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ANALYTICAL STUDY FOR HUMAN FACTORS AND ITS RELATIONSHIP WITH OPERATION ACCIDENTS IN AGRICULTURAL MECHANIZATION

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ABSTRACT

Design of agricultural machine should include an understanding of the operator-machine interface, knowledge of human factors engineering, and integration of safety into the design. The objective of this study is to analysis the interaction between the labor anthropometrics and the machines parts which cause accidents through a survey conducted in 7 farm machinery-servicing stations belong to the Ministry of Agricultural (MOA), Rice Mechanization Center (RMC) & Small Farm Mechanization Project belong to Agricultural Engineering Research Institute, and Egyptian Project for improving the main crops production. Seven measurements were taken: stand height, shoulder height, waist height, knee height, arm length, waist, and weight. The results revealed that the tractor related accidents in the sample under study consider the highest percentage (20.3%), followed by local balers (17.2%), threshers (16.4%), and combines (11.7%). This is due to the tractors had unsafe frame (ROPS) or cab and there are some without cab or frame. On the other hand the dangerous rapid parts which found in local balers (feeding head), threshers (the fly wheel, rotating rollers), and combines (sharp edges, rotating gears, rotating rollers, chain and sprocket drive), which cause injure. Casualty type distribution indicated that death cases reached (8.2%), while (36.8%) ruptures, (27.2%) broken parts, and (20.6%) cut parts. The highest number of victims was in the age group of (36-40) years (44.9%), followed by (41-45) years (20.5%), above 51 years (0.7%), and below 30 years (9.6%). This is due to the highest percentage of workers lay in this group working in the farm machinery.

Results showed that there are significant differences between the waist and weight for injured and not injured labors, significant correlation, and significant relationship between accidents factors.

INTRODUCTION

It worth to state that there has been interest in applying safety, health and ergonomics principles in the agricultural field since the 1960 in U.S. and Europe countries. But there is a deep drape at the researches in these science in the developing countries. Carelessness of workplace condition is the direct and indirect reasons to injuries, diseases, accidents and employers rate decrease. In agricultural mechanization, the advent of the machine has introduced not only major changes in work organization but also gradual alteration to the acceptable level of operator skills. This, in turn, increases the demand for higher productivity during work cycle, and the need to apply ergonomics to improve the design of the workplace environment ***(Farag, 2003).***

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FMO (1974) defined accident as it is an event that occurs where a person is injured unintentionally as a result of either machine failure or human error which is caused by many factors: carelessness, fatigue, overload, preoccupation, incompatibility between man and machine. Often human error results in hurts the pocketbook, but a damaged machine can be repaired or replaced. On the other hand, when the error causes a damaged human body, results are frequently more serious. Repairs for human body are a little harder to come by. There are no replacement parts for eyes, fingers, hands, and other body parts.

Human limitations and capabilities can be classified into three groups:

- Physical; person's physical characteristics are differences in size, strength, table (1).
- Physiological; every body has certain Physiological characteristics and limitation.
- Psychological; personal safety and performance depend heavily upon psychological factors.

Table (1): Selected human physical dimension for adults.

Body Measurement	Dimension, mm		
	5th Percentile	50th Percentile	95th Percentile
Standing height with shoes, mm	1550	1715	1880
Sitting height, normal, mm	798	879	960
Knee height sitting, mm	495	555	614
Horizontal seat height, mm	398	440	482
Elbow sitting height, mm	189	214	239
Thigh height sitting, mm	533	598	662
Knee to buttock length, mm	524	586	648
Buttock to calf length, mm	409	457	505
Elbow-to-elbow width, mm	386	443	500
Hip width sitting, mm	325	360	395
Hip pivot to horizontal seat height, mm	64	80	96
Hip pivot to floor (leg length) , mm	816	916	1016
Arm span, mm	1564	1742	1920
Hip pivot width, mm	168	177	188
shoes width, mm	90	103	116
Foot width, mm	84	94	104
Weight, kg	48	73	98

Source: SAE Standard J833 MAY 89 (SAE, 1999).

Notes: 5^{th} percentile data is for female population, 95^{th} percentile data is for male population.

Verma et al. (1978) conducted a survey of thresher-related incidents that caused injuries in Punjab state and reported that about 73% of these incidents were due to human factors, 13% were due to machine factors, and 14% were due to crop and other factors. The survey also mentioned that 59% of the victims were hired laborers. Responding to the public uproar created by these incidents, the government of India enacted the Dangerous Machines (Regulation) Act of 1983 and made safe feeding chutes and feeding systems compulsory on power threshers.

Younis (1986) reported that local manufacturing of tractors and farm machines has many advantages for the overall national development and has its impact in the economics for the agricultural production. Proper matching of machine requirements with the human capabilities forms the essential parameter to base our farm mechanization on firm foundation. Anthropometric data is a basic necessity for achieving that goal. Available data on human factors of Egyptian farm workers is very little. From the seat, levers and height of handling point of view, seven measurements were taken on 100 subjects. The data were analyzed for percentile distribution, standard deviation range of variation and linear regression. The analyzed data showed differences between the dimensional elements of Egyptian agricultural workers and that of other countries. The developed relationships between the standing height and other linear measurements can help to predict the main linear anthropometrics data for future design studies or for determining the specification of the imported farm machinery.

