

Effect of Pesticides on Reproductive Health and an Ergonomic Evaluation amongst Female Agricultural Workers of West Bengal, India

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ABSTRACT: Women constitute almost half of the work force engaged in agriculture. Nowadays female agricultural workers are exposed to various stressors including pesticides that results in health hazards easily. *Objectives:* To assess the strain of female agriculture workers in field in terms of newer parameters, reproductive hormonal imbalances due to different stress factors in addition to standard ergonomic assessment has been followed. *Materials & Methods:* The double blind study, conducted in “Madhupur” village, Burdwan, West Bengal amongst female farmers. Different parameter was measured. *Result:* Farmers showed raised Systolic Blood pressure (SBP). Posture analysis measured painful awkward posture. Reproductive hormone status showed abnormal status in comparison to control counterpart. *Conclusion:* They faced ergonomic and musculoskeletal disorders (MSDs). For pesticide exposure they become prone to Ischemic heart disease (IHD). Also presence of high progesterone and estrogen level and low follicular stimulating hormone (FSH) level, lead to infertility and early menopause.

KEYWORDS: Agriculture, Reproductive Hormone, MSD, Pesticide Effect, IHD.

I. INTRODUCTION

Of late, India ranks third contributing, around 7.5% to the world’s agricultural production. Production wise India has always remained in the top ten since last twenty years. With a production of around 26 million metric tons (MT) in 2007, India ranks fourth in area and third in global potato production. It produces around 8% of the world’s total production. In this huge success female farmers play a major role. Not only potato but also in paddy cultivation they are the backbone of the whole procedure.

Women constitute almost half of the work force engaged in agriculture. The rural women participate in a broad range of agricultural activities such as production, processing preservation and utilization of food. They play a key role in the entire food system starting from the selection of seeds, conservation and seed selection to planting, harvesting, storing and marketing and feeding the family from the harvested produce. It is imperative to understand that they appear to influence the decisions regarding the choice of farm enterprise as well as the desirable production features of a particular commodity or crop. It has been shown that whether it is shifting cultivation, subsistence and low or high input in agriculture.

Women work longer and harder than men though they are paid less. They also work on more tasks than men. In spite of their enormous contributions to farming, the women have largely remained invisible as active farmers. Most people have failed to recognize the work that the women’s involvement in agriculture is enormous.



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Farming is a physically demanding occupation with work tasks that cause musculoskeletal disorders (MSDs) and work disability due to lifting heavy objects, moving and carrying equipment and awkward working postures. [1]

According to 2011 census in India, female ratio is 940 per 1000 male. About one-third of women do more work than men, is a matter of common knowledge, while their work remains largely under recorded, hence the real issue, therefore, is more serious. Despite their involvement in agriculture work in such a large magnitude, women have not been actively involved in the main stream of development and there is hardly any appreciation and recognition of their extensive contribution. [2]



Nowadays female agricultural workers are exposed to pesticides that occurs health hazards easily. Pesticides are used in agriculture to control insects, weeds and vectors of disease. Exposure to pesticides can occur directly from occupational and environmental sources and indirectly through diet. There is a growing public concern about the impact of exposure to pesticides on human health. Lack of knowledge, careless attitude and appalling safety practices in handling pesticides pose a serious health risk to our farmers. Some pesticides were classed as reproductive and developmental toxins in the Pan American Pesticide Database classification [3]. Pesticide exposure has been also associated with several disease conditions including hypertension, hepatomegaly, dermatosis, neurological and immunological effects, chromosomal aberrations and elevated cancer risks. [4], [5].

Photograph 1a and 1b: Type of work performed by Female Agri-worker.

Reproductive effects that have been associated with pesticide exposure in women are decreased fertility, spontaneous abortions, stillbirth, premature birth, low birth weight, developmental abnormalities, ovarian disorders, and disruption of the hormonal function [6].

The number of women agricultural workers is increasing worldwide. Several personal and environmental factors are affecting their personal and professional life simultaneously. So its need to gaining attention towards them and try to find out qualitative and quantitative outcome.

Under the above circumstances the present study tries:

- To assess the reproductive hormonal imbalances due to wide variety exposure to pesticide used in paddy and potato field
- To assess the awkward posture of female workers in harvest and post- harvest activity in potato and paddy field.
- To recommended some suitable technique to less exposure to pesticides.

