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Exploring The Anti-Inflammatory Properties Of Amla In Occupational Health

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Abstract

Medicinal plants are invaluable natural resources that have played a significant role in human health and well-being for centuries. According to the World Health Organization (WHO), approximately 80 per cent of the population in developing countries depends on traditional medicine for primary healthcare needs. Amla is widely recognized for its therapeutic, nutritional, and occupational health benefits. It is rich in antioxidants, vitamin C, polyphenols, flavonoids, and essential minerals. Amla has been extensively used in Ayurvedic and Unani medicine for treating various ailments, including inflammation, diabetes, cardiovascular diseases, and cancer. A Cross Sectional Study was done among the workers based on their occupation in Kalikampatti Village, Athoor Block, Dindigul District, Tamil Nadu. Occupational health is a critical aspect of community well-being, particularly in rural areas where workers are exposed to ergonomic risks, strenuous labor, and limited healthcare access. The study also explores occupational health challenges among the workers and address the role of Amla **(***Phyllanthus emblica***)** as a therapeutic intervention to improve worker health. The aim of the study is to find the socio-economic profile and to assess the common occupational health issues faced by the workers in Kalikampatti Village. The present study further explores ergonomic risk factors and musculoskeletal disorders among workers, highlighting gender-based differences in exposure to postural risks and work-related pain conditions. Findings of the study shows that females experience higher ergonomic strain due to bending, squatting, and repetitive tasks, while males are more exposed to prolonged standing and lifting**.** These insights emphasize the potential of Amla-based dietary interventions and workplace modifications in reducing musculoskeletal strain and improving occupational health outcomes**.** The study concludes that Amla's anti-inflammatory, antioxidant, and musculoskeletal benefits make it a valuable natural remedy for enhancing worker health and productivity.

Further research is recommended to explore its long-term efficacy in occupational settings and formulate evidence-based health interventions**.**

Keywords: *Amla, Antioxidant, Musculoskeletal, Occupation, Ergonomic risks*

Introduction

Medicinal plants are the most precious creation of nature which is the ultimate gift for all the creatures includes mankind also. It plays vital role for maintaining the human health. According to WHO survey 80 per cent of the populations living in the developing countries rely almost exclusively on traditional medicine for their primary health care needs and play an important role in health care system of remaining 20 per cent of population. Amla (Indian gooseberry) is a gift of nature to mankind. It is an indispensable part of the ayurvedic and unani system with amazing remedial qualities. Phyllanthus emblica fruit is one of the top selling botanicals having diverse applications in healthcare, food and cosmetic industry (Fatema Pria, 2019).

Phyllanthus emblica (Indian gooseberry or Amla) which are the natural product found to be very much beneficial for the society and mankind. Various types of dried and fresh fruits of the plant are used in traditional Indian medicine. Including the fruit, seed, leaves, root, bark and flowers, all parts of the plant are used in various Ayurvedic herbal medicine preparations. The amla fruit is sour and astringent with sweet, bitter and pungent secondary taste according to Ayurveda. Amla is also known as Indian gooseberries (Phyllanthus emblica) which grows on a flowering tree of amla. These are round and bright or yellow-green in colour. Several health benefits such as antioxidants and vitamins are found in amla berries [6]. Amla is a small to medium sized deciduous tree, found in throughout India, Pakistan, Uzbekistan, Sri Lanka, South East Asia, China and Malaysia. It grows about 8-18m height with thin light grey bark, leaves are simple, light green, sub-sessile, closely set along the branchlets looks like pinnate leaves; flowers are greenish yellow; fruits are globose, fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds in two seeded three crustaceous cocci [3].

