each group were also determined.

The biochemical parameters consisted of measuring the fasting blood sugar, C-reactive protein (CRP) and determining the lipid profile of the participants.

All measurements (anthropometrics, biochemical, and cardiovascular parameters) were performed after eight hours of fasting during the morning of the experimental day (i.e., 8:00 h). For vascular function, we used hemodynamic parameters such as Flow medicated dilation or dilation mediated (FMD).

This involved measuring the diameters of the humeral artery and calculating the flow-mediated dilation which consists of compressing the artery for 5 minutes then measuring the diameter of the vessel after the compression is lifted.

The diameters of the humeral artery were measured at different times:

- Before compression: T0
- After compression: T1 = just after lifting the compression; then at T2=2 min; T3 = 5 min; T4 = 10 min; T5 = 15 min; and T6 = 30 min after lifting of the compression

To carry out this work, we used as instruments a cuff of a manual sphygmomanometer to perform the compression of the humeral artery and an echodoppler device (Vascular Doppler Sonotrax 8 MHz) to measure its diameter.

The FMDs at the different times of the ultrasound examination were calculated using the following formula: FMDx = [(Diameter at Tx – Diameter at T0) / Diameter at T0] *100 (18).

Statistical analyzes of data

Data were collected and analyzed in an Excel spreadsheet by determining means and standard deviations. The statistical tests used for the quantitative variables were the analysis of variances (ANOVA) or of covariances (ANCOVA) for the comparison of the groups. Analyzes with the Newman-keuls software were also carried out to determine the differences between the groups. The significance threshold is set at a P-value < 0.05. The Chi-square test was used for the analysis of the qualitative variables with the Pearson coefficient for the determination of the P-values. The correlation curves made it possible to study the interdependence relationships in the evolution of 2 given variables. Significance rates were determined by the Pearson and Spearman tests.

Ethical considerations

Our work was carried out with the authorization of those responsible for the structures and the data was collected confidentially and anonymously.

Results

Anthropometric parameters

The average age between the three groups was comparable. Indeed, the average age was 37.7, 38.2 and 38.8 years for smokers (group 1), withdrawal (group 2) and controls (group 3) respectively. The average weight of the 3 groups was respectively 70.5 kg (G1), 71.7 kg (G2), and 75.9 kg (G3). The average height in G1(smokers), G2 (withdrawals), G3 (controls) was 176.4 cm, 177.7 cm, and 179.5 cm, respectively.

Also, the average BMI of the subjects was almost identical in the 3 groups with 22.3, 22.6, and 23.6 kg/m^2 for G1, G2 and G3 respectively. However, the percentage of overweight individuals was higher in G3 with 33.3% against 6.6% for G1 and G2 p < 0.001, OR = 0.1528; $_{95\%}$CI: 0.063-0.366 (table I).

Table I: Average anthropometric parameters of the 3 groups

Parameters	Group 1	Group 2	Group 3	P-value
Age (years)	37.7 ± 6.7	38.2 ± 5.9	38.8 ± 6.6	0.8843
Weight (Kg)	70.5 ± 4.8	71.7 ± 7.7	75.9 ± 6.2	0.0841
Height (cm)	176.4 ± 4.9	177.7 ± 5.3	179.3 ± 4.1	0.4531
BMI (Kg/m2)	22.3 ± 1.5	22.6 ± 2.3	23.6 ± 2.4	0.3847
Overweight (%)	6.6	6.6	33.3	< 0.001

Group 1: tobacco users; Group 2: weaned; Group 3: controls; BMI: body mass index

Cardiovascular parameters

A history of diabetes, hypertension, dyslipidemia, or other medical pathologies was not found in individuals from the 3 different groups. Examination of the cardiovascular systems of the subjects in the 3 groups showed no detectable clinical abnormalities.

The mean systolic blood pressure (SBP) of G1 was 125.1 ± 6.5 mmHg and 80.5 ± 7.2 mmHg for the mean diastolic blood pressure (DBP). The mean SBP and DBP of G2 were 118.5 ± 6.6 mmHg and 76.1 ± 5mmHg respectively. For G3, mean SBP was 118.5 ± 3.5 mmHg and mean DBP was 76.7 ± 4.4 mmHg. The mean blood pressure of the 3 groups was respectively, 102.8 ± 6.1 mmHg, 97.3 ± 5 mmHg, and 97.6 ± 3.1 mmHg. (Table II).

Table II: Average cardiovascular parameters of the 3 groups

Parameters	Group 1	Group 2	Group 3	P-value
SBP (mmHg)	125.1 ± 6.5	118.5 ± 6.6	118.8 ± 3.5	0.0293
DBP (mmHg)	80.5 ± 7.2	76.1 ± 5.0	76.7 ± 4.4	0.1770
MAP (mmHg)	102.8 ± 6.1	97.3 ±5.0	97.6 ± 3.1	0.0332

Group 1: tobacco users; Group 2: weaned; Group 3: controls; SBP-DBP: systolic and diastolic blood pressure; MAP: average arterial pressure

Biochemical parameters

Furthermore, the fasting blood sugar levels and lipid profiles of individuals in the 3 groups returned normal. The CRP measurements came back negative for the subjects in the 3 different groups.

Hemodynamic parameters

Measurement of humeral artery diameter (HAD)

Concerning the diameter of the humeral artery, before compression, the mean diameter of the humeral artery (HAD0) was 4.22 ± 0.3 mm, 4.45 ± 0.3 mm, and 5.22 ± 0.6 mm respectively for G1 (smokers), G2 (weaned) G3 (controls). After lifting the compression (T1), the HAD1 were 4.78 ± 0.4 mm for G1, 4.91 ± 0.3 mm for G2 and 6.66 0.8 mm for G3.

At T2, the mean diameter of the humeral artery (HAD2) of G1 measured 4.57 ± 0.3mm, 4.70 ± 0.4mm for G2 and 5.73 ± 0.7mm for G3. The results obtained at T3 were 4.44 ± 0.3 mm, 4.53 ± 0.4 mm, and 5.15 ± 0.6 mm for G1, G2 and G3 respectively. The HAD4 were 4.29 ± 0.3 mm, 4.48 ± 0.4 mm, and 5.15 ± 0.6 mm for groups G1, G2 and G3 respectively.

At T5, the HAD5 had given 4.24 ± 0.3 mm in tobacco users (G1), 4.42 ± 0.3 mm in weaned people (G2) and 5.15 ± 0.6 mm in controls (G3). At the last ultrasound time (T6), the HAD6 of G1 was 4.24 ± 0.3 mm, G2 4.43 ± 0.3 mm and G3 5.15 ± 0.6 mm (Table III).

Table III: Average diameters of the humeral artery (HAD) of the 3 groups at the different ultrasound times

Parameters (%)	Group 1	Group 2	Group 3	P-value
HAD0	4.22 ± 0.3	4.45 ± 0.3	5.22 ± 0.6	0.0004
HAD1	4.78 ± 0.4	4.91 ± 0.3	6.66 ± 0.8	< 0.0001
HAD2	4.57 ± 0.3	4.70 ± 0.4	5.73 ± 0.7	0.0002
HAD3	4.45 ± 0.3	4.53 ± 0.4	5.15 ± 0.6	0.0257
HAD4	4.29 ± 0.3	4.48 ± 0.4	5.15 ± 0.6	0.0045
HAD5	4.24 ±0.3	4.42 ± 0.3	5.15 ± 0.6	0.0014
HAD6	4.24 ± 0.3	4.43 ± 0.3	5.15 ± 0.6	0.0013

Kinetics of Flow Mediated Dilation (FMD)

The results at the different times of the ultrasound examination of the kinetics of the FMD of the 3 groups are represented in Figure 1. The average FMD at T1 was for G1 13.51%; G2 10.59% and G3 was 28.15%.

At T2, smokers (G1) had an average FMD equal to -4.25%; the weaned (G2) -0.92% and the controls (G3) at 10.17%. The average FMD at T3 of G1, G2 and G3 were 5.78%, 1.93% and -1.41%, respectively.

Group 1 had a mean FMD of -4.82% at T4; group 2 by 0.56% and group 3 by -1.41%. At T5 the average FMD was 0.6% for group 1, -6.49% and -1.41 for groups 2 and 3 respectively. The mean FMD at T6 was for G1 0.6%; G2 -0.39% and G3 -1.41%.

Thus, the kinetics of the FMD of the 3 groups showed that that of the smokers (G1) was less regular than that of the controls (G3) which was more regular with stability from T3. Furthermore, the kinetics of the weaned (G2) were closer to those of the controls.

It should be noted that the higher the FMD, the greater the artery benefits from good endothelial function. A rapid decrease, over time, in FMD values also shows good vascular compliance.

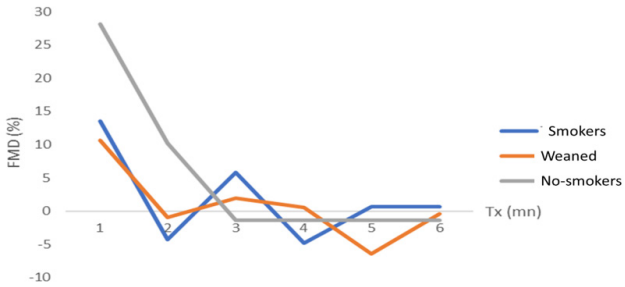
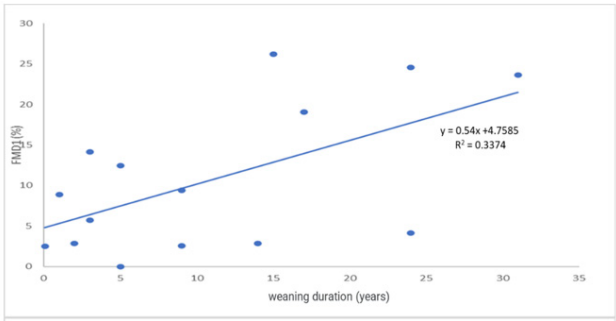


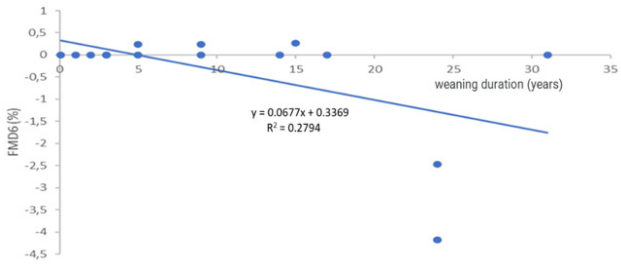
Figure 1: Kinetics of FMD 3 groups at different times of the ultrasound examination

The links between the FMD values and the different parameters were determined using the correlation curves.