Shan (1987) investigated the threshing machine related accidents, which have caused mutilating hand injuries, revealed that poor design of crop feeding systems and work station arrangements were responsible for the majority of such accidents. An analysis was made of the man-machine aspects of some commonly used designs of wheat threshers in order to illustrate adaptable improvements. Design recommendations were given for the crop feeding chute and the feed reverse control in order to avoid the accidents cause.

Kolstad et al. (1990) conducting a pilot study of farms in Minnesota, USA, interviewed persons having agricultural machinery related injuries. Their results indicated the need to improve machine designs to reduce slips and falls.

Cavaletto (1991) mentioned that safety considerations have not always preceded or coincided with the development of machinery. It was a "user behaviour" environment during the industrial revolution. Workers Compensation laws enacted in the early 1900s had as objectives to reduce accidents through employer incentives, encourage accidents analysis.

Wilkinson (1991) stated that any equipment, no matter how well designed, can be damaged and abused by an operator who is uncomfortable or inefficient. Even more importantly, the operator or others may be inhuried due to the poor "operator-equipment fit". Techniques that allow designers to address the operator-machine interface are vitally important in achieving a "good fit design. Using anthropometrics to eliminate "design error" as much as possible will go a long way towards minimizing" operator error" when the equipment is being used. Engineering anthropometry is the area of human factor engineering that involves the science of physically measuring the human body, and the mechanical aspects of human motion. Anthropometry, the measure of man, is a subdivision of the border topic of anthropology, the science of man and how he functions as a social being. He also mentioned that most men fall somewhere in between three types as shown in figure (1), the three types are:

- Ectomorph: Slender limbs and body, small face, physically spry, great walker.
- Mesomorph: Massive, solid form, heavily muscled, awkward.

- Endomorph: Soft, round form, loose flabby tissue, low density, physically weak.

Duncan et al. (1994) indicated that one definition of the discipline of human factors is application of behavioral principles and data to engineering design to do two things: * Maximize an individual's contribution to the effectiveness of the system, which he/she is a part.
* Reduce the impact of that system on the individual.

Allard et al. (1995) mentioned that the purpose of ergonomics is to design a workplace and work procedure such that injuries do not result. Ideally, this is implemented during the initial design of the workplace. In existing work environment, the prevention of occupational injuries must be achieved mainly through changes in job design and work methods. Several factors appear in the epidemiological literature to be potential contributors to the development of musculoskeletal injuries in the work environment. These factors include body motions, workplace factors, Anthropometric factors, and psychosocial factors.

Hamam et al. (1999) stated that accident information, useful in identifying farm safety problem areas, is scarcely available, especially these required for producing safe farm machines and for improving farm safety systems. They carried out a two-step simple procedure includes reviewing accident information readily available from governmental resources (Central Agency for Public Mobilization and Statistics (CAPMS) and Rental stations), and developing a survey to one of the major safety problems was accomplished.

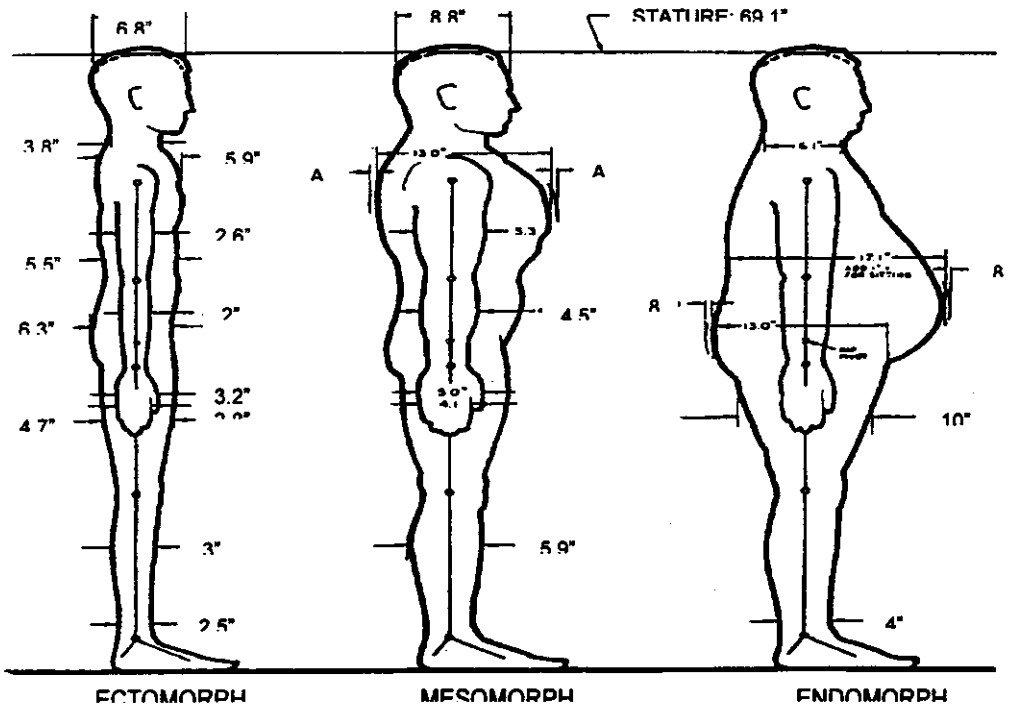

Fig. (1) : Three basic human body types.