Table 1

Taxonomical Classification

Kingdom	*Plantae*
Division	*Flowering Plant*
Class	*Magnoliopsida*
Order	*Malpighiales*
Family	*Phyllanthacae*
Tribe	*Phyllantheae*
Subtribe	*Fluegginae*

(Singh et al., 2012)

Morphology

Morphology Amla tree is a small to medium sized deciduous tree with an average height of 8-18 m, with thin light grey bark exfoliating in small thin irregular flakes, exposing the fresh surface of a different color underneath the older bark. The average girth of the main stem is 70 cm. In most cases, the main trunk is divided into 2 to 7 scaffolds very near to the base. Leaves are 10 -13 mm long, 3 mm wide, closely set in pinnate faishon which makes the branches feathery in general appearance. After setting of the fruits leaves develop. Flowers are unisexual, 4 to 5 mm in length, pale green in color, borne in leaf axils in clusters of 6 to 10. Fruits are fleshy, almost depressed to globose shape, 2.1-2.4 cm in diameter, 5.3-5.7 g in weight, 4.5-5.0 mL in volume. The stone of the Amla tree is a small to medium sized deciduous tree with an fruit is 6 ribbed, splitting into three segments each average height of 8-18 m, with thin light grey bark exfoliating in small thin irregular flakes, exposing the fresh surface of acontaining usually two seeds; seeds are 4-5 mm long and 2-3 mm wide, each weighing 572 to 590 mg [6].

Chemical Composition of Amla

One of the plants that has been examined the most is amla. According to reports, it includes phenols, alkaloids, and tannins. Twenty-eight per cent of the total tannins found in the plant are found in the fruits. The fruit includes two antioxidant-rich hydrolyzable tannins called Emblicanins A and B. One of these tannins, when hydrolyzed, produces gallic acid, ellagic acid, and glucose, while the other yields ellagic acid and glucose. Phyllemblin can also be found in the fruit. The existence of many phytochemicals, including gallic acid, corilagin, furosin, and geraniin, was discovered using activity-directed fractionation. There are alkaloids like phyllantine and phyllantidine as well as flavonoids like quercetin. Along with this, it predominantly comprises the substances listed in Table 1 along with amino acids, carbs, and others. The maximum quantity of vitamin C (478.56 mg/100 mL) is found in its fruit juice. Nutritional worth Amla is renowned for its dietary benefits. It is regarded as one of the richest sources of vitamin C (200–900 mg per 100 g of edible portion), as well as being rich in minerals and polyphenols [1].

Table 2

Chemical Constituent from Different Plant Parts of Amla

Fruit pulp (Kumar., et al. 2012)	Leaves (Singh., et al. 2011)	Seed (Khan, 2009)
Moisture Mineral	Gallic Acid	Fixed Oil
Crude Cellulose Albumin Gum	Chebulic Acid	Phosphatides Essential oil
Tannin Gallic Acid	Ellagic Acid	Seed (Khan, 2009)
Fruit pulp (Kumar., et al. 2012)	Chebulinic Acid	-
Moisture Mineral	Amlic Acid Alkaloids	-
Crude Cellulose Albumin Gum	Phyllantine	-
Tannin Gallic Acid	Phyllantidine	-

(Ikram et al., 2021)

Nutritional composition of Amla

Amla (Emblica officinalis) is one of the most widely studied as well as highly beneficial fruit that is gifted to us by Mother Nature. The amla fruit contains carbohydrate (82.91 gm/100g), protein (6.04 gm/100g), fiber (2.78 gm/100g), ash (2.3%/100g), fat (0.51 gm/100 gm) and high moisture content (82.76 g/100 gm). A fresh fruit of amla contains several water soluble vitamins like Biotin (1.42 µg/100 gm), thiamine (0.01 mg/100 gm), riboflavin (0.03 mg/100 gm), niacin (0.12 mg/100 gm), pantothenic acid (0.35 mg/100 gm), pyridoxine (0.27 mg/100 gm), and fat soluble vitamins like ergocalciferol (0.27 mg/100 gm), phylloquinones (1.64 µg/100 gm), α- tocopherol (0.11 mg/100 gm), γ-tocopherol (0.01 mg/100 gm), δ-tocopherol (0.06 mg/100 gm) and α- tocotrienol (0.05 mg/100 gm). According to various studies it has been revealed that amla is a rich source of vitamin C having about 478.56 mg ascorbic acid per 100 g of serving It is a rich source of various major minerals like potassium (282.0 mg/100 gm), phosphorous (21.85 mg/100 gm), calcium (20.14 mg/100 gm), magnesium (6.50 mg/100 gm), and sodium (1.37 mg/100 gm) which are also classified as electrolytes in our body. Furthermore, trace minerals like iron (1.2 mg/100 gm), chromium (0.82 mg/100 gm), zinc (0.23 mg/100 gm), copper (0.22 mg/100 gm), manganese (0.11 mg/100 gm), aluminium (0.08 mg/100 gm), nickel (0.010 mg/100 gm) lead (0.001 mg/100 gm), lithium (0.001 mg/100 gm), and molybdenum (0.001 mg/100 gm), are also present in amla, needed in small amounts but are very essential for proper growth and development of body. The fruit is also a rich source of various essential, semi-essential and non- essential amino acids. The major essential amino acids present in amla fruit are, lysine (23.6 mg/100 gm), phenylalanine (4.85 mg/100 gm), leucine (4.25 mg/100 gm), threonine (3.30 mg/100 gm), valine (2.99 mg/100 gm), histidine (2.40 mg/100 gm), isoleucine (1.49 mg/100 gm), tryptophan (0.75 mg/100 gm), and methionine (0.73 mg/100 gm) [7].

