

Health of Coconut Tree Climbers of Rural Southern India – Medical Emergencies, Body Mass Index and Occupational Marks: A Quantitative and Survey Study

BINCY M. GEORGE, MUDDANNA S. RAO, ARUNACHALAM KUMAR, NIVEDITHA SUVARNA, JESSICA SUSHMA D'SOUZA

ABSTRACT

Introduction: Coconut plucking, a profession of a few communities in southern India, is an arduous calling now. Permanent cosmetic defects to the skin, apart from medical emergencies, have forced many to abandon this time honoured profession. The objective of the present study was to explore the health status and the casualties in traditional coconut tree climbers in southern India.

Method: A total of 240 male volunteers, all below 55 years, who were engaged in the profession, were interviewed between January 2006 and December 2008. A survey on the history of the falls, injuries, changes in the skin or body parts and the incidence rate of the withdrawal from the occupation were collected. The anthropometric data of 220 participants and their body mass index (BMI) was calculated. The parts which were afflicted due to occupational dermatosis were photographed and measured by using the scion image software.

Results: 15% volunteers from group1 (<10 years of experience), 26.6% from group 2 (10-20 years of experience), 44% from group 3 (20-30 years of experience), and 41.3% from group 4 (>30 years of experience) fell down from trees, resulting in injuries. The histories of accidental cuts/lacerations from special knives which were used and those of skids/slips during the monsoon season in groups1, 2, 3, and 4 were 7.7, 15.0, 16.9, 12.0% respectively. The body weight and the BMI of the climbers in groups 2, 3 and 4 showed significant declines as compared to those of the non-climbers. Colles, vertebral and maxillary fractures, tendocalcaneus lesions and severe allergies, were among the medical emergencies which were listed.

Conclusion: This study establishes a decline in the BMI with a progress in the tree-climbing experience, with marked falls being noted in groups 3 and 4. We suggest that this type of data should be taken into consideration in the plantation industry that depends on physical attributes, pesticides and lethal farm implements as the routine requirements.

Key Words: Coconut tree climbers, Occupational Injuries, BMI, India

INTRODUCTION

Coconut plantation is one of the agricultural activities in the southern part of India. Sociocultural compulsions made crops like coconut, economically viable for the planters. The regular plucking of coconuts and spraying of pesticides to coconut trees, which is done manually to a large extent, requires specialized labourers. This activity is traditionally carried out by the socio-economically backward communities, where men are trained in the art of climbing trees rapidly and plucking the coconuts or spraying pesticides. These communities are distributed wherever coconut trees are cultivated in large numbers as coconut plantations.

The trees are scaled through a series of upward hops along the vertical face of the tree trunk. The movements which call for flexion, abduction, extension and the lateral rotation of the hip, flexion and extension of the knees, plantar and dorsiflexion at the ankle, inversion at the subtalar joint, and flexion at metatarsophalangeal and interphalangeal joints of the foot, are required for climbing a vertically grown coconut tree. The arms flex, medially rotate and hold the tree trunk, while the body elevates [Table/Fig-1]. To assist the leverage, a loop which is made of coir is worn around the waist or between the palms, which in turn is wound around the tree trunk. A similar loop which is wound across the ankles, prevents the splaying of the feet, keeping them approximated to the trunk surface at all times of ascent or descent. The climbing process



[Table/Fig-1]: A.Coconut tree climber climbing the coconut tree
B. Plucking the coconuts

induces tremendous gravitational strain on the tibiotalar and the intertarsal joints, as each professional climber works about 4 hours a day, climbing 25-30 trees in a day.

As India is in a transitional state in terms of the economic profile, an occupational research approach would balance between the understanding of the modern industrial exposures and the health risk of the traditional sectors like agriculture and plantations [1].

To our knowledge, there are no studies which have been done, which rate the occupational hazards in the traditional coconut climbers of southern India. Thus, the ambit of this study was focused on the attempt to overview the health status and the medical emergencies of these traditional climbers, to understand the impact of this particular occupational adaptation better.

The objective of the present study was to explore the body mass index, the extent of the occupational marks and the casualties and injuries which were associated with the traditional coconut tree climbing occupation in rural southern India.