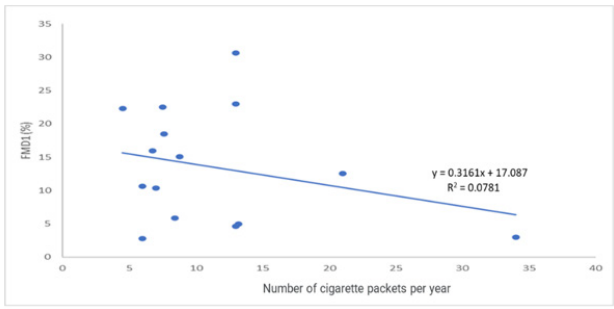
The correlation curve between FMD1 of weaned subjects and the duration of their withdrawal showed a positive trend because FMD1 had higher values when the duration of withdrawal was longer (p = 0.0411) (Figure 2a).



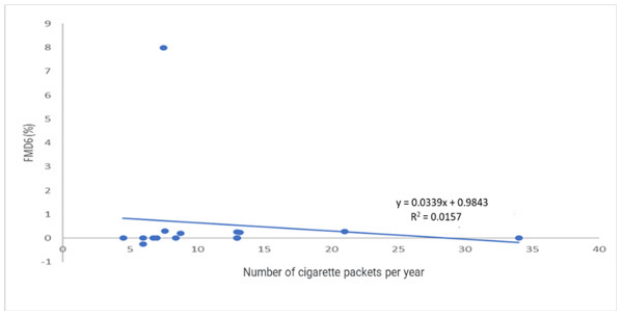
The correlation curve between FMD6 (at 30 min after compression) of G2 and the duration of weaning showed a negative trend, the mean FMD6 values were lower with more prolonged weaning. This shows that the more weaning is prolonged, the faster the return to resting diameter is (p = 0.0428) (figure 2b).



The correlation curve between the FMD1 of tobacco users and their number of packs/years showed a negative trend, the greater the number of P/A, the lower the FMD1 values were (p = 0.02) (figure 3a).



In addition, the correlation curve between FMD6 of tobacco users and the number of packs/years also showed a negative trend (p = 0.04) (figure 3b).



Finally, the correlation curve between the FMD and the mean arterial pressure of the subjects in the 3 different groups showed a negative trend because the FMD values were less significant at higher baseline blood pressure values (p = 0.0266).

Discussion

In this comparative study, the age difference between the 3 groups studied was not significant. Likewise, the analysis of anthropometric parameters,

notably BMI, did not show a significant difference between the 3 groups.

Age and BMI being important cardiovascular risk factors, the quasi-homogeneity of the anthropometric parameters in the 3 groups limited the impact of the latter on the results of the study. The study population was made up of soldiers with relatively comparable on regular physical and sporting activity. This allowed us to better discern the specific effect of smoking and withdrawal on vascular function.

In addition, individuals in the 3 groups did not have any cardiovascular or metabolic diseases or other medical conditions that could interfere with the results.

However, when comparing the mean blood pressure values, those of smokers were higher than those of controls, with a statistically significant difference ($p < 0.05$). This finding has been reported in the literature because smoking (nicotine) can transiently modify the regulation of blood pressure through a rapid effect on the autonomic nervous system. It also accelerates arterial aging, implicated in chronic hypertension, responsible for increased stiffness [10]. Thus, smokers could be at greater risk of developing cardiovascular diseases. If hypertension is the primary risk factor for stroke, tobacco has a more powerful impact on coronary heart disease, aortic aneurysm, or even obliterating arteriopathy of the lower limbs [6,12].

Furthermore, our results showed that non-smoking controls had better vascular compliance ($p < 0.0004$) and therefore better reactive vasodilation with average FMD1 higher than those of weaned people and smokers. This demonstrated better dilation of the vascular wall of controls after compression of the humeral artery following the release by the endothelium of vasodilator factors such as NO. It is known that tobacco influences arterial vasomotor function by causing an arterial spasm which suddenly reduces the diameter of the artery and blood flow [19,20]. This mechanism is triggered by hypoxia caused by CO which has a greater affinity with hemoglobin than oxygen, which causes cellular ischemia [21–23]. In our study, this could explain the fact that the mean arterial pressure was higher and that the baseline humeral arterial diameter was less dilated in smokers and former smokers compared to controls.

It has been reported in the literature that flow-mediated dilation was significantly lower in smokers (6.26%, 95%CI 5.58-6.94) compared to never smokers (8.68%, 95% CI 7.92-9.44), ($P < 0.0001$) [1].

Furthermore, the results showed that chronic tobacco consumption was correlated with more impaired vascular function. In fact, in the group of smokers, the higher the number of cigarette packs per year, the lower the value of Flow Mediated Dilation. Thus, the vascular response in smokers was less significant, less rapid, and less regular due to the alteration of the structure of the vessels. This was recently confirmed (2020) by a study which explained the probable role of oxidative stress in vascular dysfunction in tobacco users [22].

Also, it was noted that the humeral artery was better dilated depending on the duration of the subjects' withdrawal. Long-term withdrawal improved vessel wall compliance and vascular function in the arteries of weaned subjects. The beneficial effects of smoking cessation on the blood vessels have also been mentioned in the literature; it prevents early vascular accidents in primary prevention and reduces recurrences by 30 to 50% in secondary prevention [2,7,17,24].

Quitting smoking not only brings significant and immediate health benefits, but also reduces most of the associated risks within a few years of quitting [25–27]. Even people who drop out later in life benefit from it. For example, among smokers who quit at age 65, men gain on average two years of life and women three [15]. Quitting smoking is associated with a 36% reduction in risk of all-cause mortality among people with cardiovascular disease [13,28,29].

Conclusion

Our results demonstrated that tobacco use has detrimental effects on vascular function, which increases cardiovascular risk. On the other hand, they showed that stopping smoking improves vascular function and thus constitutes a means of preventing cardiovascular diseases. However, our study has limitations, notably the small study population but also, we were not able to assess the biodiversity of the NO. Additional scientific work is therefore necessary to better study the effect of smoking cessation

by evaluating the biodiversity of nitric oxide in smokers compared to quit subjects. But also follow a larger cohort over several years to better study the relationship between smoking cessation and the beneficial effect on vascular function.

Although Senegal has signed the WHO Framework Convention on Tobacco Control (FCTC) and has implemented legislative measures to reduce tobacco use, the promotion of smoking cessation remains an essential parameter in cardiovascular disease prevention strategies.

Conflicts of interest: The authors declare that they have no conflict of interest.

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Original Article

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Evaluation of Cardiovascular Risk among Carpenter Cabinetmakers in the Dakar Region: Study of Vascular Function and Heart Rate Variability

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Abstract

Background: Contemporary concerns recognize atmospheric air pollution as a significant contributor to cardiovascular diseases. Notably, wood dust, colloquially known as sawdust, emerges as a source of air pollution. Our investigation sought to assess the impact of wood dust on the cardiovascular health of carpenters in the Dakar region.

Methods: This cross-sectional study encompassed one hundred (100) carpenters in the Dakar region. A comprehensive questionnaire gathered data on socio-demographic features, professional experience, medical history, preventive measures, and lifestyle habits. Vascular function assessment involved determining finger-toe pulse wave velocity (ft-PWV) using a popmeter. Additionally, we screened for obliterative arteriopathy of the lower limbs (OALL). Heart rate variability measurement provided insights into the sympatho-vagal balance of nervous control over cardiac activity.

Results: The average age in our population was 38 ±7.2 years, with a body mass index of 22.7 ±2.8 kg/m2. A majority (69%) worked an average of 10.2 hours per day for six days per week. Approximately 73% of the shops were observed to be enclosed. Respiratory and ocular symptoms were prevalent among participants. Analysis using the Pop meter revealed arterial stiffness (ft-PWV>10 m/s) in 3% of participants, and 11% exhibited arterial hypertension. OALL was present in 8% of participants. Furthermore, a positive correlation (P=0.003; r=0.581) between ft-PWVV and mean arterial pressure was noted. Data on cardiac variability indicated a substantial proportion of participants displaying decreased tone in the cardiac-parasympathetic nervous system in the supine position (94.73% had RMSSD values above norms). Notably, abnormal activation of the parasympathetic system (HF) and decreased sympathetic system activity (low values for HF, LF, and LF/HF compared with norms) were observed in the orthostatic position.

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Conclusion: Carpentry work in environments with elevated air pollution, potentially emanating from wood dust, poses inhalation risks for workers. The inhalation of wood dust appears linked to an increased risk and exacerbation of cardiovascular complications.

Keywords: Air pollution, Wood dust, Cardiovascular system, Finger-to-eye pulse wave velocity, Heart rate variability

Introduction

Woodworking, a craft deeply intertwined with human history, serves as the foundation for countless structures and artifacts. However, the very nature of this craft exposes artisans, particularly carpenters and cabinetmakers, to potential health risks associated with their occupational environment[1]. This study delves into the cardiovascular health of carpenter and cabinetmaker populations in the Dakar region, shedding light on the intricate interplay between occupational exposure, vascular function, and heart rate variability.

Occupational hazards in woodworking extend beyond the immediate concerns of cuts and splinters. The inhalation of wood dust, a ubiquitous byproduct of carpentry, has long been identified as a potential health risk, with respiratory and cardiovascular implications[1]. Additionally, the physical demands of the profession, characterized by prolonged periods of standing, lifting, and manual labor, may contribute to cardiovascular strain over time[2].

The current research emerges against the backdrop of a global surge in awareness regarding occupational health. While the focus has often been on respiratory effects, this study aims to unravel the intricate cardiovascular dynamics that may be influenced by the occupational milieu of carpenters and cabinetmakers in the Dakar region.

The assessment of cardiovascular risk in this population involves a multifaceted approach, incorporating an exploration of vascular function and heart rate variability. Vascular function, encompassing parameters such as arterial stiffness and pulse wave velocity, provides insights into the structural integrity and elasticity of blood vessels[3]. Simultaneously, heart rate variability serves as a window into the intricate balance of the autonomic nervous system, reflecting the adaptability and responsiveness of the cardiovascular system to various stressors[4].

The correlation between woodworking, cardiovascular health, and autonomic regulation has been a subject of limited exploration. Our study endeavors to bridge this gap by comprehensively evaluating the cardiovascular risk profile of carpenter and cabinetmaker populations in Dakar. The inclusion of both vascular function and heart rate variability metrics ensures a holistic understanding of the cardiovascular implications associated with this occupation.