Occupational health Benefits of Amla

Anti-inflammatory, Antipyretic and Analgesic effect or Activity

Extracts of Emblica officinalis leaves and fruits possess potent anti-inflammatory, anti- pyretic as well as analgesic activity. Fruit extracts of Emblica officinalis possess potent anti-pyretic and analgesic activities. A single Oral dose of ethanolic extract and aqueous extract (500 mg/kg) showed significant reduction in hyperthermia in rats induced by brewer's yeast, both of these extracts elicited pronounced inhibitory effect on acetic acid- induced writhing response in mice in the analgesic test. This may be due to the presence of tannins, alkaloids, phenolic compounds, amino acids and carbohydrates Yet in other research studies, fruit extract was found to be an effective anticoagulant and anti-inflammatory agent as it potentially and significantly reduced lipopolysaccharide (LPS)-induced tissue factor expression and von Willebrand factor release in human umbilical vein endothelial cells (HUVEC), it also decreased the concentrations of pro- inflammatory cytokines, TNF-a and IL-6 in serum on oral administration of the amla fruit extract (50 mg/kg body weight. Further, the Beta-glucogallin an aldose reductase inhibitor that catalyzes the reduction of toxic lipid aldehydes to their alcohol products and mediates inflammatory signals triggered by lipopolysaccharide (LPS) was isolated from Emblica officinalis. This molecule may be a potential therapy for inflammatory diseases [2].

Anti-ulcers characters or Activity

A herbomineral Ayurvedic formulation called Pepticare has been analyzed for its anti-ulcer and antioxidants in rats consisting of Emblica officinalis, Tinospora cordifolia, and Glycyrrhiza glabra. Peptic has anti-ulcer attitudes, due to its antioxidant properties. Emblica officinalis extract was tested for the treatment of ulcers. Emblica officinalis extract has powerful curative and therapeutic impacts on the ulcer, which can affect both defense and offensive mucosal factors.

Cardio-protective activity

The chronic effects of Amla's homogeneous and fresh fruit as oral administration on myocardial system antioxidant and Isch-Emic-Reperfusion Injury (IRI) to the oxidative stress was tested in mice. Prolonged administration stimulates myocardial adaptation through swelling endogenous antioxidants as well as secures the heart of rats against IRI-associated oxidative stress.

Antimicrobial and Antimutagenicity activities

Due to its antimicrobial activities, Emblica officinalis has been divulged. Against Escherichia coli, K.ozaenae, Klebsiella pneumonia, Proteus mirabilis, Pseudomonas aeruginosa, S. paratyphi B, and Serratia marcescens, the Emblica officinalis plant is endowed with puissant antibacterial activities. For an antimutagenic effect with a TA 98 and TA 100 Salmonella Typhimurium Test strain, using a histidine reversal assay to test a phenobarbitone-induced hepatic s9 rat, Triphala’s chloroform, water, and acetone extracts were sussed out against the direct-active mutagens, 4 nitrophenylenediamine (NPD) and sodium azide and indirect- active promoutagents, 2 Aminofluorene (2AF). The mutagenicity reticence of both direct and s9 – based mutagens in the chloroform and acetone extracts in a succession was evident [5].

