A Kinesiological and Postural Analysis for Various Upper Body Extremities of Nursery and Afforestation Workers

Habip Eroğlu[1], Yıldırım Kayacan[2], and Rahmi Yilmaz[3]

[1]Assoc. Prof., Karadeniz Technical University, Trabzon, Turkey; [2]Dr., Artvin Çoruh University, Artvin, Turkey; [3]Res. Assist., Artvin Çoruh University, Artvin, Turkey.
E-Mail: habip@ktu.edu.tr

Abstact:

This study will outline the challenges undertaken by works of nursery and afforestation workers, and the change they bring to the workers' posture and body mass index after taking into account their working hours and inputing the date in an anthropometry set and calculating proper and healthy postures according to computer programs. Thus providing us to offer a description of postural change as a result of the type of work undertaken. For this purpose; a test was performed over 32 men belonging to the Artvin Regional Forest Directorate in the Ardanuc and Seyitler Forest Nursery and afforestation area at Bogaboynu. In conclusion, the average age of workers tested was 46, their height was measured at 172.44 cm, weight 80.41 kg, body mass index 15.41, and have worked for 15.41 years on average. Results as per posture analysis on the computer programs of Lafeyette Anthropometric Set and Orthoimager Posture: 1-Right-left deviation of the head's anterior for 94% of workers, 97% of the works shows sagital deviation towards the front or back 2-Asymmetry between the distance of the head posture and Acromion Process 3-Deviation between right-left Acromion Process for 91% of the workers 4-Deviation between the sagittal's Acromion Process and Plumbline for 97% of the workers 5-Deviation to the right or left between the anterior Sternal Notch and Plumb Line for 94% of the workers 6-Deviation to the right or left between the anterior's Plumb line and Acromion Process in all workers. As a result, the type of labour in forestry, commonly known as nursery and afforestation creates a negative effect of deformation, especially in upper extremities.

Key words: Posture analysis, forestry workers, body mass index, Artvin

Introduction:

Forestry is a labour-intensive industry in Turkey. The Ministry of Forests and Water Affairs alone provide approximately 15 million person/day employment a year (Eroğlu vd., 2013). Forestry activities are an organization which covers various works, usually conducted in outdoors circumstances and compromises of heavy works.

Forest labour in Eastern Black Sea Region is of utmost importance because of the dense forests in the region and the resulting frequency of forest labour. Eastern Black Sea Region has a ground with 65% and above mean incline. This causes some major problems when forestry activities are being carried out (Erdaş and Acar, 1995).

Forest labour is different than other lines of work for many reasons such as the fact that the work is generally done under harsh circumstances, on wide areas and in rough locations at great heights, the worksite is away from the social hubs, it is usually mandatory to work in day time and recruited workers' pays are lower in comparison to other lines of work (Erdaş ve Acar, 1995).

Forest workers in Turkey's forestry; are made up of those who work at forests administrations and who have social security and union right, those who are employed for a limited time by the forest administrations and who have social security and some rights, those who are employed via private establishments (such as contractors) and whose social security rights are monitored by these establishments and forest villagers without social securities who make up the majority and who are the subject of this study (Engür, 2006).

Disruptions in musculoskeletal system are one of the major health problems in the industrial world. Even though especially waist pain is identified to be a common ailment, the increase in back, neck, shoulder ailments is interesting. The situations that cause individual injuries put the companies in difficult positions as far as sick leave and early retirement are concerned (Gamperiene and Stigum 1999).

Adult posture was planned to maintain body's position with the fewest moves in space. It can also minimize the antigravity stresses forced on the body tissues. Forces applied to the body from the outside may cause postural deviation by affecting the gravity axis. In the case of neutral posture's gravity axis deviation being habitual, the risk of developing waist pain increases. Especially the weights applied to the back of the body can corrupt the posture by shifting the weight centre of the body (Ural vd.. 2004).

There are many factors that define and manage the posture structure seen in an individual. These factors maybe usually genetic or environmental. Genetic factors are innate factors that originate from the human's anatomical and kinesiological structure. Environmental factors are factors such as practices, games, diseases, sports and exercises, frequency of one's use of limbs, method and nutrition during growth and childhood especially during babyhood. For example, American Indians placing their babies onto their backs in a standing position and carrying them this way, is a simulation of the baby's standing up and standing experiences (Thomas, 1956).

Intense exercises done in early ages can make the frequently used limbs of the individual dominant while making the other side powerless and weak. This affects postural structure negatively (Kılınç, 2009).