METHODS

Subjects and Study Parameters

The data which are presented in this paper were obtained from a random sample survey which was conducted between January 2006 and December 2008 in a few villages of the southern Indian states (Kozhikode, Ernakulam, Kollam and Idukki districts of Kerala state and Bodi and Bodinaykannur districts of Tamilnadu state). A total of 240 male volunteers who were aged less than 55 years, from communities which were engaged in coconut tree climbing as their full-time profession, were included in the study survey. In these volunteers i) the anthropometric data was collected to calculate their body mass index ii) the skin on their body parts were observed carefully for scars/marks that affect cosmetics and the areas of occupational dermatosis. Such scars/marks and dermatosis were photographed for documentation and quantification and (iii) the history of (a) fall from trees during climbing (b) injuries due to climbing and (c) withdrawal from the tree climbing occupation was taken to find their correlation with the years of experience of the volunteers and the reasons for their withdrawals.

Body Mass Index

The anthropometric data of 220 participants, those who were regular in tree climbing, were collected, to find out their body mass index. The body mass index (BMI) was calculated by using the formula, $BMI = \text{weight in kilograms} / \text{height in meters}^2$. For statistical analysis, the subjects were divided into 4 groups, based on the years of experience that they possessed in coconut tree climbing. Group 1: less than 10 years of experience, group 2: 11-20 years of experience, group 3: 21-30 years of experience, and group 4: more than 30 years of tree climbing experience. For comparisons, the anthropometric data of 80 non-climbers were also collected and they were grouped as group 0.

Occupational Dermatoses

The areas of occupational dermatosis were photographed and measured by using the scion image analysis software (NIH Image for Windows-4.0.3.2, Scion corporation Frederick, Maryland (USA). The images were converted into bit map images and were opened in the scion image analysis software. Appropriate calibration was done by using the scale in the image. The areas of dermatosis were measured by using the area option in the software

History of Fall, Injury and Withdrawals

A survey was taken to find out the history of the fall and its correlation with the years of experience of the volunteers (whether it increased or decreased with the years of experience), the history of the injuries, observational changes in the skin or the body parts that affected cosmetics, the history of the withdrawals of the volunteers from their traditional occupation and the reasons for the same.

RESULTS

Body Mass Index (BMI)

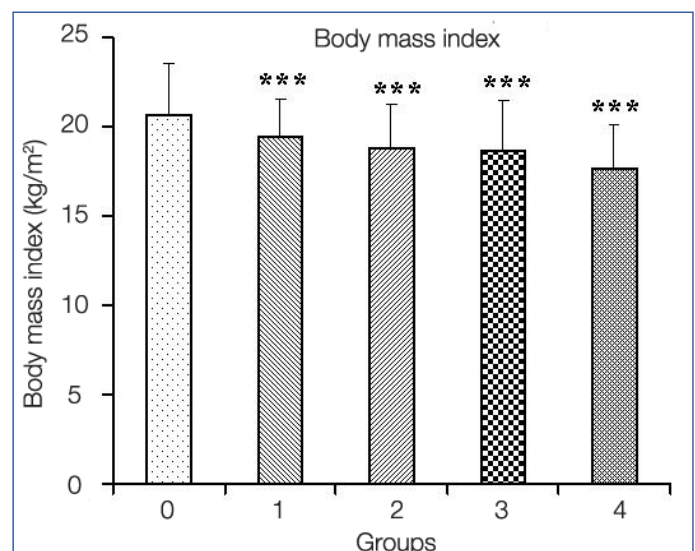
The body weight and the calculated BMI of the climbers in group 1 ($19.41 \pm 2.15 \text{ kg/m}^2$), group 2 ($18.82 \pm 2.46 \text{ kg/m}^2$), group 3 ($18.62 \pm 2.83 \text{ kg/m}^2$) and group 4 ($17.62 \pm 2.50 \text{ kg/m}^2$) showed significant difference as compared to those in the groups of the non-climbers ($20.71 \pm 2.86 \text{ kg/m}^2$, $P < 0.001$, One way Anova, Bonferroni's test). The BMI showed a successive decline with the increase in the years of experience. Group 4 alone showed grade 1 thinness [Table/Fig-2].