Anti-Cancer and Anti-Oxidant activities

Amla is one of the richest sources of vitamin-C and low molecular weight hydrolysable tannins which makes Amla a good antioxidant. The tannins of Amla like emblicanin-A (37%), emblicanin-B (33%), punigluconin and pedunculagin are reported to provide protection against oxygen radical included haemolysis of rat peripheral blood erythrocytes. The mechanism behind antioxidant activity is due to the recycling of sugar moiety and conversion of the polyphenol into medium and high molecular weight tannins. The powerful antioxidant Ellagic acid, present in Amla, can inhibit mutations in genes and repairs the chromosomal abnormalities. Amla inhibits the growth and spread of various cancers like breast, uterus, pancreas, stomach and liver cancers. It can prevent and/or reduce the side effects of chemotherapy and radiotherapy. More than 18 compounds were identified in Amla fruit which can exert anti-proliferative activity on gastric and uterine cancer cells. The main mechanism behind its activity is by enhancing Natural Killer cell activity in various tumor cells. Emblicanin A & B of Amla fruit are reported to possess strong antioxidant and anti-cancer properties [6].

Anti-Diabetic properties

Diet has a crucial role in the treatment of diabetes and its consequences. Numerous classical herbs have been documented to have anti-hyperglycaemic and hypoglycaemic action in varied degrees. These actions appear to be achieved by higher insulin production via pancreatic cell stimulation, interfering with dietary glucose absorption, or insulin sensitization. On normal and alloxan (120 mg/kg) diabetic rats, oral

treatment of the extracts (100 mg/kg body weight) dramatically lowered blood sugar levels in 4 hours. In rats, E. Officinalis and a concentrated portion of its tannoids are efficient at delaying the onset of diabetic cataract. Aldose reductase (AR) plays a role in the development of diabetes secondary consequences, such as cataracts. Diabetic neuropathy is one of the most frequent microvascular consequences of diabetes, affecting more than half of all diabetic patients. In a study, the effects of a high flavonoid extract of E. officinalis in male Sprague-Dawley rats with diabetic neuropathy from due to type 2 diabetes [7].

Miscellaneous activities: In Osteoporosis and Dental Problems

Osteoclasts (OCs) are involved in rheumatoid arthritis and in numerous pathologies associated with bone loss. Current results support the concept that, certain medicinal plants as well as derived natural products from them are of great interest for developing therapeutic approaches against bone disorders, including rheumatoid arthritis and osteoporosis. A study reported that, extracts of amla fruits exhibit probable activity for the treatment of rheumatoid arthritis and osteoporosis by triggering programmed cell death of human primary osteoclasts. Furthermore, there is a need for effective nutraceuticals for osteoarthritis care. The roots of Phyllanthus emblica Linn. (10 g) are ground and taken twice daily for one day only after taking food. Alternatively, the leaves of Phyllanthus emblica Linn. Are squeezed to extract the juice. This juice then put in the ear (a few drops) to relief from toothache. A final alternative is to grind the node of a Phyllanthus emblica Linn. and mix it with water. After vigorous stirring it is filtered through a cloth. This water is put drop by drop in the right ear if the teeth on the left hand side are in pain and vice versa. The remedy is continuing for three days. A cytokine like substances, Zeatin is also present in amla leaves and fruits that helps in refining the mouth, strengthens teeth and bones [4].

Applications of Amla in Occupational Health

Fortifies the liver

Amla-Berry helps purify the Rasa Dhatu (nutrient fluid) and Rakta Dhatu (blood), thus supporting the functions of the liver. Amla-Berry helps purify the Rasa Dhatu (nutrient fluid)
and Rakta Dhatu (blood), thus supporting the functions of the liver. It also strengthens the liver, helping it in eliminating toxins from the body.

Strengthens the lungs

Amla-Berry is a wonderful tonic for strengthening and nourishing the lungs and the entire respiratory tract. It also pacifies Shleshaka Kapha, which among other things governs moisture balance in the lungs. A fruit with seeds used for asthma, bronchitis and biliousness.

Helps the urinary system

Because it enhances all the thirteen agnis (digestive fires) and supports Apana Vata, Amla-Berry is especially supportive to the urinary system and can be helpful if you experience a mild burning sensation while urinating. It supports natural diuretic the urinary system and can be helpful if you experience a mild burning sensation while urinating. It supports natural diuretic action, but does not force water from the body like diuretic pills. In other words, it helps eliminate waste from the body but does not over-stimulate the urinary system. In other words, it helps eliminate waste from the body but does not over-stimulate the urinary system.