- Casualties type distribution indicated that death cases constitute 19.7%, while 24.2% injuries, 31.8% broken parts, 16.7% cut parts and 7.6% ruptures.
  85% of the death cases was due to the tractor rollover. 70.3% of tractors under study were found without of Rollover Protective Structure (ROPS). 91% of tractors without PTO shield. 93.7% of tractors without seatbelt.
- The farm machinery related accidents is considered as the most important factor causing casualties. The tractor related accidents constitute the highest percentage of 31% followed by combine 22%, and thresher 11%.

Rautiainen and Reynolds (2002) summarized the trends in agricultural injuries and illnesses in the past decade, as well as the needs for surveillance in the future. Agriculture is one of the most hazardous industries in the U.S. The fatality rate in agriculture remained high (about 22/100,000 workers) through the 1990s, and tractors remained the leading source of death, causing approximately 300 fatalities each year.

MATERIALS AND METHODS

A survey was conducted to collect information on such incidents that happened during the years 2003-2004 through periodic visits in seven selected farm machinery-servicing stations belong to the Ministry of Agricultural (MOA), Rice Mechanization Center (RMC) & Small Farm Mechanization Project (SFMP), belong to Agricultural Engineering Research Institute, and Egyptian Project for improving the main crops production, from four governorates: Sharkia, Kafer Elshiekh, Gharbia, and Kalubia. The governorates were selected on the basis of highest tractors and farm machines density in the region. The farm machinery-servicing stations selected for the survey were: Kafer sakr, Hehya, Abokaber, Sakha, Kotour, Kanater, and Tokh.

The collected data were divided in two major categories:

1- Data of accidents related to tractors and farm machines were taken for 136 subjects chosen randomly among tractor drivers, farm mechanics, and farm labors working at the seven farm machinery-servicing stations. Data were collected interviewing persons using a questionnaire format as shown in figure (2), and were also collected from archives.

2- Data of anthropometrics measurements were taken for 342 subjects chosen randomly among tractor drivers, farm mechanics, and farm labors working at Kafer sakr, Hehya, Abokaber, (RMC), (SFMP), and Egyptian Project for improving the main crops production selected on the basis of highest number of accidents, included 34 subjects had accidents using a format as shown in figure (3) Seven measurements were taken: stand height, shoulder height, waist height, knee height, arm length, waist, and weight, figure (4). The measurements posture was such that the subject stands with his feet closed and his body vertically erected. Weighing balance and measuring tape were used for the measurements. The data were processed for Frequencies procedure, Crosstabs (X^2), Analysis of variance, and Correlation's matrix ***(Snedecor and Cochran, 1980).***

RESULTS AND DISCUSSION

Data obtained from survey were statistically analyzed and plotted in the following Figs (5-13). Accident information were classified according to age

at accident time, machine which cause accident, casualty type, Cause of accident, qualification status, education status, training, deficiency, and type of cloth. Fig. (5): showed that the highest number of victims was in the age group of (36-40) years (44.9%), followed by (41-45) years (20.5%),(31-35) years (15.4%), (46-50) years (8.9%), above 51 years (0.7%), and below 30 years (9.6%). This may be due to the highest percentage of workers lay in this group Fig. (6): showed that the tractor related accidents in the sample under study consider the highest percentage (20.3%), followed by local balers (17.2%), threshers (16.4%), combines (11.7%), workshop tools (9.4%), mowers (7.8%), plows, sprayer motors, and irrigation pumps the same percentage (4.7%), and finally diggers (3.1%). That increasing trend indicated that attentions should be directed to solve the design problems found in agricultural machines.

1. Date :-
2. Governorate :-
3. Farm machinery-servicing station name :-
4. What is your name?
5. What is your age?
6. What is your healthy status?
   - ☐ Injuried
   - ☐ Not Injuried
7. What is your qualification?
   - ☐ Without
   - ☐ Less than intermediate
   - ☐ Intermediate
   - ☐ More than intermediate
   - ☐ Graduate
8. How is your education?
   - ☐ Illiterate
   - ☐ Read and write
9. What is the kind of training course do you attend?
10. What is the kind of machine which cause accident for you?
    - ☐ Tractor
    - ☐ Plow
    - ☐ Combine
    - ☐ Sprayer motor
    - ☐ Thresher
    - ☐ Irrigation pump
    - ☐ Local baler
    - ☐ Digger
    - ☐ Mower
    - ☐ Workshop tools
11. What is your age at accident time?
12. What is your casualty type?
    - ☐ Rupture
    - ☐ Blind
    - ☐ Broken
    - ☐ Deaf
    - ☐ Cut
    - ☐ Back Bain
    - ☐ Temporary illness
    - ☐ Poison
    - ☐ Perennial disease
    - ☐ Death
13. What is the cause of accident which happen for you?
    - ☐ Personal default
    - ☐ Somebody else default
    - ☐ Road accident
    - ☐ Unsuitable machine parts
14. How much disability do you have?
    - ☐ Partial
    - ☐ Whole
    - ☐ Death
15. What is the kind of cloth type do you wear at accident?
    - ☐ Gelbab
    - ☐ Overall
    - ☐ Tie
    - ☐ Shirt and trousers

Fig. (2) : Accidents related to tractors and farm machines questionnaire.