The posture structure of an individual is analysed for different purposes. Some of these purposes may be; health, ergonomics, nutrition, developmental problems (Maslen and Straker, 2009; Widhe T., 2001), work (Bao vd., 2007) or to increase or define performance in sports (Lien, 2005), diagnostics and treatment. The analyses can not only cover the entire body but it can also be focused on specific regions such as hands, fingers, feet (Redmond vd 2008) or shoulder. These analyses may differ based on the methods used.

Three basic methods, namely direct measurement, the survey method and posture monitoring, are used in posture analysis (Boa vd.. 2009). Other common methods in posture analysis; New York Posture Classification Chart (Hennessy and Watson, 1993), Human modelling and Computerised analyse software (Liu vd.. 1997; Ohya vd., 2002: Normand vd., 2007), Posture Analysis via Grill Method (Kaya, 1991) and Radiographic Measurements (Kılınç vd., 2009; Van Niekerk vd., 2008; Normand vd., 2007; Whitmore vd., 1996,).

This study analyses the changes in the worker's body posture by the workloads afforestation workers are subject to during work. For this, we aim to reveal the changes in the workers' postures according to their Body Mass Index (BMI) and working time.

Material and Method:

The study was conducted on 32 male plantation and afforestation workers in the fields of Zeytinlik/Boğaboynu, Saçinka/Seyitler Nursery, Ardanuç Nursery in Artvin (Figure 1, Table1). Posture analysis was conducted using Lafeyette Antropometric set and Posture Analysis computer software (Eroğlu et. al. 2013b).

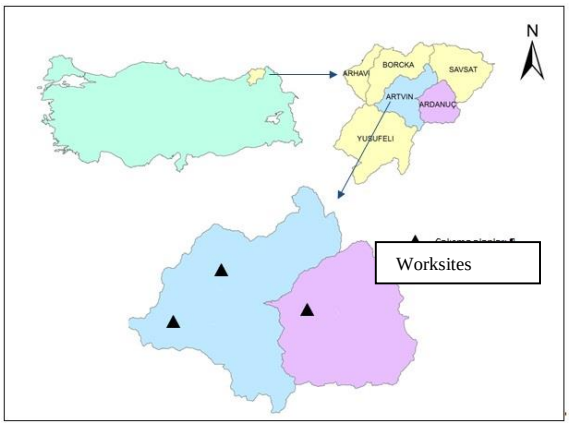

Figure 1. A map showing the worksites

Table 1. Information about the worksites

Worksite	Number of Workers Studied	The Work
Artvin/Zeytinlik/Boğaboynu	9	Afforestation
Artvin/Saçinka/Seyitler Nursery	8	Nursery
Ardanuç/Ardanuç Nursery	15	Nursery
Total	32	3

As a part of the study, anthropometrical characteristics of the workers were first identified. After the workers' age, sex, height and weight have been identified; coloured markers were placed on the reference points on the body, photos were taken from an anterior and lateral perspective on a platform on flat ground and transferred to the posture analyse software. During the measurements, real-time control of the measurements taken with anthropometrical set was ensured. While also taking into consideration the BMI values of the participant, anterior and sagittal balance, general standing posture and the angular relationship between the extremities were identified and some upper extremities were analysed. Healthy standard posture was taken as a reference in the posture analysis. Angular values are expressed as "angle" (^{o}) while distance and length are expressed as "cm". The method and reference points used in posture analysis are shown in Table 2.

Table 2. Reference points used in posture analysis

Perspective of the Photo Shoot	Anterior and Lateral
Number of Photos Taken	2
Size of the Photo	1280 X 960 pixels
Anatomical position of the individual	Standing up, Natural and Comfortable, In an Upright Position, Arms on the Sides, Palms Face the Back./ Frontal Arm in 90° sagittal flexion position.
Anatomic Reference Points	Glabella, jaw, acromion process, epithermal notch, anterior superior iliac spine (ASIS), patella, mortise (anterior ankle), Auditory Canal, posterior superior iliac spine (PSIS), greater trochanter, lateral femoral condyle, lateral malleolus.

Results and Discussion:

Workers are 46 years old in average, their average height is 172.44cm, their average weight is 80.41 kg, their average BMI is 26.96 and their average working history is 15.41 years. Data obtained from the posture analysis conducted with the photos taken from both ways and via computer software is provided in Table 3.

When we look into Table 3; we see that 30 workers had deviation to left-right in head posture in anterior plane and asymmetry on the anterior plane between Acromion process, all of the workers had asymmetry between head posture and acromion process on sagittal plane, horizontal distance asymmetry between acromion process and plumb line, horizontal distance asymmetry between Sternal Notch and Plumb Line on Anterior plane, asymmetry between acromion process and sternal notch, asymmetry between Plumb line and Acromion, asymmetry between Claviculare bones.