Increases vitality

Because it has five tastes and supports all the doshas and many bodies' functions and cleanses the blood and the micro- channels of the body, Amla-Berry increases energy and removes fatigue. It supports regeneration of cells-the process by which tired old cells are replaced by vital, new ones.

Improves muscle tone

Amla-Berry enhances protein synthesis, which is why it is good for strengthening muscles and building lean muscle mass. Its unique Ayurvedic action offers athletes and body-builders a natural way to tone muscles and build lean mass.

Liver cancer

Only a few studies have speculated the chemopreventive effects of P.emblica against liver cancer. It was tested in vivo in wistar ratstreated with carcinogen Diethylnitrosamine (DEN) to induce liver cancer. The results showed that pretreatment of methanolic fruit extract exhibited significant pathological manifestations at both the doses. Emblica officinalis has the potential to be useful in ameliorating the carcinogen-induced response in rat.

Skin Cancer

Research indicative of chemopreventive potential of P.emblica against skin carcinogenesis [8].

Objective of the Study

- To find the socio-economic profile
- To assess the ergonomic risk factors and musculoskeletal issues faced by the workers.

Methodology

A community based cross-sectional study was conducted among workers in Kalikampatti village based on their occupation. The target group chosen for the study was based on Musculoskeletal Disorders and other physically intensive workers in the selected area. Sixty-three participants were selected through stratified random sampling. Written Informed Consent form was collected from the target group. Samples were selected based on inclusion and exclusion criteria. Those who are not willing to participate in the study was excluded. The questions were translated into the regional language. The investigator administered the questionnaire and collected it after their completion. The data was coded in SPSS version 23 for further analysis.

Table 1

Demographic and Socioeconomic status of the Workers

Variables	N = 23 Female		N = 40 Male	
	No.	%	No.	%
Age				
40-50 years	12	52.2	16	40.0
51-60 years	11	47.8	16	40.0
>60 years	-	-	8	20.0

Socio Economic Status				
Lower Class (<5)	5	21.7	8	20.0
Upper Lower Class (5-10)	11	47.8	19	47.5
Lower Middle Class (11-15)	7	30.4	13	32.5
Upper Middle Class (16-25)	0	0	0	0
Upper Class (26-29)	0	0	0	0
BMI				
Underweight (<18.5)	9	39.1	9	22.5
Normal (18.5-24.9)	7	30.4	17	42.5
Obesity Grade I (30.0-34.9)	7	30.4	14	35.0

The study presents demographic and health-related characteristics of 23 female and 40 male participants, categorized by age, socio-economic status, and Body Mass Index (BMI). Among females, 52.2 per cent fall within the 40-50 years age group, and 47.8 per cent belong to the 51-60 years category. None of the females are above 60 years of age. In contrast, males are more evenly distributed across age groups, with 40.0 per cent in both the 40-50 and 51-60 years groups, while 20.0 per cent are above 60 years. The socio-economic classification reveals that a significant proportion of both males and females belong to the Upper Lower Class 47.8 per cent of females and 47.5 per cent of males. The Lower Middle-Class accounts for 30.4 per cent of females and 32.5 per cent of males. A smaller percentage falls within the Lower Class 21.7 per cent of females and 20.0 per cent of males. Notably, none of the participants belong to the Upper Middle- or Upper-Class categories. BMI analysis highlights that underweight prevalence is higher among females 39.1 per cent compared to males 22.5 per cent.

However, the proportion of individuals with normal BMI is higher among males 42.5 per cent than females 30.4 per cent. The prevalence of Obesity Grade I (BMI 30.0-34.9) is slightly higher among males 35.0 per cent than females 30.4 per cent, indicating a greater tendency toward obesity in the male population.