As we navigate the intricate tapestry of occupational health, this research not only contributes to the scientific discourse on the cardiovascular effects of woodworking but also holds potential implications for occupational safety guidelines and health interventions tailored to this specific artisanal community. Through rigorous examination and correlation of data, we aspire to illuminate the nuanced relationship between woodworking occupations and cardiovascular well-being, providing valuable insights for both practitioners and policymakers alike.

Methods

Study Design and Participants:

This cross-sectional study aims to evaluate the cardiovascular risk among carpenters and cabinetmakers in the Dakar region, focusing on vascular function and heart rate variability. The research adheres to ethical principles and has received approval from the ethics committee of the Dakar Faculty of Medicine. Informed consent was obtained from all participants.

The study population included male carpenters and cabinetmakers aged 25 to 60 years, with at least five years of professional exposure. Individuals with pre-existing cardiovascular conditions, respiratory disorders, or those on medications affecting cardiovascular function were excluded.

Data Collection:

Demographic and Occupational Data:For each participant, information was collected on age, smoking status, and duration of woodworking exposure. Occupational history, including specific tasks performed and the type of wood commonly worked with, was documented.

Anthropometric and cardiovascular Measurements Height, weight, waist circumference, and blood pressure (systolic, diastolic arterial pressures) were measured using standardized procedures. Mean arterial pressure (MAP) was calculated as follows: SAP + 2 x DAP) / 3

Vascular Function Assessment: :was evaluated by finger-toe pulse wave velocity (ft-PWV) using non-invasive tonometry (popmetry). The Arterial Stiffness was revealed when ft-PWV>10 m/s. The pop meter software indicated also the index for obliterative arteriopathy of the lower limbs (OALL).

Heart Rate Variability (HRV) Measurement:

- Participants underwent continuous electrocardiogram (ECG) monitoring for at least 10 minutes under controlled conditions.

HRV parameters, including time-domain (SDNN, RMSSD) and frequency-domain (LF, HF, LF/HF ratio) measures, were analyzed using dedicated software.

Statistical Analysis:

Descriptive statistics summarized demographic, occupational, and clinical characteristics. Continuous variables were expressed as means ± standard deviations or medians (interquartile ranges) based on data distribution. Categorical variables were presented as percentages.

Associations between woodworking exposure, vascular function parameters, and HRV measures were assessed using regression models. Subgroup analyses based on age, and duration of exposure were performed.

Statistical significance was set at $p < 0.05$. Data analysis was conducted using R software, and the results were reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Results

The investigation involved a cohort of one hundred carpenters in the Dakar region, revealing pertinent insights into the interplay between wood dust exposure and cardiovascular health.

Demographic and Work Characteristics: The participants, with an average age of 38 ± 7.2 years and a mean body mass index of 22.7 ± 2.8 kg/m², engaged in demanding work routines. A majority, 69%, toiled for an average of 10.2 hours daily, six days a week, within often enclosed shops.

Symptoms and Working Conditions: A noteworthy finding was the prevalence of respiratory and ocular symptoms reported by the carpenters. This underscores the potential health impact of prolonged exposure to wood dust within the working environment.

Table 1outlines the prevalence of working conditions and protective measures. Notably, 73% of carpentry shops were closed, and 51% of participants reported using masks for protection.

Table 1: Working Conditions and Protective Measures

Variables	Numbers (n)	Pourcentage (%)
Farm workshops	73	73
Open workshops	27	27
Wearing a mask	52	51
Wearing glasses	3	3
Wearing gloves	1	1

Clinical Manifestations: The study identified various clinical manifestations among carpenters. Respiratory and ENT (Ear, Nose, and Throat) issues accounted for 30.65%, cardiovascular problems for 27.10%, ocular and cutaneous concerns for 24.84%, and neurological complications for 17.42%. Table 2 represents the different categories of clinical manifestations noted among carpenters.

Among respiratory and ENT disorders, sneezing was the most common symptom, reported by 19.02% of participants.

Cardiovascular disorders were dominated by palpitations affecting 57.58% of participants followed by heart cramps with 29.55%.

The eye and skin symptoms reported were predominated by eye irritation 26.49% and itchy skin (25.83%).

Regarding neurological symptoms, memory disorders were predominant at 27.42% followed by headaches (24.87%).

Table 2: clinical manifestations among carpenters

Signs	Numbers (n)	Pourcentages (%)
Respiratory and ENT Troubles		
Sneeze	70	19.02
Cough	49	13.32
Nasal obstruction	51	13.86
Chest pain	29	7.88
Dyspnea	19	5.16
Chronicphlegm	29	7.88
Pneumonia	35	9.51
Rhinitis	18	4.89
Expectoration	34	9.24
Throat irritation	34	9.24
Cardiovascular Troubles		
High blood pressure	15	11.36
Palpitation	76	57.58
Cardiacarrythmia	2	1.51
Heartcramp	39	29.55
Ocular and Cutaneous Symptoms		
Eye irritation	40	26.49
Itching	39	25.83
Dermatitis	33	21.85
Tearing	20	13.85
Rashes	14	9.27
conjonctivitis	5	3.31
Neurological Symptoms		
Memory problems	54	27.42
Headache	49	24.87
Dizziness	40	20.30
Behavioraldisorders	8	4.06
Sleepdisorder	46	23.35

Vascular Function Assessment: Utilizing popmeter technology, the study identified 3% of participants with elevated finger-to-toe pulse wave velocity (ft-PWV>10 m/s), signifying arterial stiffness. Concomitantly, 11% of the cohort exhibited arterial hypertension, indicating a potential association between wood dust exposure and adverse cardiovascular effects.Table 3 presents the results of vascular function parameters.

Table 3: ft-PWVand OALL Results

Variables	Mean± Standard deviation	[min-max]	Frequency
ft-PWV	6, 6 ± 1	[4,3-9, 7]	97 %
ft-PWV>10m/s	12,5 ± 1,1	[11,6-14,2]	3 %
OALL	—	—	8 %

Arterial Obstructive Disease: Obliterative arteriopathy of the lower limbs (OALL)was observed in 8% of participants. This finding suggests that the vascular system, particularly in the lower limbs, may be adversely affected by the nature of carpentry work and associated wood dust exposure.

Correlation Analysis: A statistically significant positive correlation (P=0.003; r=0.581) between finger-to-toe pulse wave velocity (ft-PWV and mean arterial pressure was discerned. This correlation underscores a potential link between wood dust exposure and alterations in cardiovascular parameters.

Heart Rate Variability (HRV) Analysis: Assessment of heart rate variability unveiled intriguing patterns. In the supine position, 94.73% of participants exhibited decreased tone of the cardiac-parasympathetic nervous system, as indicated by RMSSD values above norms (table 4). In the orthostatic position, abnormal activation of the parasympathetic system (HF) coupled with decreased sympathetic system activity (low values for HF, LF, and LF/HF compared with norms) was observed (table 5).

These findings underscore the complex relationship between wood dust exposure and cardiovascular health among carpenters in the Dakar region.

Table 4: Results of the overall activity of the Autonomic Nervous System in decubitus

Parameters	Age group (years)	Low values (%)	Normal values (%)	High values (%)
SDNN (ms)	20-30	100	0	0
	30-40	97.73	0	2.27
	40-50	100	0	0
	50-60	100	0	0
RMSSD (ms)	20-30	5.27	0	94.73
	30-40	11.37	2.27	86.36
	40-50	14.81	0	85.19
	50-60	30	0	70
PNN_{50} (%)	20-30	5.27	0	94.73
	30-40	0	2.27	97.73
	40-50	25.92	0	74.08
	50-60	10	0	90

SDNN: Standard deviation of all normal RR intervals;

RMSSD: The root mean square of successive differences between normal heartbeats R-R intervals;

PNN50: percentage of R-R intervals for which there is a difference of more than 50 ms from the previous R-R interval.

Table 5: Results of sympathetic-vagal balance activity in decubitus

Parameters	Age group (years)	Low values (%)	Normal values (%)	High values (%)
LF (ms) ²	20-30	21.05	0	78.95
	30-40	40.90	0	59.10
	40-50	25.92	0	74.08
	50-60	40	0	60
HF (ms) ²	20-30	5.26	0	94.74
	30-40	11.36	0	88.64
	40-50	7.40	0	92.60
	50-60	30	0	70
LF/HF	20-30	15.79	0	84.21
	30-40	34.10	0	65.90
	40-50	40.74	0	59.26
	50-60	30	0	70

LF: Low Frequency; **HF:** High Frequency

Discussion

The findings of our study shed light on the multifaceted impact of wood dust exposure on the cardiovascular health of carpenters in the Dakar region. The observed prevalence of respiratory, cardiovascular, ocular, and neurological symptoms underscores the occupational health risks associated with carpentry, particularly in environments where wood dust is a prominent factor.

Respiratory and ENT Manifestations: The high prevalence of respiratory and ENT symptoms, including sneezing, cough, and nasal obstruction, suggests a substantial burden on the respiratory system among carpenters. These findings align with previous research linking wood dust exposure to respiratory issues, emphasizing the need for adequate respiratory protection measures [7–10]. As evidenced by the low utilization of masks (51%) among participants, there is a clear need for improved adherence to safety measures[11,12].

Cardiovascular Implications: Cardiovascular concerns, such as palpitations and cardiac cramps, were notably prevalent among the carpenters in our study. The correlation between arterial stiffness (ft-PWV>10 m/s) and mean arterial pressure underscores the potential impact of wood dust exposure on vascular function [2,13]. The association between occupational wood dust exposure and arterial hypertension has been recognized [14], emphasizing the importance of cardiovascular assessments in carpentry occupational health. Tanko et al, in Nigeria found that the effect of wood dust on carpenters increases the arterial blood pressure, decreases the forced vital capacity, forced expiratory volume in 1 sec and peak expiratory flow rate[2].

Ocular and Cutaneous Effects: The ocular and cutaneous symptoms reported including eye irritation and dermatitis, align with the irritant nature of wood dust. The low usage of goggles (3%) indicates a potential gap in protective measures against ocular exposures. Occupational safety measures should emphasize the importance of eye protection to prevent these symptoms[15].

Neurological Implications: Neurological symptoms, particularly memory troubles and headaches, were prevalent in our study cohort. While the exact mechanisms linking wood dust exposure to neurological effects warrant further investigation[16,17], these findings highlight the need for comprehensive neurological assessments and monitoring among carpenters.

Vascular Function Parameters: The majority of participants exhibited a ft-PWV below 10 m/s, indicating normal vascular function. However, the 3% with arterial stiffness and 8% with lower limb arteriopathy (OALL) emphasize the need for cardiovascular screening in carpentry occupational health programs[2,3]. The positive correlation between ft-PWV and mean arterial pressure further supports the potential cardiovascular implications of wood dust exposure[9,10,12,18].