Today, the body composition is an important parameter to achieve optimal efficiency in terms of physical performance in addition to being a health criterion (Zorba and Ziyagil, 1995). Weight is important, but repetition of the lifting the object rather than its weight is also important. A study showed that lifting objects weighting 25 lb (approximately 11.34kg) more than 25 times without bending the knees increase disc prolapses risk 7 times. It was discovered that lifting 5kg objects with one hand and a rotation move forces and extra 40kg on lumbar region (Berker, 1998). As forest workers similarly lift objects with specific weights repeatedly, incidences of postural deviations are expected. Additionally, it was identified in Acar and Eroğlu (2001), Erdaş and Acar's (1995) studies that forest workers had health issues related to parameters based on especially physical work load. Hagen vd. (1998) correlated musculoskeletal deviations of the type of work that is carried out with physical work factors.

Table 3. Measured parameters of plantation-afforestation workers

Sıra No	Angle of Lateral Head Deviation – Left- Anterior	Angle of Lateral Head Deviation – Right- Anterior	Distance of Head Posture from Acromion Process - Sagittal	Angle between the Left and Right Acromion Processes – Anterior-Left	Angle between the Left and Right Acromion Processes–Anterior-Right	Horizontal Distance from Acromion Process to Plumb Line – Sagittal-Left	Horizontal Distance from Acromion Process to Plumb Line – Sagittal-Right	Horizontal Distance from Sternal Notch to the Plumb Line – Anterior-Left	Horizontal Distance from Sternal Notch to the Plumb Line – Anterior-Right	Height of the Acromion Process from Sternal Notch – Anterior-Left	Height of the Acromion Process from Sternal Notch – Anterior-Right	Middle of the Acromion Processes to the Plumb Line – Anterior-Left	Middle of the Acromion Processes to the Plumb Line – Anterior-Right	Angle of the Clavicles – Anterior-Left	Angle of the Clavicles – Anterior-Right
1	0	2	1,9	1	0	1,9	0	0	0,6	0,2	-0,4	0	1,2	1	-1
2	2	0	2,5	0	2	2,5	0	0,9	0	0,7	2,1	0	0,7	3	7
3	0	1	4,6	4	0	0	4,6	0	1	1	-1	0	0,3	3	4
4	0	4	5,4	7	0	0	5,4	0	3,9	3,2	-0,7	0	3,6	11	-3
5	2	0	1,4	0	1	0	1,4	0	1,2	0	0,7	0	2,9	0	2
6	1	0	2,8	1	0	0	2,8	0	0	2,8	2,3	0	0,1	9	7
7	1	0	4,1	0	5	0	4,1	3,1	0	0	2,8	2,3	0	0	9
8	0	1	1,8	6	0	0	1,8	0,7	0	6,6	2,9	0	0,7	23	9
9	0	5	1,8	4	0	0	1,8	0,2	0	2,7	0,6	0	1,2	10	2
10	0	1	3,2	0	0	0	3,2	0	1,4	3	2,8	0	2,1	12	10
11	0	5	4,2	6	0	0	4,2	0	0,7	3,3	0,3	0	0	12	1
12	0	5	6,3	0	0	0	6,3	0,6	0	2,9	3,1	0	0,2	12	11
13	2	0	5,1	4	0	0	5,1	0	0,3	1,7	-0,7	0	1,8	6	-2
14	0	1	2,7	0	1	0	2,7	0	1,5	1,2	1,5	0	1,4	4	5
15	0	2	6,5	0	0	0	6,5	0	0	2,8	2,8	0,1	0	9	9
16	0	2	3,8	1	0	3,8	0	0,7	0	-1,1	-0,4	1,4	0	-4	-2
17	2	0	9,2	2	0	0	9,2	0	1	6,4	5,1	0	1,5	22	17
18	4	0	1,4	1	0	0	1,4	0,4	1,8	1,8	1,2	0	2	7	4
19	0	0	5,1	0	2	0	5,1	1,3	0	0,3	1,6	0	0,5	1	5
20	0	7	2,4	5	0	2,4	0	0	1,5	4,8	1,8	0	1,3	15	6
21	1	0	6,8	0	5	0	6,8	1	0	1,3	4,5	0,5	0	4	14
22	0	2	3,6	0	1	3,6	0	0	0	1,6	1,9	1,3	0	5	7
23	10	0	7	0	6	0	7	8,1	0	0,4	3,7	7,7	0	1	14
24	0	1	3	1	0	0	3	0	1	2	1,3	0	1,6	8	5
25	1	0	3,9	1	0	0	3,9	0	0,7	1,8	1,4	1,1	0	5	5
26	0	0	10,3	0	2	0	10,3	1,5	0	0,8	1,9	0	0,6	3	6
27	0	2	0	3	0	0	0	0	3,8	2,5	0,6	0	3,3	9	2
28	0	8	2,7	2	0	0	2,7	0	0,8	3,5	2,3	0	1	12	8
29	1	0	3,7	2	0	0	3,7	0	0,3	2,8	1,6	0	3,1	13	5
30	2	0	4,8	2	0	0	4,8	0,3	0	3,9	2,4	0	0,9	13	7
31	0	9	1,6	3	0	0	1,6	1,2	0	3,7	1,6	1,1	0	12	5
32	1	0	1,5	2	0	1,5	0	0,4	0	0	-1,1	0,2	0	0	-4