Figure 1

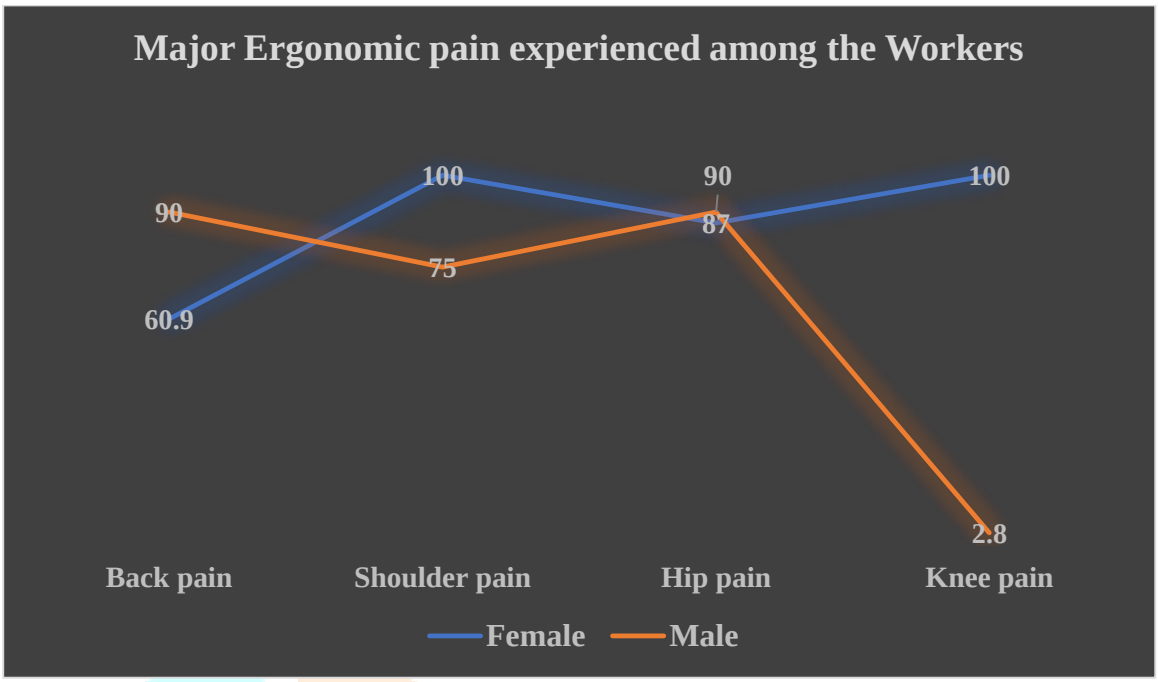

Figure 1 presents a comparison of major ergonomic pain experienced by female and male participants in the study area. The pain types analyzed include back pain, shoulder pain, hip pain, and knee pain. A higher percentage of males ninety per cent reported back pain compared to females 60.9 per cent. Females cent reported a significantly higher prevalence of shoulder pain compared to males (75%). The prevalence of hip pain is similar for both groups, with ninety per cent of females and 87 per cent of males reporting this issue. This indicates that hip pain is a common ergonomic problem affecting both genders almost equally. This suggests that shoulder pain is a predominant issue among women, which could be linked to work posture, repetitive tasks, or musculoskeletal strain. This indicates that men in the study area are more affected by back pain, possibly due to occupational or lifestyle-related factors.

Table 2

Ergonomic Risk factors of the Workers

Variables	N = 23 Female		N = 40 Male	
	No.	%	No.	%
Walk/ Stand				
Moderate Exposure	9	39.1	32	80.0
High Exposure	14	60.9	8	20.0
Back twisted/ Bend				
Moderate Exposure	15	65.2	15	37.5
High Exposure	8	34.8	25	62.5
Arms above Shoulder				
Moderate Exposure	18	78.3	12	30.0
High Exposure	0	0	6	15.0
Repeated arm movement				
Moderate Exposure	9	39.1	17	42.5
High Exposure	14	60.9	23	57.5

Squatting/ Lying on knees				
Moderate Exposure	13	56.5	3	7.5
High Exposure	10	43.5	37	92.5
Pushing/Pulling				
Moderate Exposure	9	39.1	32	80.0
High Exposure	9	39.1	32	80.0
Carrying /Lifting				
Moderate Exposure	8	34.8	25	62.5
High Exposure	18	78.3	12	30.0

Table 2 presents data on ergonomic risk factors experienced by 23 male and 40 female participants, focusing on different postures and movements associated with their work environment. The exposure levels are categorized as Moderate Exposure and High Exposure for each activity.