The observed correlations and prevalence of arterial stiffness, hypertension, and OALL highlight the need for comprehensive occupational health measures and further research in this field.

These detailed findings provide a comprehensive understanding of the health implications of wood dust exposure among carpenters in the Dakar region. The reported symptoms and vascular function parameters underscore the need for targeted interventions and occupational health initiatives within this profession. Figures and detailed prevalence tables contribute valuable insights for further research and policy development.

Study Strengths and Limitations:

Strengths: Firstly. our study provides a thorough examination of the cardiovascular health of carpenters. encompassing respiratory. cardiovascular. ocular. and neurological aspects. This comprehensive approach contributes to a more nuanced understanding of the health implications associated with wood dust exposure. Secondly **t**he use of finger-to-toe pulse wave velocity (ft-PWV) as an indicator of vascular function adds an objective dimension to our cardiovascular assessments. This measure enhances the precision and reliability of our findings. particularly in evaluating the impact of wood dust on arterial stiffness. **Thirdly with** a sample size of one hundred carpenters. our study achieves a robust representation of the carpentry workforce in the Dakar region. This large sample size enhances the generalizability of our findings to the broader population of carpenters exposed to wood dust.

Limitations: The cross-sectional nature of our study limits our ability to establish causal relationships between wood dust exposure and cardiovascular outcomes. Future longitudinal studies are essential to explore the temporal dynamics of these associations. Furthermore, the reliance on self-reported symptoms introduces the potential for recall bias. Participants may not accurately recall or report all symptoms.

impacting the precision of our findings. Future research could benefit from incorporating objective measures to complement self-reported data. Thirdly **o**ur study focuses on carpenters in the Dakar region. and while this provides valuable insights into a specific population. it may limit the generalizability of our findings to carpenters in other geographic locations with potentially different environmental conditions. Lastly, although our study identifies neurological symptoms. the assessment is exploratory. Future research should employ more in-depth neurological evaluations to better understand the nature and extent of neurological effects associated with wood dust exposure.

Longitudinal studies are warranted to explore the cumulative effects of wood dust exposure on cardiovascular health. Additionally, future research should consider objective measures and biomarkers to enhance the accuracy of health assessments.

Conclusion

In conclusion. our study provides comprehensive insights into the cardiovascular implications of wood dust exposure among carpenters in the Dakar region. The high prevalence of respiratory. cardiovascular. ocular. and neurological symptoms. coupled with vascular function parameters. underscores the need for targeted occupational health interventions. Initiatives promoting respiratory protection. cardiovascular monitoring. and neurological assessments can contribute to mitigating the health risks associated with carpentry. Occupational health programs tailored to the specific challenges faced by carpenters are crucial for ensuring a healthy and sustainable working environment in this profession.

Conflicts of interest: The authors declare that they have no conflict of interest.

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Evaluation of Masticatory Function of Senegalese Patients for Removable Partial Dentures Wearers with Distal Extension Edentulism

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Abstract

Background/Aim. The aim of this study was to evaluate the masticatory function of subjects wearing a metal partial denture restoring Kennedy's class I and II edentulism and to compare them with a control group.

Methods. The evaluation included 68 patients (33 wearers of removable partial metal denture restoring terminal edentulism and 35 dentate control subjects without appliances). Peanut and raw carrot were used as test foods. Video recordings were used to collect values for the number of chewing cycles and chewing times. After passing through the calibrated sieves, a "Mastica" input mask was used to record the average particle size of the chews (D50).

Results. In the 33 subjects with removable partial denture (RPD), 82% of whom had Kennedy class I edentulism and 18% had class II edentulism. Among them, 54.5% were women and 45.5% were men. The age group 46-71 years was predominantly represented in this study with 75.7%. The subjects who had worn their prostheses for 6 months were in the majority with 57.57% of the population. Concerning the length of edentulism (LE), 42.4% had a small LE, 39.4% a medium LE and 18.2% a large LE For both test foods, the number of chewing cycles was twice as high with RDP wearers compared to the control subjects. For the duration of the sequence, subjects with RDP performed twice as long for the carrot and three times as long for the peanut to make the food suitable for swallowing. The average D50 of RDP subjects was similar to that of the control subjects, i.e. 1.90 mm ± 0.19 (D50 peanut control: 1.93 ± 0.5) and 1.74 mm ± 0.36 (D50 carrot control: 1.79 mm ± 0.44) for peanut and carrot respectively.

Conclusion. This study revealed that subjects with RPD restoring distal extension edentulism had efficient compensatory chewing with a greater number and time of chewing sequences than randomly selected normodent subjects. The comparative analysis between the chewing kinetic parameters of the RPD wearers and control subjects was statistically significant.

Keywords: Distal extension edentulism, Removable partial denture, Mastication, Masticatory muscle, Granulometry

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Introduction

The removable partial denture (RPD) is highly anticipated for the restoration of good masticatory function in addition to its objectives of replacing missing teeth and preserving the health of existing structures.[1,2] However, the level of functionality of the RPD is conditioned by the multitude of possible edentulous situations and the different states of the existing paraprosthetic structures.[3] Faced with these disparities, various movements destabilizing removable metal prostheses have been reported by the authors.[4,5,6]

For RPD restoring terminal edentulism, Tabet describes six fundamental movements including three translational movements and three rotational movements.[5,6] These different movements impose a specific characteristic on the metal prosthesis restoring a terminal tooth loss and can thus induce a particular physiology of the chewing of the wearers of this type of prosthesis.

Bessadet *et al* have shown that the constraints to which the prosthesis is subjected will differ according to the number of teeth to be replaced and the type of edentulism (recessed or terminal).[7] In the event of terminal edentulism, these constraints are subject to defects in the stability of the prosthesis which lead to masticatory difficulties and changes in eating habits. In fact, a partially edentulous arch has two support structures of different compressibility, namely the teeth and the fibromucosa. It is accepted that mastication gradually deteriorates from fully dentate maxillae to atrophic edentulous alveolar ridges.[7]

Adaptation to the increasing hardness of food results in an increased number of chewing cycles in normodent subjects.[7,8,9] So in the partially edentulous, it is predictable to observe variability in mastication depending on the food consumed. The evaluation of masticatory parameters of these partially edentulous subjects, such as the masticatory frequency and the granulometry of the masticated boluses could make it possible to describe the functionality of their mastication. Throughout the literature, lower masticatory performance has been reported in wearers of partial removable prosthesis compared to normodent subjects.[7,10,11,12]

As part of the prosthetic follow-up, the evaluation of the functionality of the prostheses delivered remains an obligation and more particularly that of the chewing function.

The objective of this study was to evaluate the masticatory function of subjects wearing partial metal dentures restoring terminal edentulism by comparing them with dentate control subjects who did not have appliances.

Methods

Ethical approbation

This study was approved by the ethics committee of the Faculty of Medicine, Pharmacy and Dentistry (Cheikh Anta Diop University, Dakar, Senegal) and followed the guidelines of Helsenki Declaration. The problematics, purpose, objectives and protocol of the study were explained to the subjects. Written informed consent was obtained from all study participating. The barrier precautions for Covid-19 were respected.

Study description

This is a cross-sectional and descriptive study carried out with patients rehabilitated in the prosthesis clinic of Odontology-Stomatology Institute of Cheikh Anta Diop University (Dakar, Senegal). After analyzing the files of patients rehabilitated since 2015, telephone calls made it possible to recruit subjects to participate in this study on a voluntary basis.

Study population

Selection

Patients wearers of removable partial metal denture restoring Kennedy class I or II tooth loss were included in this study. They had to have worn their prosthesis(es) for at least three months since the last post-treatment check-up. These patients had responded positively to the telephone invitation and had given their verbal and written consent to participate in the study.

Patients who wore their prostheses using a prosthetic adhesive, deprived of autonomy or on a special diet were not included in this study. Patients who had control sessions in another structure were excluded from this study.

Sampling

The sample size was determined using the Schwartz formula for descriptive studies with:

n= (εα) ²pq/I² where ε= reduced deviation= 1.96; α= risk of error= 0.05; p= theoretical prevalence = 50%. Let q= 1-p= 0.50; I= accuracy= 4%.

A total of 68 patients were included including 33 wearers of removable partial metal prostheses restoring terminal edentulism and 35 dentate control subjects without appliances. Sampling was random, the subjects chosen all had the same chance of being recruited.

Chewing procedures

All subjects included in the study participated in chewing sessions. They were asked to chew two test foods, raw carrots and peanuts. The latter have a different hardness and consistency, therefore of different rheology and are commonly consumed by the study population. In addition, these foods allow easy particle size analysis of masticates from sampled bowls[7,10]. Each subject was first trained to chew a bite of peanut and carrot as naturally as possible. After thorough rinsing of the mouth with water, they were subjected to chewing three peanut samples and then four calibrated carrot samples.

The peanuts were sampled at 3mm in thickness and 5g in weight. The carrots were calibrated using a punch with a diameter of 3 mm at a weight of 4 g and in size 2 cm in length. The chewing had to continue until he perceived that the bowl was fit to swallow. There, the bite had 2 spells, either it was swallowed, or it was spat out into a cup. The 2 possibilities were performed alternately for each test food. All the sequences were filmed from the mouthing of the sampled bowl until the moment of collection of the masticate in a goblet. After each chewing sequence, the subjects had to rinse their mouth as many times as necessary until the oral cavity was completely empty of all food.

The number of cycles of each chewing frequency were recorded after viewing the videos of the chewing sequences. The masticates after decantation were dried and then passed through a sieve column of decreasing mesh subjected to a laboratory vibrator (figures 1,2).

Figure 1: Laboratory sieve on vibrator

Figure 2: Top view of sieves after vibrating.

After sieving, the content of each sieve is weighed with a precision balance 0.01g Brifit® Digital Pro Scale (An Hui Uni Electronics and Co®). The analysis of the particle size (D50) of the masticates was carried out on a "Mastica" input mask developed from the Rosin Rammler equation (figure 3).[13]

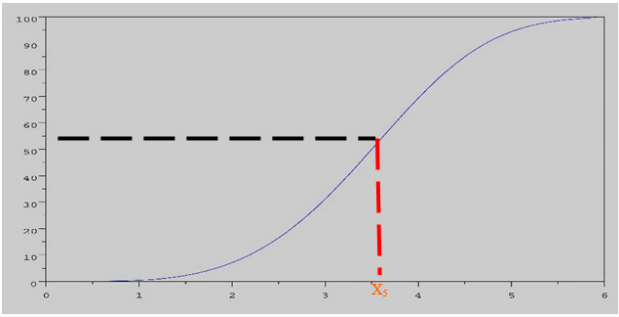

Figure 3: Respective values of the median particle size distribution (X_{50}) and the range of particle size distribution and uniformity (b) of 3.4 mm and 4 obtained and fit to the Rosin- Rammler equation.[13]

Variables

The data relating maticatory cycles, the chewing frequency and the chewing granulometry of the test foods were recorded on a spreadsheet. Excel®.