Gallagher (2001), discovered that the pressure on the lumbar region was increased by 25% in workers working in sites such as constructions and mines in a kneeling position. This pressure on the lumber region in production workers of the forestry industry may be reason of the said postural deviation.

Yakut and Algun (1986), said that the weight on the waist during squad move was too much and that intra-abdominal pressure should be stable and on inspiration while kneeling and reported that the smashing stress while kneeling, which is too much reached massive values when combined with sacrum and therefore the lumbosacral joint angling towards the horizontal plane on expression, that effort arm of intra-abdominal pressure would be shortened due to the movement of lumbar vertebras towards the anterior

similarly, that sometimes because the movement does not fit the type of breathing, expiration while kneeling and inspiration while standing up would cause problem later on if not during the movement, that overloads caused by this type of application would cause micro-trauma, ligament damage and resulting lumbar root irritation and muscular spasm, and finally irreversible degenerative changes in the discs. Production workers are under similar risks as they perform the squat move during work too much. Additionally, in especially the generation of postural deviations and degeneration in upper extremities these moves are thought to be effective when joined by the lifting of tools used during production work.

Conclusions:

The study has shown that the type of work assumed in afforestation and plantation affected postural structure substantially. Additionally, as a result of the high BMI detected, it was discovered that physical activities carried out under harsh circumstances caused more postural deformation along with high level fattening.

Having the workers employed for forestry activities go through health check-ups periodically may be helpful in preventing deviations that might develop in their postures. While choosing the works the workers will take on, their body structures must be taken into consideration. The workers must be trained in how to lift heavy weights or how their body position should be when lifting light weights repeatedly. The workers must be provided with the protective gear required for occupational safety and workers' health and it must be ensured that these gears will be used. Especially in heavy production works, mechanised techniques should be prioritized and the workers' work load should be lowered.

Acknowledgments

This study is funded by Scientific Research Council of Artvin Çoruh with the Project number 2011.F10.02.06.

References

Acar, H.H., Eroğlu, H. (2001) Ormancılıkta Odun Üretimi ve Fidanlık-Ağaçlandırma İşçilerindeki Sağlık Sorunları Üzerine Bir Araştırma, 8. Ulusal Ergonomi Kongresi, İzmir, Bildiriler Kitabı, s 9-14

Bao, S. Ninica, H. Peregrin, S. Barbara S, Nayak, P. (2009) Interrater Reliability Of Posture Observations, Human Factors, 51:3, 292-309 USA

Berker, E. (1998) Bel Ağrılarında Epidemiyoloji ve Risk Faktörleri, Türkiye Fiziksel Tıp ve Rehabilitasyon Dergisi, 5 (1), 1998.

Engür, O.M., (2006) Ağaç Kesim Teknikleri ve İş Güvenliği, OR-KOOP Eğitim Yayınları Dizisi: 1, 158 s.

Erdaş, O., Acar, H. (1995) Doğu Karadeniz bölgesi orman işçilerinde işçi sağlığı, 5. Ulusal Ergonomi Kongresi, İstanbul, Bildiriler Kitabı, s:312-322.

Eroğlu, H., Yılmaz, R., Cihan, H., Kayacan, Y. (2013a) Artvin Yöresinde Odun Hammaddesi Üretim ve Fidanlık-Ağaçlandırma İşçilerinin İzometrik Kuvvet Değerlerinin ve Vücut Kompozisyonlarının Belirlenmesi Üzerine Bir Araştırma Artvin Çoruh Üniversitesi, Orman Fakültesi Dergisi 14 (1) 126-135.