1. Date :-
2. Governorate :-
3. Farm machinery-servicing station name :-
4. What is your name?
5. What is your age?
6. What is your qualification / occupation?
7. What is your anthropometrics measurements?
   - Stand height
   - Shoulder height
   - Waist height
   - Knee height
   - Arm length
   - Waist
   - Weight

Fig. (3) : Labor anthropometrics survey.

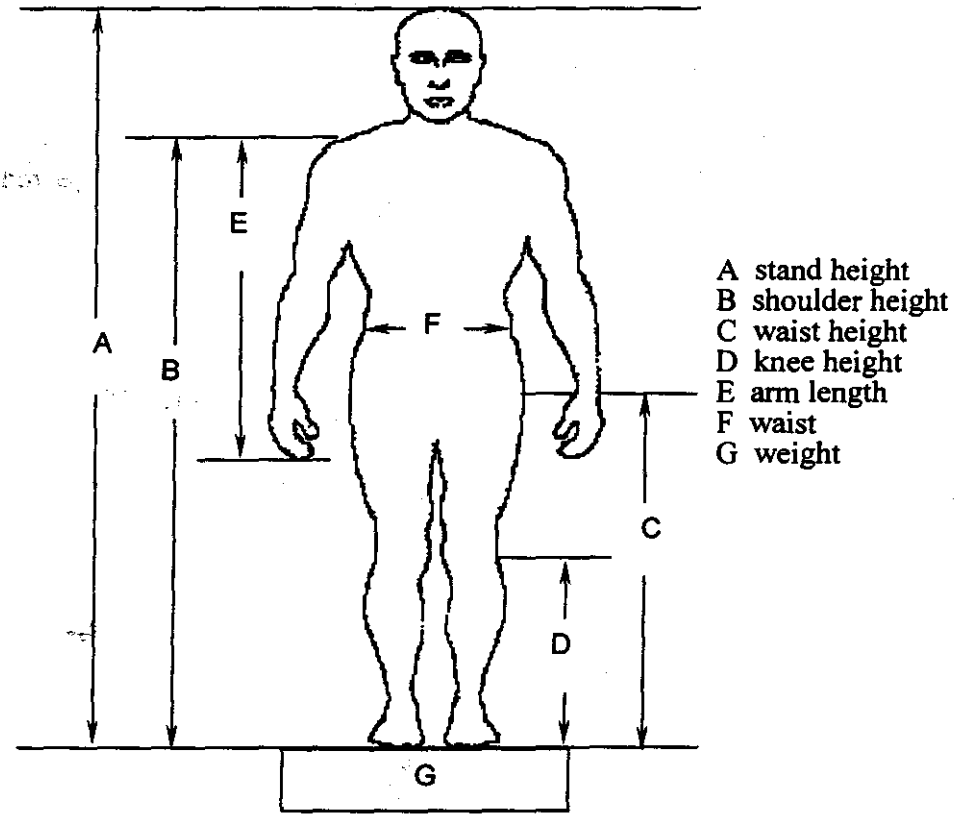

Fig. (4) : Anthropometrics measurements chart.

Fig. (7): showed that the death cases reached (8.2%), while (36.8%) ruptures, (27.2%) broken parts, and (20.6%) cut parts, (2.9%) poison, (1.5%) back bain, and the same percentage (0.7%) for temporary illness,

perennial disease, blind and deaf. These accidents occur during operation and maintenance of farm machinery or dealing directly with farm machinery.

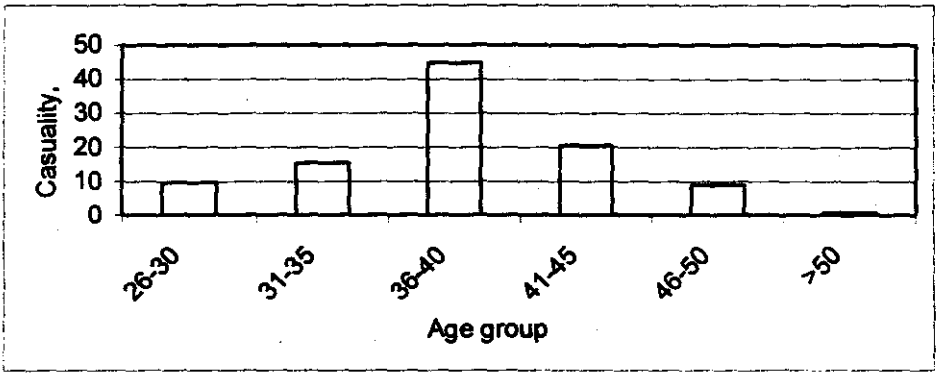

Fig. (5): Casualty distribution by age group.

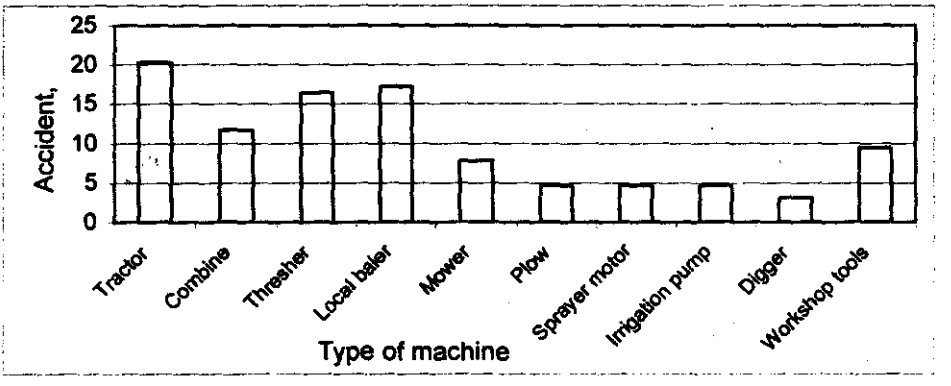

Fig. (6): Machinery which cause accidents.