Statistical analysis

The analysis was carried out on the R® software. The quantitative variables were described with the extremes, the average and the standard deviation and the qualitative variables were described with their relative frequencies. Confidence intervals were estimated at 95%. Shapiro's test was used to check the normality of the distribution. Non-parametric tests (Wilcoxon MW, Spearman, Kruskall Wallis) were used in situations where one of the distributions did not follow a normal law. Apart from these situations, parametric tests (Student, ANOVA) were used. The effects associated with our p-value were considered statistically significant at a threshold below 0.05.

Results

The sample consisted of 68 individuals. After reviewing 57 records, 33 edentulous patients' wearers of removable partial metal denture restoring terminal edentulism responded favorably to participating in this study. For the control group, 35 volunteer subjects dentate without appliances followed the peanut and carrot chewing sequences.

For 33 wearers of removable partial metal denture, women represented 54.5% of the sample with a sex ratio of 0.83, and in control subjects, men represented 54.3% of the sample with a sex ratio of 1, 18. The individuals with RPD in the study were between 27 and 71 years old. The average age was 55.7±4.5 years. Control subjects in the study were between 33 and 80 years old. The mean age of the control subjects was 54.22±6.21 years (table 1).

Table 1: Characteristics of wearers of removable partial dentures (RPD) and normodent subjects according to sex and age.

		Wearers RPD	Normodent subjects	p-value (t-test)
Age (years)	Male	58.9±12.52	55.1±6.27	0.2
	Female	53.9±11.58	53.2±6.18	
	Sample Overall	55.7±4.5	54.22 ± 6.21	0.2

The average duration of prosthesis wearing was 14.4±11.97 months. According to the Kennedy classification, 82% of the individuals in our sample were in class 1. Of our sample, 42.4% had an edentulous extent deemed small and 18.2% had an edentulous extent deemed large (figure 4).

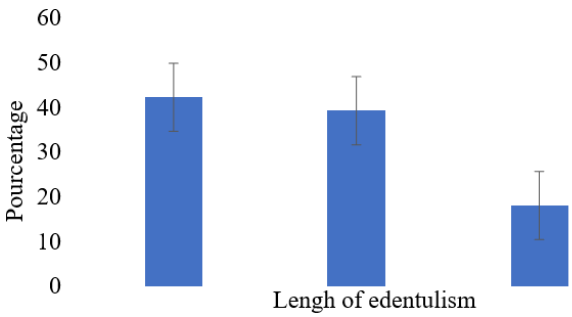

Figure 4: Distribution of individuals according to the extent of edentulousness

Chewing peanuts

The number of cycles found during peanut chewing in subjects with RPD ranged from 51.7 to

296.3 cycles. The average was 129.6±20.97 cycles with a confidence interval between [108.64- 150.58]. For the controls, the number of cycles was 52.9±14.08 cycles. The average number of chewing cycles was significantly lower in the controls than in the wearers of RPD with a $p<0.0001$ (table 2).

Subjects with RPD had a masticatory frequency for peanuts varied between 0.71 and 2.78 cycles/s. The average was 1.45±0.38 cycles/s, in a confidence interval between [1.31-1.59]. The mean chewing frequency of the controls was 1.70±0.23 cycles/s, with a statistically significant difference ($p<0.0006$) (table 2).

After chewing the peanut, the particle size (D50) was measured. The D50 was between 1.4 and 2.3 mm. The mean D50 of the subjects with RPD was 1.9±0.19 mm, with a confidence interval between [1.83-1.97]. The average D50 of the control subjects was 1.93±0.5 mm but without any statistically significant difference between the two groups (p=0.544) (table 2).

Table 2: Masticatory parameters of peanut for wearers of removable partial dentures (RPD) and normodent subjects.

Masticatory parameters of the peanut	Study subjects (mean ± standard deviation) [confidence interval]		p-value
	Wearers RPD	Normodent subjects	
Masticatory cycles (number)	129.6±20.97 [108.64 -150.58]	52.9±14.08 [48.08 -57.75]	<0.0001
Chewing frequency (cycle/s)	1.45 ± 0.38 [1.32 - 1.59]	1.70 ± 0.23 [1.62 - 1.77]	0.0006
Chewing granulometry– D50 (mm)	1.90 ± 0.19 [1.83 - 1.97]	1.93 ± 0.5 [1.76 - 2.11]	0.544

Chewing raw carrots

In subjects with RPD, the number of raw carrot chewing cycles varied between 40.25 and 286.25 cycles. The average number of cycles was 137.2±19.35 cycles. For the controls, the number of cycles was 68.5±25.44 cycles. The average number of chewing cycles was significantly lower in the controls than wearers of RPD, p<0.0001 (table 3).

Mean carrot chewing frequency was higher in controls (1.72 ± 0.31), and there was a significant difference between the two groups with p = 0.0058 (table 3).

The mean D50 after chewing of the carrot by wearers of RPD was 1.74±0.36 mm, in a confidence interval between [1.61-1.86]. There was no significant difference between the two groups (p=0.624) (table 3).

In wearers of RPD, both after peanut and raw carrot chewing, there was no statistically significant difference between chewing parameters (masticatory cycles, chewing frequency, and D50) and prosthetic parameters (duration of prosthesis wearing, extent of edentulism) (p-0.05)

Table 3: Masticatory parameters of the carrot for wearers of removable partial dentures (RPD) and normodent subjects.

Masticatory parameters of the carrot	Study subjects (mean ± standard deviation) [confidence interval]		p-value
	Wearers RPD	Normodent subjects	
Masticatory cycles (number)	137.2±19.35 [117.8 - 156.5]	68.5±25.44 [59.2 - 77.9]	**<0.0001**
Chewing frequency (cycle/s)	1.46 ± 0.47 [1.29 - 1.63]	1.72 ± 0.31 [1.62 - 1.84]	**0.0058**
Chewing granulometry– D50 (mm)	1.74 ± 0.36 [1.61-1.87]	1.79 ± 0.44 [1.62 - 1.95]	0.624

Discussion

The constraints to which the prosthesis is subjected in the case of a terminal edentulousness are subject to defects in the stability of the prosthesis which lead to masticatory difficulties and changes in eating habits.

This study evaluates the masticatory function of subjects wearing a metal partial denture restoring Kennedy's class I and II edentulism and to compare them with a control group.

For the peanut, the masticatory performance parameters, the number of cycles and the chewing

time observed with the edentulous subjects with RPD are significantly higher than those observed with control subjects. These results show that subjects wearers of removable partial metal denture restoring terminal edentulism need twice as many chewing cycles and three times as long as normodent subjects to obtain a food bolus (peanut) ready to be swallowed. In fact, studies have shown that rehabilitation with RPD only partially restores chewing function.[11,14,15] However, the masticatory frequency observed with the subjects' wearers of RPD is significantly lower than that of the control subjects. This fact can be explained by the greater disparities in chewing time observed in the subjects fitted with hearing aids and these had a statistical impact on the confidence interval of these subjects [1.32-1.59], which was larger than that of control subjects [1.62-1.77]. Moreover, the correlative analysis shows that the type of prosthesis had a significant influence on the masticatory frequency. This result is in contradiction with facts reported by authors who had shown that with multiple and frequent mandibular movements, a mandibular removable prosthesis was subjected to more destabilizations resulting in insufficient mastication.[4,5,6] According to the type of prosthesis, the frequency of chewing in patients with removable complete denture/metal removable partial denture was higher and statistically significant than in patients with metal removable partial denture/ natural teeth (p=0.033). This same difference is observed with the wearers of metal RPD/natural teeth (1.22 cycles/s) and the wearers of metal RPD/ resin RPD (2.5 cycles/s). In these two cases, wearers of metal RPD/natural teeth have a lower frequency compared to other types of prostheses. So, subjects with a normodent arch have better masticatory performance. In fact, the fragmentation of a bowl of peanuts in the wearer of a removable prosthesis is a destabilizing factor for the prosthesis, given the rheological nature of this food.

The mean particle size (D50) found is almost similar for the fitted patients and control subjects being 1.9 mm, which is not in line with the results of some studies.[10,16,17]

With regard to carrot, the same trend as with peanuts is observed for the number of cycles and chewing time. In fact, the fitted subjects do twice as many cycles and times as the control subjects. Higher values for the number of cycles and chewing time were found in patients with removable complete denture/metal removable partial denture as for the peanuts. These results are similar to those of Moraru et al.[18] and can easily be explained by the instability of the removable complete denture linked to the phenomena of bone resorption.[19] Comparative analysis with control subjects showed a significant difference in the number of cycles, time and frequency of chewing, as with peanuts. The higher activity of the masticatory muscles in wearers of removable prostheses compared to normodent subjects makes it possible to understand this significant difference.[20] In addition, a pilot study conducted in patients with removable partial metal denture restoring terminal edentulism revealed fairly long chewing times.[12]

There was no statistical relationship between D50 and prosthetic parameters. However, this similar D50 between the subjects with metal RPD and the control subjects is not in line with the results of Bessadet et al. who had found a D50 in controls higher than the level of metal RPD wearers[10]. The chewing performance parameters were significantly higher than those of the control subjects and for the chewing efficiency materialized by the D50 no significant difference was noted. Previous studies showed that metal RPD wearers had moderately or even weakly restored masticatory function.[21,22]

Conclusion

This study reveals that patients with terminal edentulism rehabilitated by metallic removable prosthesis have an effective mastication by compensation. The masticatory parameters significantly higher than those of normodent subjects in the control group.

Conflict of interest: Authors of this study have no conflict of interest.

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Review Article

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Comparative Study of Instrument Assisted Soft Tissue Mobilization and Massage on Neck Pain

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Abstract

Objective: This review article aims to compare and analyse the effect of Instrument Assisted soft tissue mobilization and massage on neck pain.

Methods: This review analysed two databases i.e. (PubMed, google scholar), and extracted the studies of neck pain. Article published in the English language were included in the studies from 2016 to 2023. 10 studies were included in this review. Outcome measures used neck pain intensity, and neck disability, and secondary outcomes measure were quality of life (QOL), neck range of motion (ROM), visual analogue scale(VAS).