II. RELATED WORK

A critical review of literature on socio economic characteristics, health problems, involvement of female labourers in farm activities, drudgery prone farm activities, work, worker, and work efficiency, muscular problems, rating of perceived exertion and drudgery reducing technologies/ suggestions in the field of agriculture and other occupations are presented in this section. The health effects of pesticides have been extensively studied in epidemiology, mainly in agricultural populations. The various applications of these matrices in epidemiological studies have proven that they are valuable tools to assess pesticide exposure. [7] Farming is a physically demanding occupation with work tasks that cause MSDs and work disability, such as lifting heavy objects, moving and carrying equipment and awkward working postures has been shown by Lee K et al. [8] Musculoskeletal pain is associated with demographic, occupational and physical factors, those have been studied by Burdorf A et al. Their study investigated the prevalence and factors associated with musculoskeletal pain [9]. Work activities, which are frequent and repetitive or activities with awkward postures cause these disorders, which may be painful during work or at rest have been studied by Kaushik V et al. [10].

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Hasalkar *et al* reported that the majority of the women complained very severe to severe pain in shoulder joint, upper arm, low back wrist/hands and knees while performing the topdressing of fertilizer by traditional method compared to improved method. Further, the author observed that the decrease in percentage of women (91.42%) complaining the shoulder pain when fertilizer activity was performed with the improved technique. [11]

III. CONTRIBUTION

Considering inevitable and compulsory use of agricultural pesticide, the primary goal is to find out protections/recovery methods combating its detrimental effects. So, quantifying damages in terms of steroidal hormonal status and working posture is the novel dimension of the paper. Additionally, requirement of low cost technology development with respect to weeding, harvesting, lifting and carrying heavy loads is highlighted to avoid musculo-skeletal disorders.

IV. METHODS

SELECTION OF THE SITE AND SAMPLE FOR THE STUDY:

The Present study was carried out on the female agricultural workers of “Modhupur” village of Burdwan district, West Bengal, India. 95 female workers involved in the harvest and post harvest activity of paddy and potato field regularly were randomly selected as the experimental group Double blind study was carried out where by another 95 female who were involved in other forms of works like vegetable seller, shop keepers for equal numbers of day was selected to serve as a control group.

All the subjects were belonged to same socio-economic status and had been working in their respective fields more than 5 years uninterrupted. They did not suffer from any chronic ailments.

All the following parameters were assessed between two groups.

Ethical clearance was procured from Institutional Ethics Committee (IEC-H) from Calcutta University.

Table 1: Study of different physical and reproductive parameters

Serial No	Parameter assessed	Testing Methods
1.	Height	Anthropometric Rod
2.	Weight	Weighing Machine
3.	BMI	Calculator
4.	W/H ratio	Tape
5.	Blood Pressure	Sphygmomanometer
6.	RULA	Ergofellow Software
7.	REBA	Ergofellow Software
8.	OWAS	Ergofellow Software
9.	Progesterone	ELLISA Method
10.	Estrogens	ELLISA Method
11.	FSH	ELLISA Method

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DATA COLLECTION:

Structured cum schedule interview technique was adopted to elicit the information relating socio economic background, health status, activity profile, time span frequency of performance, Total days of yearly activity assessed using the PLIBEL questionnaire check list method. Data was analyzed using software of Minitab 16. Descriptive statistics of socio-demographic variables were computed as mean, standard deviation. Student t-test was calculated with those data.

V. RESULTS

The age range of both experimental and control group was 25 to 35 years. Though, they were belonged from same socio economic group, they had insignificant value of Height, Weight, Body Mass Index (BMI) and Waist/Hip ratio (W/H ratio). They had slight difference in lung function parameters values but that are not statistically significant. Interestingly they had significant raised Systolic Blood pressure (SBP) in comparison to Diastolic Blood Pressure (DBP). According to Rapid Entire Body assessment(REBA), Rapid Upper Limb Assessment (RULA), Ovako Working Posture Assessment (OWAS) score, they had higher risk to suffer in MSDs due to use of awkward posture in different types of agricultural work. Also they had significant difference of reproductive hormonal level than selected control group.