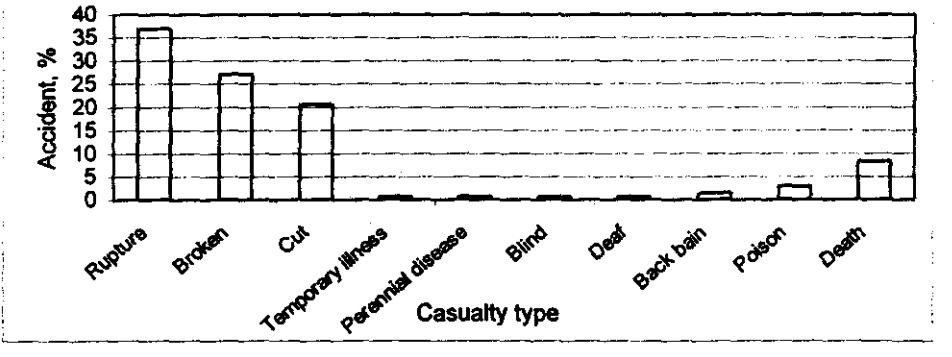

Fig. (7): Casualty distribution according to injures parts.

Fig. (8): showed that the highest percentage of cause of accident (71.3%) personal default, followed by (15.4%) somebody else default, (8.1%) road accident, and (5.2%) unsuitable machine parts.

Fig. (9) and Fig. (10): showed that the highest percentage of subjects who had qualification was less than intermediate (50%), followed by without qualification (38.2%), intermediate (6.7%), more than intermediate (3.6%), and (1.5%) for graduate, on the other hand, there was (89%) read and write, and (11%) illiterate. The trend of decreasing accident number with increasing level of qualification and education status is logically accepted, the difference between the status of illiterate and person who can read and write only is not technically significant under the Egyptian circumstances. Therefore one may say that the training on operating or utilizing machines may be the effective factor for these cases.
Fig. (11): showed that (48.5%) had no training course about tractors and farm machines, followed by (47.1%) had training course in maintenance and operation, and (4.4%) had training course in maintenance, operation, and occupational safety.
Fig. (12): showed that the highest percentage of disability (83.8%) partial disability, followed by both of whole and death (8.1%).

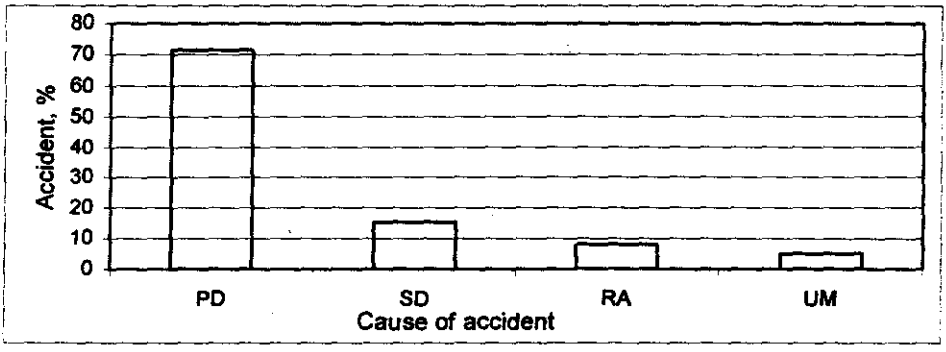

Fig. (8): No. of accident related to cause of accident.
PD = Personal default SD = Somebody else default
RA = Road accident UM = Unsuitable machine parts

Fig. (13): showed that the highest percentage of type of cloth related accident was shirt and trousers (59.6%), followed by overall (31.6%), Gelbab and tie (4.4%).

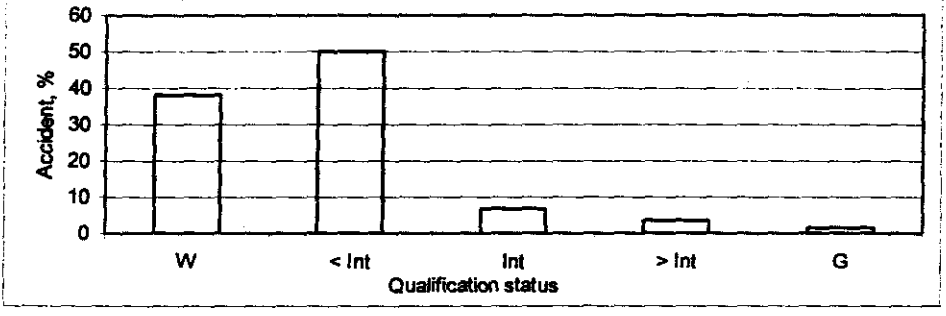

Fig. (9): No of casualties related to qualification status.
W = Without < Int = Less than intermediate
Int = Intermediate > Int = More than intermediate G = Graduate