Result: Ten studies on 328 patients with neck pain comparing IASTM with Massage were included. Finding of the studies demonstrated that both IASTM and massage treatment were efficient in lowering neck discomfort and enhancing neck range of motion. IASTM showed significant improvement as compared to massage treatment in terms of minimising discomfort and enhancing neck mobility.(p=0.05, p=0.001)

Conclusion: It can be inferred from the comparative study of instrument-assisted soft tissue mobilisation (IASTM) and massage on neck pain that both treatments are efficient in easing discomfort and enhancing range of motion in sufferers of neck pain. IASTM was significant to massage in terms of relieving pain and enhancing neck mobility. But it's crucial to remember that each intervention has its own distinct advantages and could be a better choice for some people depending on their requirements and preferences.

Keyword: Instrument-assisted soft tissue mobilisation (IASTM) , Massage, chronic neck pain , Myofascial pain of neck.

Introduction

The pathological form of cervical pain syndrome, which has a high epidemiological incidence rate and several etiological causes, is known as cervical pain syndrome. Among the above aetiological factors, postural pathological adaptations of the human body have been particularly linked to the development of stress and pain conditions in the cervical region. These include muscle strains or ligament sprains, pathological adaptations of the cervical soft tissues, arthropathies, disc pathologies, and poor posture.[1] Trigger points are the source of the chronic pain in myofascial pain syndrome. It is linked to autonomic symptoms that impair the patient's physical capabilities as well as musculoskeletal issues

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(muscle spasm, limited range of motion (ROM), and diminished fibre extensibility).[2]. The hypersensitive, palpable nodules known as myofascial trigger points are located along tight bands of muscle fibres. They frequently affect the neck and shoulder muscles. The muscle most usually affected is the trapezius. Trigger points in the neck are thought to be present in 85% of patients who visit pain clinics, and they affect women more frequently than males. While latent trigger points only create pain when touched and impede mobility, active trigger points induce continual discomfort at rest and are linked to referred pain patterns. Trigger points are the source of the chronic pain in myofascial pain syndrome. It is linked to autonomic symptoms that impair the patient's physical capabilities as well as musculoskeletal issues (muscle spasm, limited range of motion (ROM), and diminished fibre extensibility).[4.]

Different therapy IASTM, massage, modalities, exercise are used to treat persistent neck discomfort.

IASTM is derived from the conventional Chinese medicine, which was called as "gua sha" in another source and as "strigil" in classical Greece and Rome. It is based on James Cyriax's cross friction massage, which is used to treat connective tissue issues as well as musculoskeletal issues. IASTM's primary goals are to lessen discomfort, promote soft tissue mobility, and enhance joint ROM and function. In other words, this technique causes micro trauma to give connective tissue its normal suppleness and functionality.[3] IASTM, which is a helpful technique for treating trigger points and accompanying discomfort, is instrument-assisted soft tissue mobilisation. IASTM is the use of a specifically made device to soft tissue mobilisation, with the goal of minimising discomfort and enhancing ROM and function. IASTM allows for greater penetration to better reach fascia and remove limitations while reducing stress on the practitioner's hand.[2]

Strapping massage that concentrates on the skeletal muscle and fascia's deeper levels. Manually deactivating myofascial trigger points using a direct approach is said to be a reliable and secure technique. When SM is applied to sore muscles, it can lead to ischaemia and reflexive hyperaemia. As a result of the increased local blood flow, the muscles and fascia are more flexible, adhesions are broken down, and pain perception is lessened.[2] Massage treatment frequently includes manipulating soft tissues with the hands, such as the muscles and tendons, in order to stimulate blood flow, relax tension in the muscles, and foster feelings of increased wellness. It is typical for patients to seek massage treatment from a massage therapist, physical therapist, or other competent health practitioner when they experience persistent neck discomfort and stiffness.[2] In this review article use different type of massage such as strapping massage, classical massage, ischemic compression massage, traditional soft tissue mobilization.

This is the first study related to IASTM and Massage.

The purpose of this study was to assess and evaluate the effects of instrument-assisted soft tissue mobilization (IASTM) and massage on neck pain.

Methods

For assessing the research studies on IASTM and massage for all type of neck pain, we used two electronic databases (Google Scholar and PubMed). All relevant studies had to be published in the English language between 2016 and 2023. For the IASTM and massage on chronic neck pain, myofascial neck pain, and neck syndrome, we looked at a total of 10 papers. Figure 1 shows the procedure used to determine eligible studies. Suitable research included RCT: Randomised controlled trial A RCT examines the results of two groups of individuals who were randomly assigned to either an intervention group (such as IASTM) or a control group (such as massage). There were no restrictions on the type, length, or duration of IASTM or massage. IASTM evaluation studies were among the eligible intervention studies:- Bat board (B-shaped), Hook board (S-shaped), Search board (c-shaped), Triangle board (A-shaped), and Big M board (M-shaped) as opposed to Swedish,

deep- tissue, Swedish, and classical massage. Common neck pain, chronic nonspecific neck pain, chronic mechanical neck pain, and myofascial pain syndrome of the neck are all examples of neck pain problems. Studies pertaining to other medical issues were not included.

Outcome measures used neck pain intensity, and neck disability and secondary outcomes measure were quality of life (QOL) neck range of motion (ROM), visual analogue scale(VAS). because all forms of neck discomfort were assumed to be assessed using these criteria.

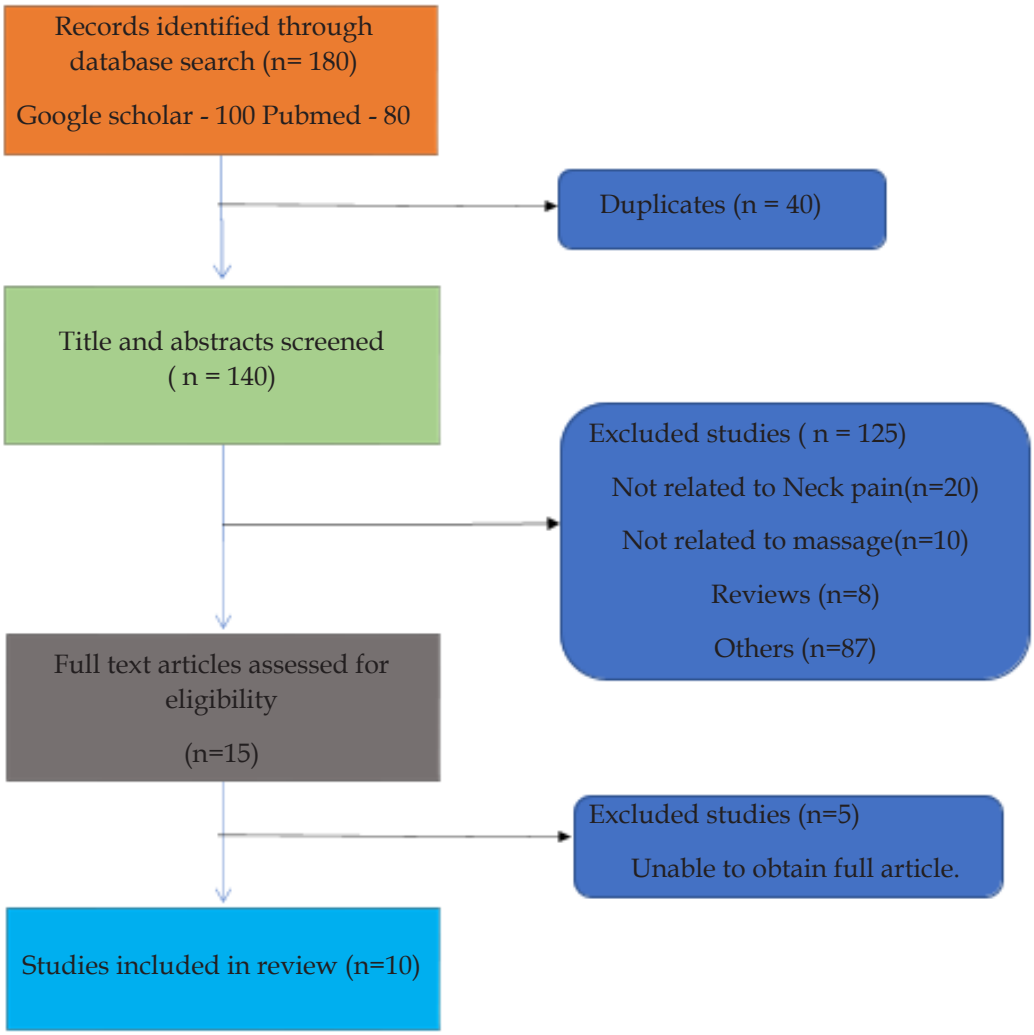

Fig: 1. Flow diagram of eligible studies

Table 1: Characteristics of Eligible studies

AUTHOR	YEAR	REGION	DESIGN	SAMPLE SIZE (MEAN AGE IN YEARS)	TYPE OF NECK PAIN	COMPARISION	PROGRAM LENGTH	OUTCOME MEASURES	RESULTS/CONCLUSION
Konstantinos Mylonas1 et al.	2021	Greece	Randomized	20 (43-65)	Cervical Vertebral Angle	IASTM+ Classical Massage Neuromuscular Exercise	4 Weeks	- VAS - Neck Disability Index	- Combined IASTM and classical massage give significantly greater improvement in CVA. - IASTM was give significant effect on cervical pain.- (P=0.080)
Hend A. Hamdy 2 et al.	2020	Egypt	Randomized Clinical Trial	30 (18-29)	Chronic Neck Pain	IASTM+Strapping Massage	4 Weeks	- VAS - Neck Disability Index - Pressure Pain Threshold	- IASTM has more effective methods for improving pain and function in patients with upper trapezius trigger points. - (p<0.001)
Zehra GüçhanTopcu[3] et al.	2022	Cuyprus	Randomized Clinical Trial	52 (10-11)	Chronic Neck Pain	IASTM + Classical Massage	6 Weeks	- ROM - Pressure Pain Threshold	- IASTM could be more effective for Neck Pain. - Long term effect gets with a combination of neck exercises. - (P>0.05)
Dr. Konstantinos Fousekis[4] et al.	2020	Greek	Randomized Clinical Trial	20 45-65	Mechanical Neck Pain	IASTM+Classical Massage Some set of exercise	4 Weeks	- VAS - NDI - ROM	- IASTM and classical Massage with some set of exercise can improve the neck pain and