Walking/Standing Exposure

A higher percentage of males (60.9%) experience high exposure, compared to only 20 per cent of females. Conversely, 80 per cent of females report moderate exposure, compared to 39.1 per cent of males. This suggests that prolonged standing or walking is more intense among men, whereas women engage in these activities at a moderate level.

Back Twisting/Bending Exposure

Majority 62.5 per cent of females experience high exposure, compared to 34.8 per cent of males. Moderate exposure is almost equal between males (65.2%) and females (37.5%). This indicates that women are at greater risk of spinal strain, likely due to occupational roles requiring frequent bending or twisting.

Arms Above Shoulder Exposure

Majority 78.3 per cent of males report moderate exposure, but none report high exposure. Among females, only 30 per cent report moderate exposure, while 15 per cent experience high exposure. This suggests that arm elevation above the shoulder is a less frequent but more intense ergonomic challenge for females.

Repeated Arm Movement Exposure

High exposure is slightly more common among females (57.5%) compared to males (60.9%). Moderate exposure levels are comparable (39.1% in males vs. 42.5% in females). This shows that both genders engage in repetitive arm movements, which could lead to muscle fatigue and repetitive strain injuries.

Squatting/Lying on Knees Exposure

A significant gender difference is observed: 92.5 per cent of females experience high exposure, compared to only 43.5 per cent of males. Very few females (7.5%) report moderate exposure, whereas more males (56.5%) experience it at moderate levels. This suggests that women are more involved in tasks that require prolonged kneeling or squatting, which can contribute to knee and joint-related disorders.

Pushing/Pulling Exposure

Both males and females report equal levels of moderate and high exposure (39.1% in males and 80% in females for both categories). This indicates that pushing and pulling tasks are common among both genders, with a notable percentage reporting high exposure.

Carrying/Lifting Exposure

Majority 78.3 per cent of males report high exposure, compared to only thirty per cent of females. On the other hand, 62.5 per cent of females report moderate exposure, compared to 34.8 per cent of males. This suggests that men are more involved in intense lifting and carrying activities, whereas women perform these tasks at a moderate level.

Therefore Females have a higher ergonomic burden in activities like bending, kneeling, and squatting. Males are more exposed to prolonged standing/walking and lifting heavy objects. Pushing/pulling and repetitive arm movements are common risk factors for both genders. Interventions such as ergonomic adjustments, postural training, and workload redistribution could help reduce work-related musculoskeletal strain.