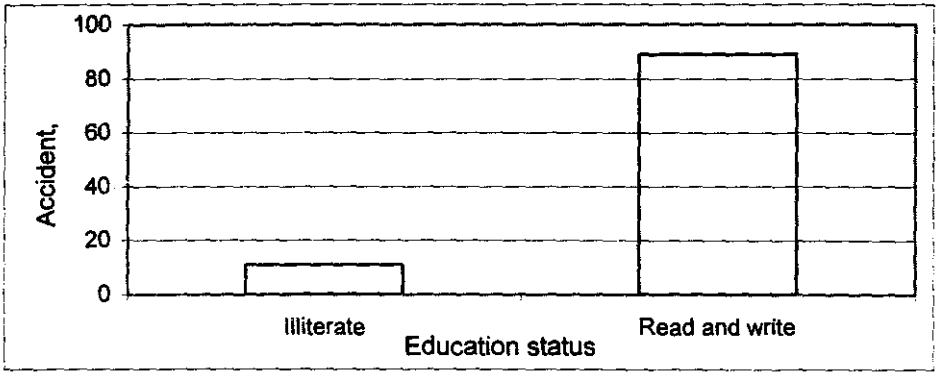

Fig. (10): No. of accident related to education status.

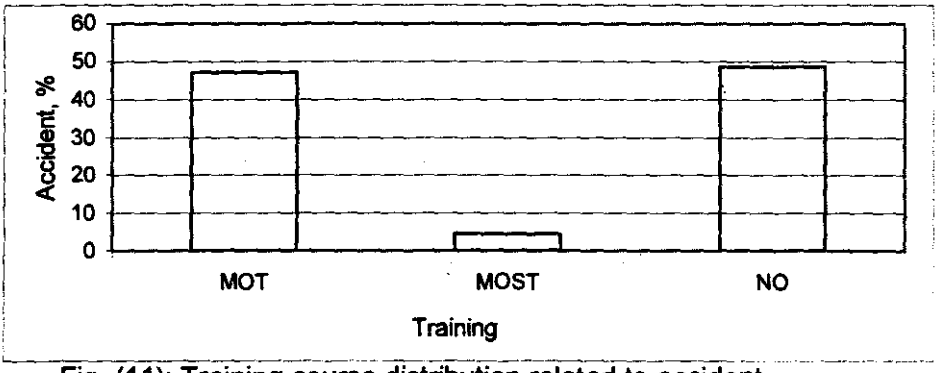

Fig. (11): Training course distribution related to accident.
MOT = Maintenance, operating training course
MOST = Maintenance, operating, and occupational safety training course
NO = No training course

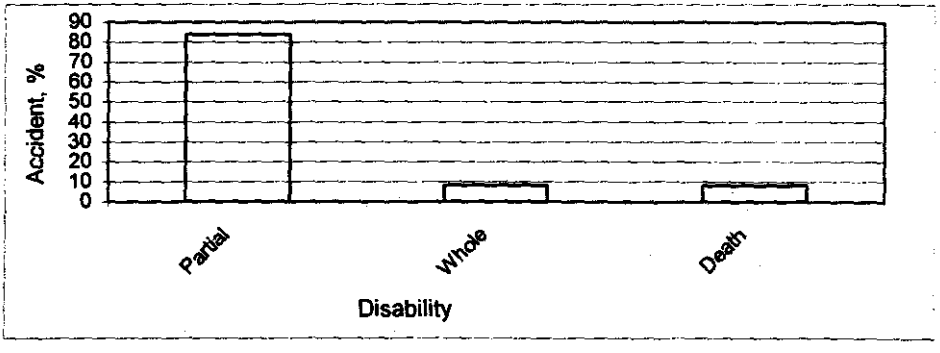

Fig. (12): Accident distribution according to disability.

Statistical analysis was thoroughly and in details performed to test the significancy of all the intractable factors which affect accidents, cause of accidents and casualty type. The Chi-Square Tests revealed that there were significant relationship between the

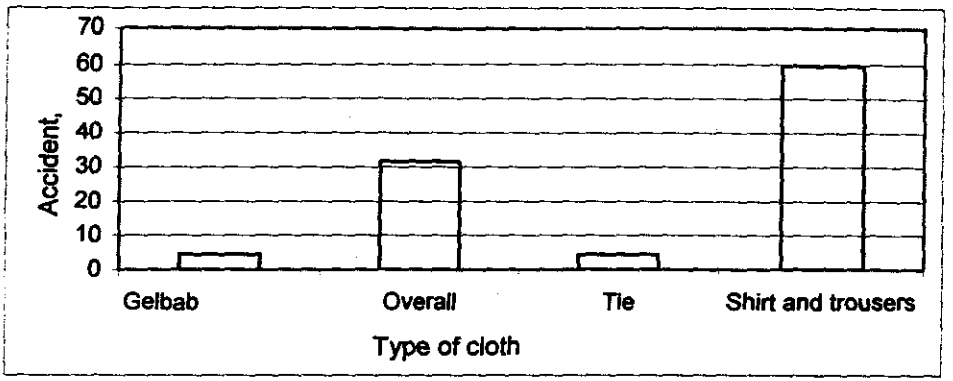

Fig. (13): Accident distribution according to type of cloth.

type of machine and casualty type, cause of accident, degree of caused disability, type of worker cloth. On the other hand, the casualty type was affected significantly by the causes of the accident, by disability, and by type of worker cloth. A The Chi-Square Test was also performed on cause of accidents and disability. The data revealed that there was no significant relationship, that means disability is not related to cause of accidents but may be related to decrease in training or qualification status.