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									functional status and induce positive postural adaption. - (P=0.080)
Dr. Rajas Edgaonkar[5] et al.	2020	India	Experimental Study	30 18-21	Chronic Myofascial Neck Pain	IASTM + Ischemic Compression Massage	2 weeks	- Numerical pain rating scale (NPRS) - Cervical rang of motion - Pressure Pain Threshold	- IASTM Showed better result than ischemic compression in reliving trapezius trigger point or neck pain - (P<0.001)
HebatallaM. Said Zaghloul[6] et al.	2022	Egypt	Randomized Clinical Trial	30 (20-40)	Mechanical Neck Pain	IASTM + mobilization massage	4weeks	- NPRS - CROM - NDI	- The upper thoracic spine mobilization was effective at increasing the range of motion of the cervical region, while the IASTM was effective at relieving pain and dysfunction in the cervical spine in patients with mechanical neck pain - (P<0.05)
Bonsol, John Paul[7] et al.	2022	California	Randomized	18-30	Neck pain	IASTM + Traditional Soft Tissue Mobilization	3 Months	- Neck disability index (NDI) -The visual analog scale (VAS)-	- In this systematic review found inconclusive evidence that the utilization of IASTM was

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									favorable over STM - The 7 results of the systematic review found IASTM to be an effective treatment for neck pain($p>0.05$)
Hasan Gercek[8] et al.	2022	Turkey	Randomized control Trial	39 (18-65)	Chronic Neck Pain	IASTM	6 Weeks	- VAS	- IASTM performed better than other groups analyzed in terms of VAS scores. - IASTM decrease VAS and increase joint position error. - ($P<0.05$)
Erden Arzu[9] et al.	2020	Turkey	Randomized Clinical Trial	22 (36.86 + 10.28)	Myofascial Neck Pain	IASTM + Massage Physiotherapy intervention	4weeks	- VAS - NDI - QOL	- There is found IASTM effect is more significant on neck pain as compare to massage.($p=0.05$)
Mohamed Serag Elden Mostafa[10] et al.	2019	Turkey	Randomized Clinical Trial	30 (25-40)	Mechanical Neck Pain	IASTM + Neuromuscular exercise proprioceptive isometric	4weeks	- VAS	- IASTM has a favorable effect than conventional treatment in reduction mechanical neck pain. - ($P<0.05$)

Results

Based on the provided information, a database search was conducted which resulted in the identification of 180 records. Out of these, 80 were found through Pubmed and 100 were found through Google Scholar. Upon screening the titles and abstracts of these records, 30 duplicates were identified and removed, resulting in a total of 140 unique records. Out of these, 125 records were excluded from the review for various reasons, including 20 not being related to neck pain, 10 not being related to massage, and 8 being reviews.

After this screening process, a total of 15 full-text articles were assessed for eligibility. Out of these, 5 articles were excluded as it was not possible to obtain the full article. Finally, 10 studies were included in the review.

328 participants from the final 10 qualifying trials were examined. Table 1 illustrates the main features of research that qualify.

In almost all investigations, the iastm significantly reduced the severity of neck pain, neck impairment, cervical range of motion, anxiety, and quality of life. The current study's findings support earlier meta-analyses and studies on the impact of ISTM on neck discomfort.

Conclusion

This evaluation was conducted to assess the effectiveness of IASTM and massage for treating different kinds of neck pain. As far as we are aware, this study is the first evaluation of IASTM and Massage for all type of neck pain. Only chronic neck discomfort or chronic neck pain were included in previous reviews. It was discovered that IASTM significantly reduced anxiety, improved pain tolerance, increased range of motion, and decreased the severity of neck discomfort and functional handicap. IASTM could be a helpful remedy for neck discomfort, however further study is required before making certain judgements. Included studies for neck pain found that IASTM performed better than massage.

Ethical Clearance: Not required as it is a review paper.

Source of Funding: Self

Conflict Of Interest: Nil

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Research Article

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The Effect of Ethanoic Extract of Xylopiaaethiopica (UDA) on Pain Sensitivity of Female Wistar Rats

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Abstract

Background: In African traditional medicine, the dried pods of Xylopia aethiopica are frequently used to manage different human ailments. In Nigeria, it is consumed in soups after childbirth to aid in wound healing, pain relief, uterine recovery, and lactation. The study investigates the impact of Xylopia aethiopicafruit extract on pain sensitivity using Wistar rats.

Methods: Twelve female Wistar rats were divided into two groups (Group 1 - Control and Group 2 -100mg/kg Xylopia aethiopicaextract-fed) and received standard rat chow and water for fourteen days following which pain sensitivity was assessed using a hot plate. The results were presented as Mean and Independent Student T-test was utilized for statistical analysis with significance determined at P≤0.05. Increased pain tolerance indicated reduced sensitivity.

The escape latencies of both groups were 5secs and 8 secs respectively. Group 2 demonstrated a noteworthy increase in pain tolerance compared to Group 1 (P = 0.003). This experimental study indicates that the ethanoic extract of Xylopia aethiopicafruit has analgesic properties.

Conclusion: The result of this study provides support for the use of dried Xylopia aethiopicapods in pain management across some communities in Southern Nigeria.

Keywords: Pain Sensitivity, Xylopia aethiopica, Hot plate test.

Introduction

Xylopia aethiopica, commonly known as Negro Pepper, holds distinct names within different Nigerian tribes. Among the Igbo tribe in the South-Eastern Region, it's called Uda, while the Yorubas in the South-West refer to it as Eeru Alamo. In the Northern region, the Hausa Tribe knows it as Chimba. This aromatic tree can grow to heights of 15–30 meters and have diameters of 60–70 centimeters. It's indigenous to lowland rainforests and moist fringe forests in the savanna zones of Africa, particularly in the West, Central, and Southern regions, as indicated by Godam et al. in 2021 and Erhirhie EO et al. in 2014[1].

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Figure 1: Dried and fresh Xylopiaaethiopica fruit with stems and leaves

Source: Ahamefula. A. Ahuchaogu, et.al, "Chemical Constituents of Methanol Fruit Extract of Xylopia aethiopica by GC-MS and FT-IR Spectroscopy", ARC Journal of Pharmaceutical Sciences, 6(1), pp. 14-24. DOI: http://dx.doi.org/10.20431/2455-1538.0601003

The term X. aethiopica originates from the fusion of two words with Greek and Ethiopian roots: Xylopia (derived from the Greek word "xylonpikron" denoting 'bitter wood') and aethiopica (from Ethiopian origin, its meaning understood). According to Burkhill[2] (1985), X. aethiopica holds numerous applications. For instance, the wood from this tree is widely used in constructing huts and boats. The fruit serves as a valuable spice in African culinary traditions, enhancing local dishes like Hausa koko, isi-ewu, and Obeata, as observed by Tairu, Hofmann, and Schieberle[3] in 1999.

X. aethiopicais a useful medicinal plant with Central Nervous System activities including neuroprotection and anti-inflammatory properties (Biney et al., 2016)[4]. Agbarukwu et al.[5] (2017) reported the used of X. aethiopica for management of rheumatism, headache, neuralgia, colic pain, bronchitis, and asthma. In traditional medicine, X. aethiopica is used for soups during post-delivery care (for discharge of placenta) (*ibid*) and for uterine contraction (post-delivery) together with T. tetraptera(Durugbo et al, 2013)[6].

Pain constitutes an uncomfortable emotional sensation that can manifest with or without physical tissue harm. It's characterized by descriptors such as sharp, dull ache, or shooting, and can elicit responses like crying and even fainting. Pain emerges from either an actual or potential injury to the body, often explained by its origin, such as the fiery sensation from a burn or the cramping resulting from muscle contraction. Pain falls into two categories: acute or chronic. Acute pain is transient and intense, often having a clear cause. Initially, it might be localized before potentially spreading. Typical treatment involves medication. On the other hand, chronic pain is persistent, with varying levels of severity. It extends over prolonged periods and poses greater challenges in management, frequently necessitating specialized professional attention. (Sembulingam, 2012)[7]

Materials and Method

A. Collection, Identification and Preparation of Plant Materials

As part of a Neurobehavioral investigation, the experiment took place from February to April 2023 at the Animal Farm situated within the College of Health Sciences at the University of Port Harcourt. Dried Xylopia aethiopica pods were acquired from a local market in Obio-Akpor Local Government Area, Rivers State. To ensure the plant's authenticity, Dr.Ajuru from the Department of Plant Science and Biotechnology at Rivers State University, Nigeria, verified it. The pods underwent drying and grinding, eventually becoming a powder. Following a method outlined by Abubakar et al.[8] in 2020, the extraction process utilized maceration. Additional pulverization of the pods into fine powder was accomplished using a laboratory manual blender. The extracted powders were quantified and recorded. Each sample's powder was soaked in 70% ethanol for three days, intermittently stirred, and filtered on the third day. Post-extraction, the micelle was separated from the menstruum through water bath-assisted evaporation.

Referring to prior research by Akinloye et al. in 2019[9], the LD50 (lethal dose for 50% of the population) for Xylopia aethiopica was determined as 3,464 mg/kg. As a result, a dose of 100 mg/kg based on body weight was administered for this study.

B. Experimental Animals and Management

A total of twelve Female Wistar rats were obtained from the animal facility within the Faculty of Basic Medical Sciences at the University of Port

Harcourt. These rats were accommodated in cages and maintained within their natural environmental settings. Their sustenance included a regular diet sourced from Flour Mill Port Harcourt. At the onset, their weights spanned from 87g to 103g. Before commencing the experiment, their weights underwent measurement. The research conducted was in alignment with the guidelines set forth by the European Community for the utilization and welfare of laboratory animals, as outlined in the year 1986.

C. Study Design

Twelve female rats were divided randomly into two groups, with each group containing six rats:

1. Group 1 (Control Group): Rats in this group were given distilled water and rat chow for a duration of 14 days.
2. Group 2 (Test Group): Rats in this group were administered 100mg/kg of Xylopia aethiopica along with rat chow and distilled water for a period of 14 days.

D. Determination of Pain Sensitivty

The hot-plate test assesses how test animals are to pain induced by heat. It involves exposing subjects to quick, intense bursts of thermal stimulus. The objective is to measure the time it takes for a response, such as an attempt to escape, assuming that quicker reactions correspond to having a lower threshold for pain. This procedure is conducted by placing rats on a heated surface within a glass enclosure equipped with a foot pedal connected to a timer. The heated surface reaches a temperature of 55°C, and rats are introduced individually within plastic containers. Once the desired reaction is observed, the timer is stopped. If the rat doesn't react within 30 seconds, the test is concluded. The parameter that's measured is the escape latency, which indicates the duration the rat requires to try to move away from the heated surface.

Results and Discussion

The results revealed that on average the rats in Group 1 had an escape latency of 5 secs, while those in Group 2 had a latency of 8secs. Group 2 demonstrated a noteworthy increase in pain tolerance compared to Group 1 (P = 0.003).