Occupational Dermatoses and Other Casualties

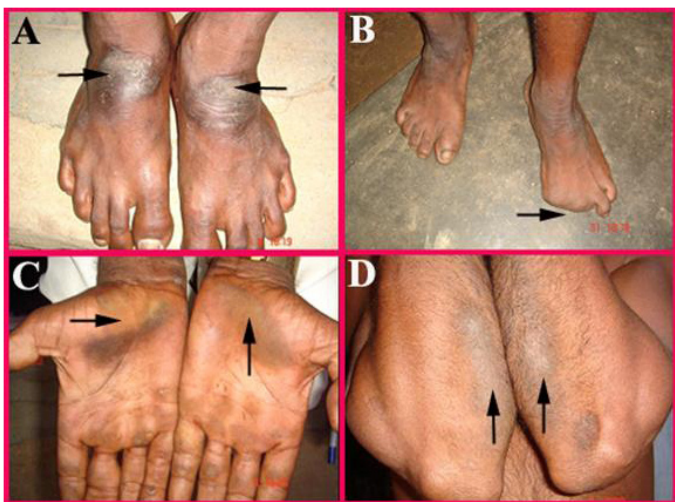
Large areas of occupational dermatoses were seen as an enlarged thickening on the ankle region and the palmar aspect of the hand and the forearm regions [Table/Fig-3]. It was also seen in the sole of the foot and the anterior abdominal wall of the climbers. The area of the occupational dermatosis in the forearm was $426.72 \pm 151.08 \text{ mm}^2$, and the area on the dorsum of the foot was $421.16 \pm 83.13 \text{ mm}^2$ in area. The climbers from Tamilnadu state presented with much larger occupational marks on the dorsum of the foot, as compared to those in the climbers from other states.

Frequency of Falls from the Tree

The percentages of the people who had fallen from coconut trees and had faced injuries in the different experience groups were: group 1 (>10 year of experience)-15%, group 2(11-20 years of experience) – 26.6%, group 3(21-30 years of experience)- 44% and group 4(< 30 years of experience)- 41.3%. A total of 35.5 % (78 cases out of 220 climbers) fell down from coconut trees while doing their job. A total of four tree climbers had a fatal fall from the



[Table/Fig-2]: Body mass index (BMI) in groups of climbers having different extent of climbing experience. Group 1-with < 10 years, Group 2- with 11-20 years, Group 3-with 21-30 years, Group 4- with > 30 years of experience. Note there is a significant decrease in BMI in all groups of climbers compared to nonclimbers (Group0,***, $P < 0.001$, One way Anova, Bonferroni's test)



[Table/Fig-3]: A-Feet of a coconut tree climber (> 20 years of experience), showing callosities (arrows) in the ankle region. B-Right foot of a coconut tree climber with amputated medial toes (arrow), C-Occupational mark (arrows) in palmar aspect of hands in a coconut tree climber, C-Occupational mark (arrows) the forearm skin in a coconut tree climber.

coconut trees which resulted in their death, from the area of the survey, as was reported by the local daily newspapers.

Cuts/Lacerations/Fractures

The histories of cuts/lacerations due to the special knives which they used to cut the coconuts while they were on the trees and the case of a slippery tree in the rainy season was 7.7% (group 1), 15% (group2), 16.9% (group3) and 12% (group4). A total of 13.6% (30/220) got wounds and were unable to do their job to meet their daily expenses for some days. Colles fracture (fracture of the lower end of the radius bone in the forearm-1/240), injury to the tendocalcaneus-(1/240), fracture of the spine (4/240), maxillary fracture (1/240) and severe allergy to the dust of the coconut tree-top (2/240) were the other medical emergencies which were reported by the study participants.

Withdrawals from the Profession

7.9% (19/240) of the tree climbers in the area of the survey withdrew from their traditional profession and remained unemployed. Among them, only 5.3% (1/19) stopped climbing trees due to health problems other than those which were associated with tree climbing. 94.7% (18/19) withdrew because of casualties that happened during their occupation.

DISCUSSION

The disabilities and the fatalities were very severe in the professional coconut tree climbers of rural southern India. Four coconut climbers who had fallen from trees died and two were disabled with paraplegia from the area of survey, according to the local daily newspapers. It was interesting to note that the accidental falls and fatalities usually involved the very experienced climbers. Colles, vertebral and maxillary fractures and tendocalcaneus lesions were few injuries that resulted due to fall from the coconut trees. We felt that this was a more serious occupational hazard than the onboard slips and falls of flight attendants which preceded backpain [2].

The less number of people in group 1(n=26) as compared to those in other groups (n=60,59,75, respectively in groups 2,3 and 4) explained the rapid withdrawal of the able bodied men, who were not ready to stick to their ancestral occupation, which was also reported by the local daily newspapers (*The Hindu*; Tamilnadu

edition, December15, 2008; *The Hindu*; Kerala edition, February 16,2008). Even though the availability of less strenuous alternate jobs and the better education status of the new generation were major reasons which they quoted for quitting this community-based profession; few explained that the cosmetic reasons, i.e. the scars which resulted from occupational dermatosis, the ugly looking foot and other body parts, inability to wear footwear that made them prominent bare foot walkers in the society, etc. were the areas of common concern (*The Economic Times*, 19 August 2009).