Eroğlu, H. Kayacan, Y. Yılmaz, R. (2013b) Artvin Orman Bölge Müdürlüğünde Üretim ve Ağaçlandırma İşçilerinin Vücut Ekstremitelerinin Kinesiyolojik ve Postural Analizinin Yapılması, Artvin Çoruh Üniversitesi, BAP Projesi, Proje No: 2011.F10.02.06.

Hagen, K.B. Magnus, P. and Vetlesen K. (1995) Neck/shoulder and low-back disorders in the forestry industry: relationship to work tasks and perceived psychosocial job stress-Ergonomıcs, 41:10, 1510- 1518.

Hennessy, L.A. Watson, S. (1993) Flexibility And Posture Assessment İn Relation To Hamstring İnjury, BritishJournal Of Sports Medicine, England, Med; 27(4)-s:243

Gallagher, S., Hamrick, C.A., Cornelius, K., & Redfern, M.S. (2001). The effects of restricted workspace on lumbar spine loading, Occupational Ergonomics, 2, 201-213.

Gamperiene, M., Stigum, H. (1999) Work Related Risk Factors For Musculoskeletal

Complaints İn The Spinning İndustry İn Lithuania Occup Environ Med; 56:411–416

Kaya Y. (1991) Sportif Hareketlerin Postür Üzerine Etkileri, Yüksek Lisans Tezi, Selçuk Üniversitesi Sağlık Bilimleri Enstitüsü, Konya, s:10

Kılınç, F., Yaman, H., Atay, E., (2009) Investigation Of The Effects Of Intensive One- Sided And Double-Sided Training Drills On The Postures Of Basketball Ply. Children, J. Phys. Ther. Sci. 21: 23–28, P-24

Lien, C.C. (2005) A Scalable Model-Based Hand Posture Analysis System, Machine Vision And Applications 16: 157– 169.

Liu, Y., Xudong Z. And Don C. (1997) Perception And Visualization Of Human Posture İnformation For Computer-Aided Ergonomic Analysis, Erconomics, 40:8, 818-833.

Maslen, B. and Straker, L. (2009) A Comparison Of Posture And Muscle Activity Means And Variation Amongst Young Children, Older Children And Young Adults Whilst Working With Computers, Work Reading, Mass.). 32(3):311-20, Australia

Normand, M. C., Descarreaux M., Harrison D., Harrison D., Perron D., Joseph R., Tadeusz F., Janik J., (2007) Three Dimensional Evaluation Of Posture İn Standing With The Postureprint: An İntra- And İnter-Examiner Reliability Study, Chiropractic & Osteopathy, 15:15

Ohya, J., Utsumi, A., Yamato, J. (2002) Analyzing Video Sequences Of Multiple Humans, Tracking, Posture Estimation And Behavior Recognition (The Kluwer Internatıonal Serıes In Vıdeo (The International Series İn Video Computing), Kluwer Academic Publishers, Boston/Dordrecht/London

Redmond, A.C. Yvonne C., Menz B. (2008) Normative Values For The Foot Posture Index, Journal of Foot and Ankle Research, 1:6.

Thomas, C.C. (1956) The Diagnosis And Treatment Of Postural Defects, Blacwell Scientific Publications LTD., Oxford, England. P:3.

Ural, H.İ., Sina E., Bayraktar B., Çakmak A. (2004) Okul Çocuklarında Sırt Çantası Taşıma ile Postür Arasındaki İlişki-Derleme Yıl: Türkiye Fiziksel Tıp ve Rehabilitasyon Dergisi 10-Cilt: 50- Sayı :5

Van Niekerk S.M., Louw O., Vaughan C., Grimmer-Somers K., Schreve K. (2008) Photographic Measurement of Upper-Body Sitting Posture Of High School Students: A Reliability And Validity Study, BMC Musculoskeletal Disorders, 9:113, 1.

Whitmore M., Andrea H. Berman, (1996) The Evolution Of The Posture Video Analysis Tools (PVAT), NASA Technical Paper 3657, Houston, Texas

Widhe, T. (2001) Spine: Posture, Mobility And Pain. A Longitudinal Study From Childhood To Adolescence, Eur pine J 10 :118-123.

Yakut Y., Algun C. (1986) Squat Egzersizleri Sırasında Lumbal Vertebralarda Oluşan Streslerin Analizi Üzerine Bir Çalışma" Spor Hekimliği Dergisi, 21:3, 73-80.

Zorba. E., Ziyagil, M. (1995) Vücut Kompozisyonu ve Ölçüm Metotları. Gen Matbaacılık Reklamcılık Ltd. Şti., Trabzon, 329 s.