Table 1: The Escape Latency of the Wistar Rats in Group 1 and Group 2 During the Hot Plate Test

ESCAPE LATENCY (Secs)		
Seq	**Group 1 -Control**	**GROUP 2 - Fed with 100mg/kg X. aethiopica**
R1	4	9
R2	3	6
R3	6	10
R4	6	7
R5	5	8
R6	6	8
Average	5	8

T-Test of Significance for Pain Sensitivity

Table 2: The Independent Student T-Test of Significance of the Escape Latency of the Wistar Rats in Group 1 and Group 2

Group Statistics					
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Escape_latency	Control	6	5.0000	1.26491	.51640
	Fed with 100mg/kg of Xylopia aethiopica	6	8.0000	1.41421	.57735

Independent Samples Test										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
ESCAPE_ LATENCY	Equal variances assumed	.000	1.000	-3.873	10	.003	-3.00000	.77460	-4.72591	-1.27409

An independent-samples t-test was conducted to determine whether there is a difference in the escape latency between the control group (Group 1) and the group fed with 100mg/kg of X. aethiopica (Group 2). The results indicate a significant difference between Group 1 (M=5.0000, SD=1.26491) and Group 2 (M=8.0000, SD=1.41421), [t (10) = -3.873, p = .003 < .05]. The magnitude of the mean difference was -3.00000, the 95% confidence interval of the difference between means ranged from [-4.72591 to -1.27409] and indicates a difference between the means of the sample. Consequently, we reject the null hypothesis that there is no difference between the sample means.

The outcomes of this test indicated that Xylopia aethiopica extract possesses analgesic properties, consistent with the findings reported by Woode et al., 2012[10], which demonstrated similar results in the tail-flick test and formalin-induced nociceptive test following administration of the extract.

Conclusion

Pain is a significant, uncomfortable, and distressing sensation that has the potential to cause harm to tissues and subsequent damage. In Nigeria, various medicinal plants are frequently employed to reduce sensitivity to pain, thereby enhancing the ability to withstand pain. Xylopia aethiopica is commonly used in different regions, particularly among postpartum women, to accelerate wound healing and expedite the recovery process. This research demonstrates that X. aethiopica contributes to an increased capacity to endure pain and supports the utilization of dried Xylopia aethiopica pods for pain management within certain Nigerian communities.

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Ethical Approval: Taken from the Ethics Committee, College of Medical Sciences, Rivers State University

Conflict of Interest: Nil

Source of Funding: Self

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Research Article

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The Effect of Ethanoic Extract of Tetrapleuratetraptera (Uyayak) on Pain Sensitivity of Female Wistar Rats

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Abstract

Background: In African traditional medicine, the dried pods of Tetrapleura tetraptera are frequently used to manage different human ailments. In Nigeria, it is consumed in soups after childbirth to aid in wound healing, pain relief, uterine recovery, and lactation. The study investigates the impact of Tetrapleura tetraptera fruit extract on pain sensitivity using Wistar rats.

Methods: Twelve female Wistar rats were divided into two groups (Group 1 - Control and Group 2 -100mg/kg Tetrapleura tetraptera extract-fed) and received standard rat chow and water for fourteen days following which pain sensitivity was assessed using a hot plate. The results were presented as Mean and Independent Student T-test was utilized for statistical analysis with significance determined at P≤0.05. Increased pain tolerance indicated reduced sensitivity.

The escape latencies of both groups were 5secs and 10secs respectively. Group 2 demonstrated a noteworthy increase in pain tolerance compared to Group 1 ($P < 0.05$). analgesic This experimental study indicates that the ethanoic extract of Tetrapleura tetraptera fruit has properties.

Conclusion: The result of this study provides support for the use of dried Tetrapleura tetraptera pods in pain management across some communities in Southern Nigeria.

Keywords: Pain Sensitivity, Tetrapleura tetraptera, Hot plate test.

Introduction

Tetrapleura Tetraptera, commonly known as "Aidan fruit," is a plant native to West Africa, particularly the rainforest regions. It holds cultural significance in various culinary practices within this area. Referred to as Uhio in the Ibo-ethnicities and Uyayak by the Efik communities both in Southern Nigeria.

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T. tetraptera serves multiple purposes, yielding products such as timber, tannins, perfumes, aromatic oils, spices, and herbs. In Nigeria, it is used as an aromatic spice for local dishes either alone or in combination. In African postpartum practices, various herbs and mixtures are given to new mothers to enhance breast milk production and support uterine recovery. Tetrapleura tetraptera is one such herb, commonly used for this purpose. The dried fruit pods of the plant are employed in preparing soups that postpartum women consume to aid in uterine involution. These soups are typically consumed from the day of delivery onward (Kemigisha et al., 2018)[1].

Figure 1: T. tetraptera at fruiting stage

Source: Tetrapleura tetraptera Taub- Ethnopharmacology, Chemistry, Medicinal and Nutritional Values- A Review - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/T-tetraptera-at-fruiting-stage_fig1_30527014

Pain is an unpleasant emotional experience that can occur with or without actual tissue damage. It's described using terms like sharp, dull ache, shooting, etc., and can lead to reactions like crying and fainting. Pain results from actual or potential bodily injury and is often described in terms of its source, such as a burning sensation from fire or cramps from muscle contraction. Pain can be categorized as acute or chronic. Acute pain is short-lived and sharp, with a clear cause, usually localized initially before spreading. It's commonly treated with medications. Chronic pain, on the other hand, is ongoing and can vary in intensity. It lasts for extended periods and is more challenging to manage, often requiring specialized professional care. (Sembulingam. 2012)[2].

Materials and Method

A. Collection, Identification and Preparation of Plant Materials

The experiment was carried out Between February and April 2023 at the Animal Farm of the College of Health Sciences in the University of Port Harcourt. Dried Tetrapleura Tetraptera pods were procured from a local market in Obio-Akpor Local Government Area, Rivers State. The plant's authenticity was confirmed by Dr. Ajuru from the Department of Plant Science and Biotechnology at Rivers State University, Nigeria. The pods were dried and ground into a powder. Following a technique described by Abdullahi et al.[3] in 2020, maceration was employed for extraction. The pods were further pulverized into fine powder using a laboratory manual blender. The extracted powders were weighed and documented. Each sample's powder was infused in 70% ethanol over three days with intermittent stirring, followed by filtration on the third day. After extraction, the micelle was separated from the menstruum through evaporation on a water bath.

Based on previous research by Jimmy et al.[4] in 2016, the LD50 (lethal dose for 50% of the population) of Tetrapleura tetraptera is 244.94 mg/kg. Consequently, a dose of 100 mg/kg of body weight was used in this study.

B. Experimental Animals and Management

Twelve Female Wistar rats were sourced from the animal house at the Faculty of Basic Medical Sciences, University of Port Harcourt. They were housed in cages and kept under natural environmental conditions. The rats were provided with a standard diet from Flour Mill Port Harcourt. Their initial weights ranged from 87g to 103g. Before starting the experiment, their weights were measured. The study adhered to the principles outlined in the European Community guidelines for the use and care of laboratory animals, as established in 1986.

C. Study Design

Twelve female rats were divided randomly into two groups, with each group containing six rats:

1. Group 1 (Control Group): Rats in this group were given distilled water and rat chow for a duration of 14 days.
2. Group 2 (Test Group): Rats in this group were administered 100mg/kg of Tetrapleura Tetraptera along with rat chow and distilled water for a period of 14 days.

D. Determination of Pain Sensitivty

The hot-plate test evaluates sensitivity to heat-induced pain by exposing subjects to brief, intense thermal stimuli. It gauges the time taken for a response (escape attempt), assuming faster reactions indicate lower pain thresholds. Rats are positioned on a heated surface within a glass cage, equipped with a timer-linked foot pedal. The surface temperature reaches 55°C, and rats are introduced in plastic containers, individually. Once the desired behaviour is observed, the timer halts. If the rat doesn't respond within 30 seconds, the test concludes. The measured behavior is the escape latency, representing the time the rat takes to attempt moving away from the heated surface.

Results and Discussion

The results revealed that on average the rats in Group 1 had an escape latency of 5±0.51 seconds, while those in Group 2 had a latency of 10±0.86 seconds. Group 2 demonstrated a noteworthy increase in pain tolerance compared to Group 1 ($P < 0.05$).

Table 1: The Escape Latency of the Wistar Rats in Group 1 and Group 2 During the Hot Plate Test

ESCAPE LATENCY (Secs)		
Seq	**Group 1 -Control**	**GROUP 2 - Fed with 100mg/kg T.tetraptera**
R1	4	12
R2	3	10
R3	6	7
R4	6	8
R5	5	11
R6	6	12
Average	5	10

Test of Significance For Pain Sensitivity

Table 2: The Independent Student T-Test of Significance of the Escape Latency of the Wistar Rats in Group 1 and Group 2

Group Statistics					
	GROUP	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
ESCAPE_LATENCY	CONTROL	6	5.0000	1.26491	.51640
	Fed with 100mg/kg of Tetrapleura tetraptera	6	10.0000	2.09762	.85635

Independent Samples Test										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
ESCAPE_ LATENCY	Equal variances assumed	1.818	.207	-5.000	10	.001	-5.00000	1.00000	-7.22814	-2.77186

An independent-samples t-test was conducted to determine whether there is a difference in escape latency between the control group (Group 1) and the group fed with 100mg/kg of T. tetrapleura (Group 2). The results indicate significant difference between Group 1 (M= 5.0000, SD=1.26491) and Group 2 (M=10.0000, SD=2.09762), [t (10) =-5.000, p = .001 > .05]. The magnitude of the mean difference was-5.00000, the 95% confidence interval of the difference between means ranged from [-7.22814 to -2.77186]

and indicates a difference between the means of the sample. Consequently, we reject the null hypothesis that there is no difference between the sample means.

This study revealed that the control group exhibited a significantly lower escape latency than the test group. This experimental study indicates that the ethanoic extract of Tetrapleura tetraptera fruit has analgesic properties. The outcomes of this test corroborates with the findings reported by Ojewole, 2005[5] that Tetrapleura tetraptera extract possesses analgesic properties.

Conclusion

Pain is an important unpleasant and distressing stimuli with a potential for tissue injury and subsequent damage. In Nigeria, several medicinal plants are often administered to decrease pain sensitivity hence increasing pain tolerance. Tetrapleura tetraptera is often utilized across various locales especially among postpartum women to promote wound healing and hasten the recovery process. This study revealed that T. tetraptera increases pain tolerance and supports the use of dried Tetrapleura tetraptera pods in pain management across some communities in Nigeria.

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