It is very possible that after a few decades, the complete lack of coconut pluckers may drive the coconut industry to seek alternative means of cultivation (*The Economic Times*, 19 August 2009). There are few machines which are available in coastal southern India, which assist in climbing coconut trees. One of the main disadvantages which the climbers quoted, was their inaccurate performance with the help of the machines while they climbed the slanting coconut trees. It was noted that a majority of the coconut trees of southern coastal India belonged to this variety. Well developed countries prefer machines over human climbers. In Malaysia, Indonesia and Thailand, trained monkeys (mainly long tailed macaques) are used in coconut and palm plantations [3]. The fatalities, medical emergencies and the present health status of these coconut climbers call for an emergency to introduce any one or both of these systems and to rehabilitate the coconut climbers and to redirect them to another productive and high yielding profession.

The technique of gripping the tree with both the hands and feet and thus pushing up the body to climb higher, results in intermittent pressure over the forearm, skin, palms and the soles. The friction which is thus created, increases the epidermal turnover, which in turn lays thickened vertically oriented collagen bundles in the papillary dermis [4]. The occupational marks which are seen in coconut climbers show no evidence which is suggestive of irritant or allergic contact dermatitis [4]. These callosities suggest the severe degree to which the skin can adapt in response to the frictional forces between the skin and the coconut tree. Similar areas of callosities were reported in 4 isolated cases from India [4-7].

In the present study, we found such callosities not only on the sole, palm and the flexor aspect of the forearm, but also on the dorsum of the foot and in a few cases, on the anterior abdominal wall. The callosities which were found on the dorsum of the foot were found to be more prominent than those in any other area, suggesting that the friction which was caused by the plantar loop which was made of coir was the reason. Fissures with callosities could be found in the sole of the foot, mostly due to the occupational adaptation of the skin, along with the occupational requirement of bare-foot walking. The experienced climbers of groups 3 and 4 complained that they are unable to wear footwear, as they are not able to grip it between their great toe and the second toe.

Falls from trees and other tree related injuries were the most common causes of trauma in some rural areas of Melanesia [8]. A review of the coconut plucking injuries in the Pacific Islands revealed that patients who fell from coconut trees, presented with upper limb and spinal fractures [9]. However, such type of data is lacking from India, to the best of our knowledge. Occupational hazards due to falls from coconut trees while plucking coconuts, have not been recorded in the literature. The withdrawal of 7.5% traditional tree climbers from their only learned skilled job because of the casualties that happened with respect to their occupation needs attention. The higher percentages of the falls in the well experienced climbers were a point of consideration, as these can

be associated with the failure of further adaptations of the foot, after a certain limit.

Occupation related injuries and fatalities in industries such as copper mining and agriculture [10, 11] have been reported. But there is no such evidence which has been found in the reports from the agricultural industry, with respect to the accidental cuts and lacerations due to the sharp objects which they use for purposes such as coconut palm harvesting. In our study, 13.6% of the coconut climbers presented with a history of wounds which were related to their routine occupation, indicating the need to find remedies to help those who are engaged in this profession.

The normal cut-off value of the BMI in Asian Indian population has been recorded as 18.5 to 24.9 kg/m² and 23 kg/m² for average men [12]. A cross-sectional survey of the BMI in an urban population of western India described its value as 21.8 ± 3.8 kg/m² (mean±SD) for men [13]. A significant decline in the BMI with an increase in the experience of the tree climbers in the present study, and the grade-1 thinness which was found in the most experienced group (group-4), drew our attention, inspiring us to take up further studies. The energy-cost of locomotion in orangutans has been studied in detail and it suggested that tree climbing was the costliest, followed by walking and lastly, descending the tree [14,15]. Whether the high energy-cost in humans decreased their BMI while they climbed trees, remains to be studied .

CONCLUSION

Coconut plucking is an arduous and laborious job. Cosmetic defects of the skin, medical emergencies, and complications make youngsters opt for less arduous occupations. As coconut is one of the important grocery items of a southern Indian kitchen and also an important item in cosmetics, a lack of tree climbers results in agriculturists not being able to sell their crops in time. This study clearly showed a decline in the BMI and an increase in the rate of fall as the experience of the subjects progressed. All these should be taken into serious consideration while opting for any modern technology to pluck coconuts, and for spraying pesticides for coconut mites. It should also be noted that the traditional tree

climbers need to be rehabilitated at least after two decades of their engagement in their profession.