The type of worker cloth is a major factor that affects both cause of accident and the degree of disability. Highly significant relationship was found between these intractable factors.

A The Chi-Square Test was also performed to check the interaction between training level and machine which cause accident, cause of accident. The analysis revealed that there were highly significant relationship between the studied factors, in spite of having training course, accident still take place. This phenomena draws the attention towards the quality of training and the need to perform safety courses in addition to looking at the suitability of machines functional parts with the anthropometrics characteristics of the labors.

On the other hand, insignificant relationship was found between the qualification of the worker and casualty type, disability. But significantly by cause of accident, and type of worker cloth.

Table (2): showed that the statistical analysis for correlation matrix between accidents factors. Data analysis showed that there was highly significant correlation between age & training, age & age at accident time, age & type of cloth, qualification & education, education & casualty type, education & disability, training & type of cloth, machine which cause accident & casualty type, age at accident time & type of cloth, and casualty type & disability. And showed that there was significant correlation between age & qualification, age & education, age & casualty type, qualification & age at accident time, education & age at accident time, education & type of cloth, training & machine which cause accident, training & age at accident time, machine which cause accident & disability, age at accident time & casualty type, and age at accident time & type of cloth. All these correlations revealed that there are need to provide training courses for labors who working in farm machinery, suitable interaction between labor anthropometrics and the

machines parts which cause accidents, and modify machines functional parts which cause accidents in the sample under study.

Table (2): The correlation matrix between accidents factors.

accidents factors	Age	Qualification	Education	Training	Machine which cause accident	Age at accident time	Casualty type	Cause of accident	Disability	Type of cloth
Age	1									
Qualification	0.174*	1								
Education	0.182*	0.255**	1							
Training	0.227**	0.114	0.019	1						
Machine which cause accident	0.036	0.106	0.076	0.220*	1					
Age at accident time	0.879**	0.177*	0.181*	0.192*	0.034	1				
Casualty type	0.216*	0.076	0.275**	0.135	0.265**	0.185*	1			
Cause of accident	0.018	0.028	0.112	0.098	0.074	0.042	0.120	1		
disability	0.123	0.008	0.254**	0.019	0.174*	0.175*	0.724**	0.155	1	
Type of cloth	0.274**	0.118	0.211*	0.237**	0.002	0.255**	0.106	0.069	0.105	1

Table (3): showed that the statistical analysis of ANOVA for the anthropometric characteristics of farm workers who injuried and not Injuried. Data analysis showed that there was highly significant difference on the mean of waist and on the mean of weight for injuried and not Injuried labors, on the other hand, there was insignificant difference on the mean of stand height, shoulder height, waist height, knee height, and arm length for injuried and not Injuried. So it is clear that the mean waist and mean weight for a labor working in machines which cause accidents were between (95.8096, 97.9241) cm, (77.8331, 80.7708) kg, respectively, according to the machine functional parts dimension in the sample under study.

SUMMARY AND CONCLUSSION

The aim of this research is to analyse the interaction between the labor anthropometrics and the machines parts which cause accidents through a survey conducted, the results indicated that:-

1- The tractor related accidents in the sample under study consider the highest percentage (20.3%), followed by local balers (17.2%), threshers (16.4%), and combines (11.7%). Because of tractors had unsafe frame or cab and there are some without cab or frame. On the other hand the dangerous rapid parts which found in local balers (feeding head), threshers (the fly wheel, rotating rollers), and combines (sharp edges, rotating gears, rotating rollers, chain and sprocket drive)
2- Casualty type distribution indicated that death cases reached (8.2%), while (36.8%) ruptures, (27.2%) broken parts, and (20.6%) cut parts.
3- The highest number of victims was in the age group of (36-40) years (44.9%), followed by (41-45) years (20.5%), above 51 years (0.7%),

and below 30 years (9.6%). This due to the highest percentage of workers lay in this group working in the farm machinery.

4- A Chi-Square Test was used to determine whether there were any statistically significant relationships between accidents factors revealed that there are need to provide training courses for labors who working in farm machinery, suitable interaction between labor anthropometrics and the machines parts which cause accidents, and modify machines parts which cause accidents in the sample under study.

5- the statistical analysis for correlation matrix between accidents factors revealed that there are highly significant correlation between age & training, age & age at accident time, age & type of cloth, qualification & education, education & casualty type, education & disability, training & type of cloth, machine which cause accident & casualty type, age at accident time & type of cloth, and casualty type & disability. And there was significant correlation between age & qualification, age & education, age & casualty type, qualification & age at accident time, education & age at accident time, education & type of cloth, training & machine which cause accident, training & age at accident time, machine which cause accident & disability, age at accident time & casualty type, and age at accident time & type of cloth.

Table (3): The statistical analysis of ANOVA for the anthropometric characteristics of farm workers who injuried and not Injuried.