Table 2: Comparison of different parameters between Experimental & control group

Serial no	Parameters	Experimental Group		Control Group		P value p<0.05	P value p<0.001
		Mean	S _D	Mean	S _D		
1.	Height	152.5	2.1	154	3.2	0.652	-----
2.	Weight	47	3.41	49	4.29	0.88	-----
3.	BMI	17.23	1.5	21.4	2.7	0.785	-----
4.	W/H Ratio	0.734	0.077	0.862	0.0107	0.625	-----
5.	SBP	142	4.1	110	3.67	0.002*	-----
6.	DBP	92	5.6	87	4.3	0.421	-----
7.	REBA	11.23	1.54	2.89	0.63	-----	0.000*
8.	RULA	6.7	0.42	2.76	0.478	-----	0.000*
9.	OWAS	3.12	0.4	1.6	0.41	-----	0.000*
10.	Progesterone	5.852	2.731	0.927	1.3	0.001*	-----
11.	Estrogens	69.368	3.52	40.252	2.89	0.000*	-----
12.	FSH	5.597	2.48	8.428	1.55	0.002*	-----

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*($p < 0.05$ & $p < 0.001$ values are significant)

FIGURE LEGENDS:

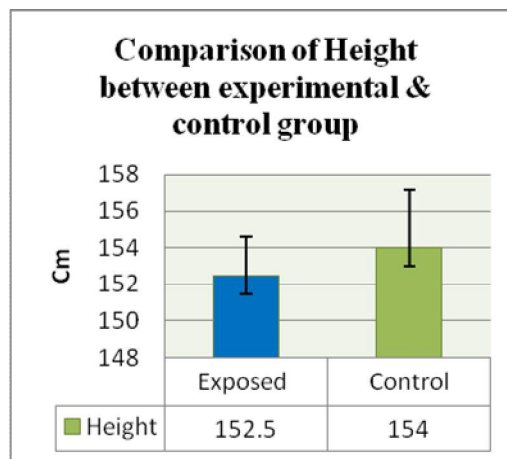


FIG1: BAR DIAGRAM REPRESENTS COMPARISON OF HEIGHT BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP

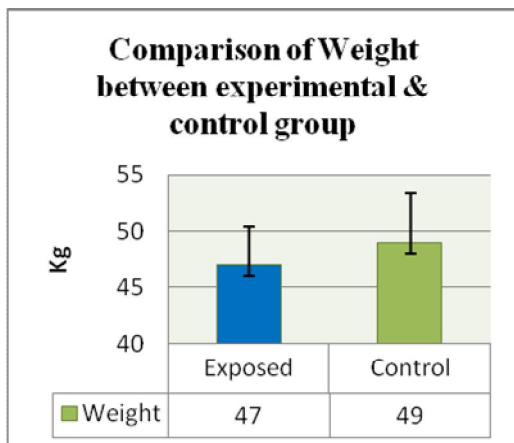


FIG2: BAR DIAGRAM REPRESENTS COMPARISON OF WEIGHT BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP.

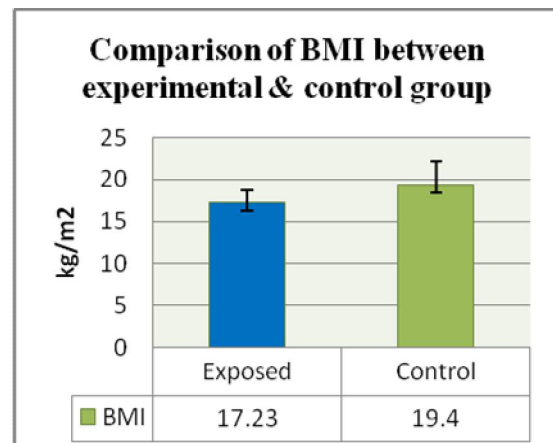


FIG3: BAR DIAGRAM REPRESENTS COMPARISON OF BMI BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP

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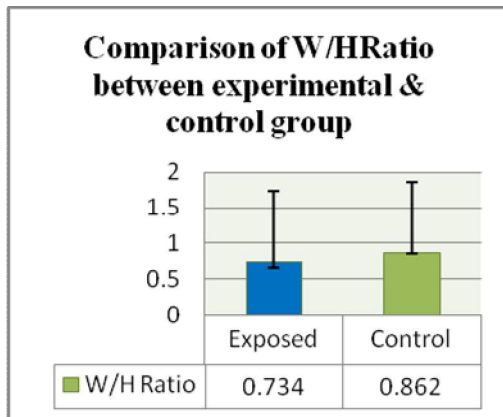


FIG4: BAR DIAGRAM REPRESENTS COMPARISON OF W/H RATIO BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP.