Figure 2

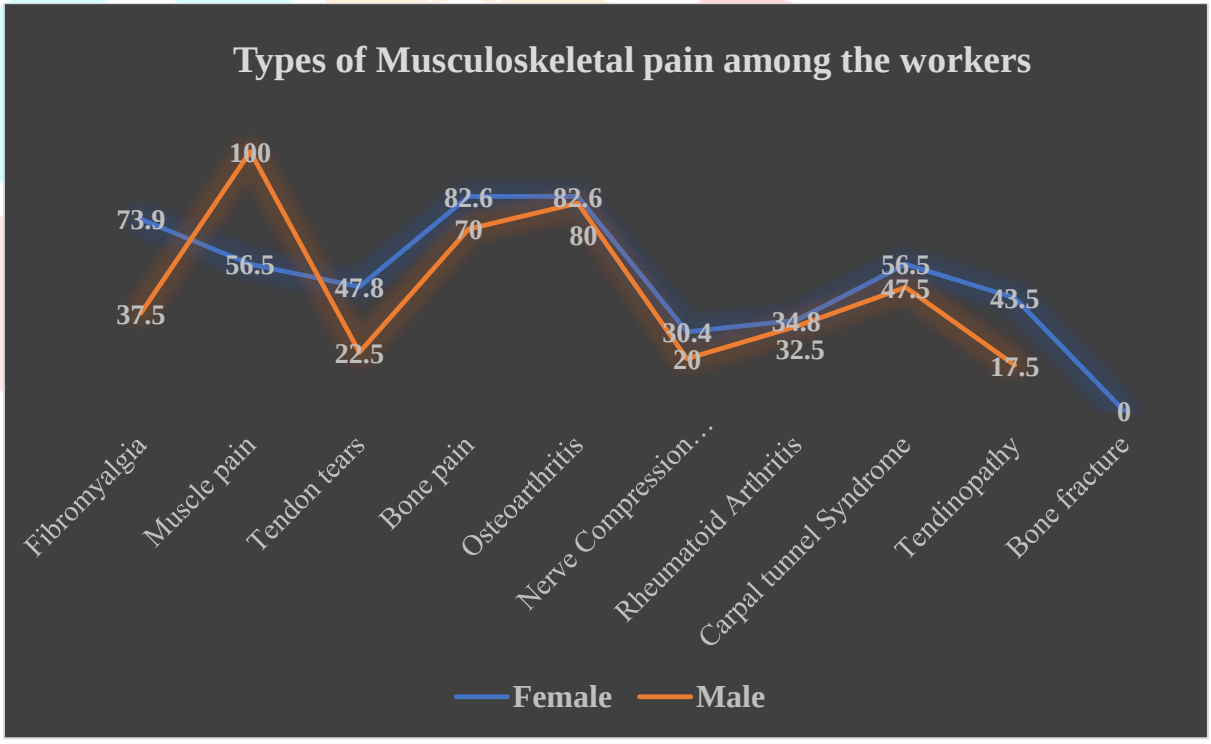

Figure 2 presents a comparative analysis of musculoskeletal pain types among female (blue line) and male (orange line) participants. The pain conditions examined include fibromyalgia, muscle pain, tendon tears, bone pain, osteoarthritis, nerve compression, rheumatoid arthritis, carpal tunnel syndrome, tendinopathy, and bone fractures**.**

More females (73.9%) reported fibromyalgia compared to males (37.5%). This aligns with existing research indicating higher fibromyalgia prevalence in women due to hormonal and genetic factors. Cent Per cent of males reported muscle pain, compared to 56.5 per cent of females. This suggests that muscle strain

and overuse injuries may be more common in men, possibly due to occupational or physical workload differences.

About 47.8 per cent of females reported tendon tears, compared to only 22.5 per cent of males. This suggests that women might be more prone to tendon-related issues, potentially due to repetitive tasks or biomechanical differences. More females (82.6%) reported bone pain compared to seventy per cent of males. This could be due to factors like osteoporosis, calcium deficiencies, or prolonged physical strain. The prevalence of osteoarthritis is relatively similar among both genders, with 82.6 per cent of females and eighty per cent of males affected. This suggests that osteoarthritis is a common musculoskeletal issue across both genders. More females (30.4%) reported nerve compression issues compared to 20 per cent of males. Women may be more susceptible to conditions like sciatica or nerve impingement, possibly due to differences in muscle mass and posture. The prevalence is relatively balanced, with 34.8 per cent of females and 32.5 per cent of males experiencing rheumatoid arthritis. This suggests both genders are equally affected, possibly due to autoimmune or genetic factors. More females (56.5%) reported carpal tunnel syndrome compared to 47.5 per cent of males. This could be due to repetitive hand movements or prolonged computer use, which are common risk factors.

About 43.5 per cent of females reported tendinopathy compared to 17.5 per cent of males. This suggests that women are more prone to tendon-related disorders, possibly due to occupational tasks or hormonal influences. No females reported bone fractures, whereas some males (17.5%) experienced them. This may indicate that men engage in higher-risk physical activities leading to fractures.

Conclusion

From an occupational health perspective, Amla's anti-inflammatory and musculoskeletal benefits are particularly relevant in reducing ergonomic risks and addressing work-related disorders. The study findings highlight significant ergonomic challenges and musculoskeletal pain among workers, with females experiencing a higher burden in tasks requiring bending, squatting, and repetitive movements, while males are more exposed to prolonged standing, lifting, and back strain. These insights emphasize the need for ergonomic interventions, workplace modifications, and nutritional supplementation to promote better occupational health. Overall, integrating Amla into dietary practices, functional foods, and workplace wellness programs can enhance physical resilience, reduce inflammation, and improve musculoskeletal health, contributing to sustainable and holistic healthcare solutions. Future research should explore its long-term effects in occupational settings and develop targeted interventions to optimize worker health and productivity.

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