REFERENCES

- [1] Agnihotram RV. An overview of the occupational health research in India. 2009; (1): 10-14.
- [2] Agampodi SB, Dharmaratne SD, Agampodi TC. The incidence and the predictors of onboard injuries among Sri Lankan flight attendants. *BMC Public Health*. 2009; 9: 227.
- [3] Bertrand M. Training without a reward: the traditional training of pig-tailed macaques as coconut harvesters. *Science* 1967;155: 3761: 484-86.
- [4] Kumari R, Thappa DM, Shivaswamy KN. Occupational marks in a coconut tree climber. *Indian J Dermatol Venereol and Leprol* 2006; 72:311-12.
- [5] Srinivas CR, Balachandran C, Singh KK. Occupational dermatosis and allergic contact dermatitis in a toddy tapper. *Contact Dermatitis*. 1987;16:294-95.
- [6] Dwivedi S, Subha S. Bilateral shoulder arthropathy and extensive occupational dermatosis in a coconut tree climber. *J Assoc Physicians India* 1989;37:729.
- [7] Balachandran C, Srinivas CR, Shenoy SD, Edison KP. Occupational dermatosis in coconut palm climbers. *Contact Dermatitis*. 1992;26:143.
- [8] Barss P, Dakulala P, Doolan M. Falls from trees and tree associated injuries in rural Melanesians. *Br Med J*.1989; 289 :22-29
- [9] Mulford JS, Oberli H, Tovosia S. Coconut palm-related injuries in the Pacific Islands. *ANZ J Surg*. 2001;71(1):32-4.
- [10] Michelo P, Bråtveit M, Moen B E. Occupational injuries and fatalities which are related to copper mining in Zambia. *Occup Med* 2009; 59, (3)191-94
- [11] Rautiainen RH, Ledolter J, Donham KJ, Ohsfeldt RL, Zwerling C. The risk factors for serious injury in Finnish agriculture. *Am J Ind Med*. 2009;52(5):419-28
- [12] Snehalatha C, Viswanathan V, Ramachandran A. Cutoff values for normal anthropometric variables in Asian Indian adults. *Diabetes Care*. 2003;26:1380-84,
- [13] Shukla HC, Gupta PC, Mehta HC and Hebert JR. Descriptive epidemiology of the body mass index of an urban adult population in western India. *Journal Epidemiol Community Health*. 2002;56:876-80
- [14] Thorpe SK, Crompton RH, Alexander RM. Orangutans use compliant branches to lower the energetic cost of locomotion. *Biology Letters*. 2007;3(3):253-56.
- [15] Watson JC, Payne RC, Chamberlain AT, Jones RK, Sellers WI. The energetic costs of load-carrying and the evolution of bipedalism. *J Hum Evol*. 2008; 54(5):675-83.

AUTHOR(S):

1. Dr. Bincy M. George
2. Dr. Muddanna S. Rao
3. Dr. Arunachalam Kumar
4. Dr. Niveditha Suvarna
5. Ms. Jessica Sushma D'Souza

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor in Anatomy, Melaka Manipal Medical College,
2. Associate Professor, Department of anatomy, KMC Manipal, Associate Professor in Anatomy, Faculty of Medicine, Kuwait University, Safat, Kuwait,
3. Dean & Professor, Department of Anatomy, K. S. Hegde Medical Academy, Mangalore 575018, India.
4. Melaka Manipal Medical College (Manipal Campus), International Centre for Health Sciences, Madhav Nagar, Manipal, Udupi, Karnataka, India.
5. Melaka Manipal Medical College (Manipal Campus), International Centre for Health Sciences, Madhav Nagar, Manipal, Udupi, Karnataka, India.

NAME, ADDRESS, TELEPHONE, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Bincy M. George
Assistant Professor in Anatomy
Melaka Manipal Medical College (Manipal Campus)
International Centre for Health Sciences
Madhav Nagar, Manipal University
Udupi, Karnataka, India - 576 104
Phone: +91 820 2922519 (Off.) +91 820 -2544298 (Res.)
+91 - 9986104682 (Mob.); Fax: 91-820-2571905
E-mail: bincyrajakumary@yahoo.com

FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Submission: **Jul 09, 2011**
Date of Peer Review: **Oct 10, 2011**
Date of Acceptance: **Dec 22, 2011**
Date of Publishing: **Feb 15, 2012**