Labor anthropometrics	healthy status	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	F Value	Sig.
Stand height	Not Injuried	172.94	5.26	0.29	172.35	173.53	0.016	0.898
	Injuried	172.82	5.16	0.88	171.02	174.62		
Shoulder height	Not Injuried	148.31	4.96	0.28	147.75	148.87	0.035	0.852
	Injuried	148.14	4.98	0.85	146.40	149.88		
Waist height	Not Injuried	99.36	4.38	0.24	98.87	99.85	0.187	0.666
	Injuried	99.70	3.92	0.67	98.33	101.07		
Knee height	Not Injuried	51.30	3.07	0.17	50.96	51.64	0.433	0.511
	Injuried	51.67	3.55	0.61	50.43	52.91		
Arm length	Not Injuried	72.14	3.04	0.17	71.80	72.48	0.471	0.493
	Injuried	71.76	3.39	0.58	70.58	72.94		
Waist	Not Injuried	96.86	9.42	0.53	95.80	97.92	6.425	0.012**
	Injuried	101.20	9.85	1.69	97.76	104.64		
Weight	Not Injuried	79.30	13.10	0.74	77.83	80.77		
	Injuried	84.82	15.55	2.66	79.39	90.25	5.231	0.023**

6- there are a significant differences between the waist and weight for injured and not injured labors.

RECOMMENDATION

1- A mean waist of (95, 97) cm, and a mean weight of (77, 80) kg, are consider the most suitable anthropometric characters for worker to perform safely.
2- Provide training course in maintenance, operating, and occupational safety in farm machinery. With providing and helding training programs for the labours in farm machinery.
3- Modify machine parts which cause accident. With providing protective shields for better operating of the dangerous rapid parts.

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الملخص العربى

دراسة تحليلية للعوامل الإنسانية وعلاقتها بحوادث التشغيل فى الميكنة الزراعية

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تصميم الآلات الزراعية يتطلب مراعاة التداخل فيما بين الأبعاد الجسمية للعامل والأبعاد الهندسية للأجزاء الوظيفية للآلات .لذا تهدف هذه الدراسة الى تحليل التداخل فيما بين الأبعاد الجسمية للعامل والأبعاد الهندسية للأجزاء الوظيفية للآلات والتي ينتج عنهما وقوع الحوادث والإصابات من خلال حصر أجرى على 7 محطات للخدمة الآلية التابعة لوزارة الزراعة الى جانب مركز ميكنة الأرز بميت الديبة ومشروع ميكنة المزارع الصغيرة التابعين لمعهد بحوث الهندسة الزراعية ، والمشروع المصري لتحسين إنتاجية محاصيل الحبوب الرئيسية .

وقد تضمن البحث قياس ستة أبعاد جسمية علاوة على وزن الفرد وتلك الأبعاد هى الطول واقفا ، ارتفاع للكتف ، ارتفاع الوسط ، ارتفاع الركبة ، طول الذراع ، ومحيط الوسط .

وقد أظهرت النتائج أن الجرار الزراعي هو أكثر المعدات الزراعية المسببة للإصابات فى العينة محل الدراسة حيث وصلت نسبة الإصابة الناتجة عنه 20.3% ، بينما وصلت نسبة الإصابة عن المكابس البلدية 17.2% ، وكانت نسبة الإصابة عن آلات الدراس 16.4% ، بينما وصلت نسبة الإصابة عن آلات الحصاد الجامعة الى 11.7% . والسبب فى ذلك يرجع الى عدم وجود هيكل الحماية (ROPS) أو كابينة أو وجود هياكل حماية غير آمنة عند حدوث الانقلابات . وتصل نسبة حالات الوفاة الى 8.2% ، ونسبة الجروح المختلفة الى 36.8% ، والكسور بأنواعها الى 27.2% ، بينما تصل نسبة الأجزاء المبتورة الى 20.6% . وتظهر هذه الإصابات نتيجة وجود حواف قاطعة وأجزاء دوارة سريعة خطرة ومكشوفة فى الآلات عينة الدراسة .

وتتركز الحوادث بنسبة عالية عند الفئة العمرية 36-40 سنة (44.9%) ، ويليها 41-45 سنة (20.5%) ، وتقل عند كل من الفئة العمرية 26-30 سنة (9.6%) وعند 51 سنة فأكثر (0.7%) . والسبب فى ذلك هو وجود شريحة كبيرة جدا من العاملين فى قطاع الميكنة الزراعية تتركز أعمارهم بين 36-45 سنة .

وأوضحت النتائج أن هناك علاقات وارتباطات معنوية بين عوامل الحوادث تتطلب الحاجة الى توفير التدريب الكاف للعمال ، هناك فرق معنوي بين محيط الوسط والوزن للعمال المصابين وغير المصابين مما يستلزم التركيز على هذين البعدين عند تصميم الآلات التي تتسبب فى وقوع الحوادث والإصابات بمراعاة التداخل فيما بين هذين البعدين والأجزاء الدوارة السريعة الخطرة وعن طريق إجراء التعديلات اللازمة على أكثر الآلات المسببة لوقوع الحوادث والإصابات وامدادها بأغطية حماية على الأجزاء الدوارة السريعة الخطرة أو تعديل طريقة التغذية فى العينة محل الدراسة وهى رأس التغذية (الغراب) فى المكبس البلدي الثابت والسير وغرفة الدراس فى آلة الدراس المحلية الصنع لتوفير بيئة عمل آمنة للعامل أثناء التشغيل .

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