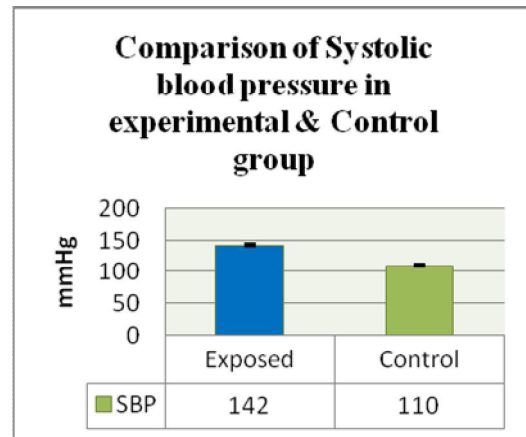


FIG5: BAR DIAGRAM REPRESENTS COMPARISON OF SBP BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP

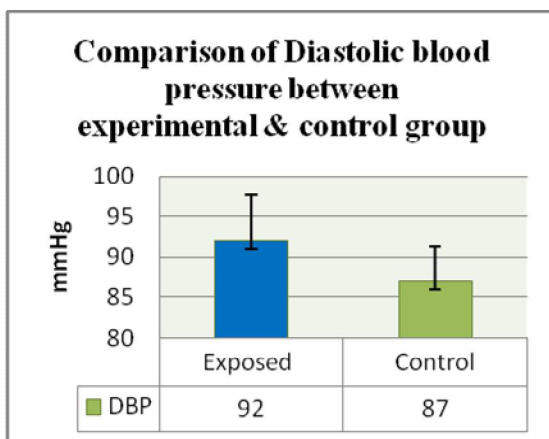


FIG6: BAR DIAGRAM REPRESENTS COMPARISON OF DBP BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP.

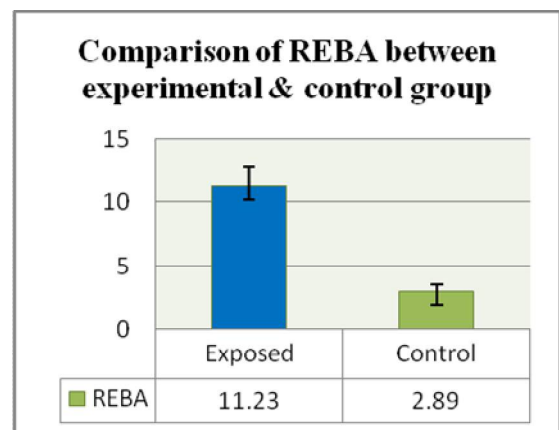


FIG7: BAR DIAGRAM REPRESENTS COMPARISON OF REBA SCORE BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP.

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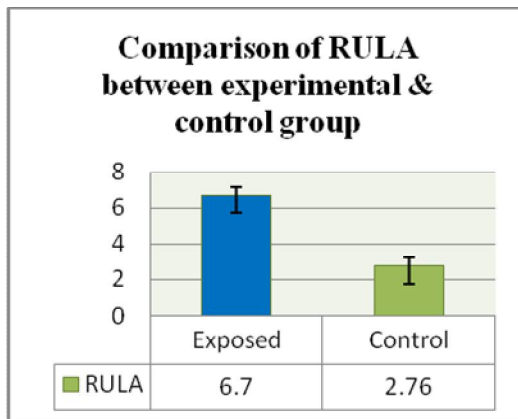


FIG8: BAR DIAGRAM REPRESENTS COMPARISON OF RULA SCORE BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP

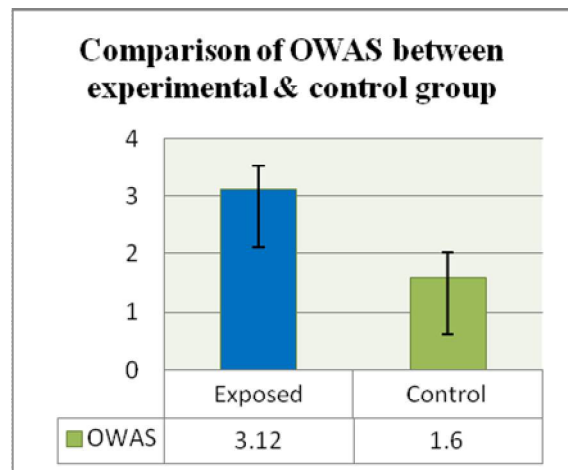


FIG9: BAR DIAGRAM REPRESENTS COMPARISON OF OWAS SCORE BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP

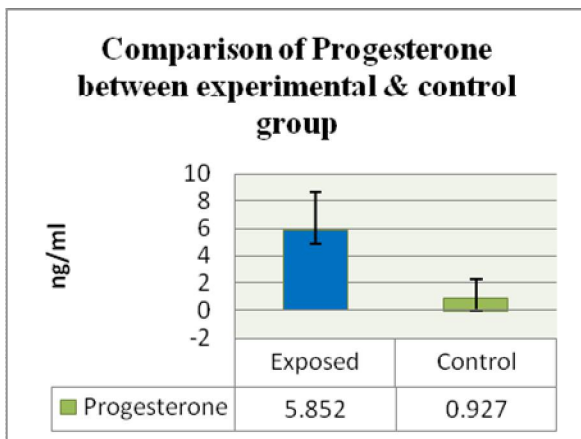


FIG10: BAR DIAGRAM REPRESENTS COMPARISON OF PROGESTERONE BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP.

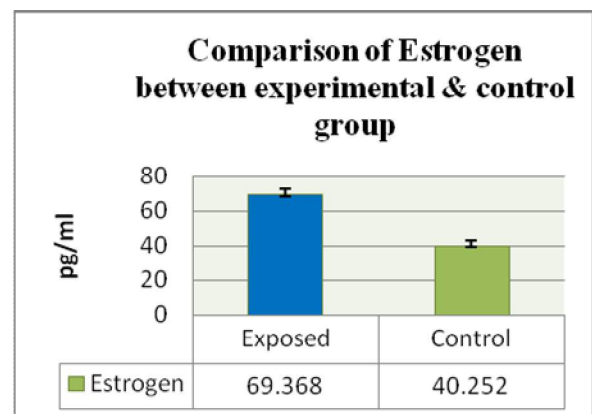


FIG11: BAR DIAGRAM REPRESENTS COMPARISON OF ESTROGEN BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP

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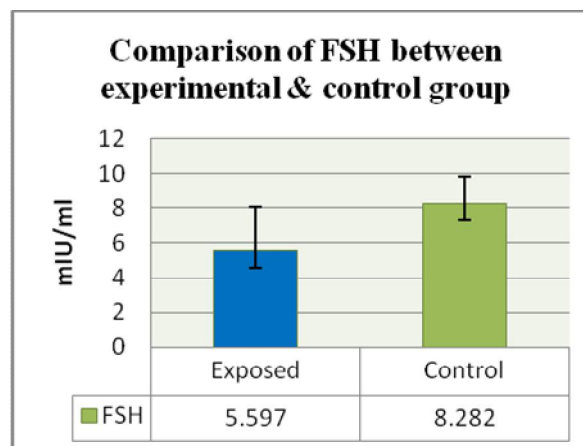


FIG12: BAR DIAGRAM REPRESENTS COMPARISON OF FSH BETWEEN WOMEN AGRICULTURAL & CONTROL GROUP.

VI. DISCUSSION

It has been estimated that in an average the Indian women spend about 5 hours per day more than the Indian man in work including the visible burden of the family. Earlier study stated that all women irrespective of land status of family provide 14 to 18 hours of productive physical labour in different chores. The nature and extent of women's involvement in agriculture varies greatly from region to region, but regardless of these variations, there is hardly any activity in agricultural production in which women are not involved.

The present study indicates that there is an insignificant difference of Height, Weight, BMI, W/H Ratio from normal counterpart. This suggests that agricultural women exhibit a parallel physique with the selected control group. Different lung functions parameters values show a little difference between selected control groups but statistically these are insignificant.

RULA, REBA, OWAS score of the experimental group who are involved in various types of agricultural work are significantly higher ($p < 0.001$) in comparison to that of the control group indicating the awkward posture followed by the workers at their workstation. All these indicate the increased level of risk of development of MSDs in these workers due to the muscular and postural stress that these workers are continuously exposed to.

The systolic blood pressure & not diastolic pressure is highly increased in agricultural female workers. That means the female agricultural workers are prone to ischemic heart disease (IHD). Basically Smoking is strongly associated with IHD and the risk ratio in male smokers is doubled compared with non-smokers. But it found to be less no of female workers are associated with smoking that means smoking is not the cause of ISD for this female workers. [12] The present data suggest a slightly increased risk for IHD which may be the result of use of chlorinated pesticides, DDT in agricultural field. That may affect their cardiovascular system. [13][14]

In this study, exposure to pesticides has been associated with menstrual cycle disturbances, reduced fertility, prolonged time-to-pregnancy, spontaneous abortion, stillbirths, and developmental defects, which may or may not be due to disruption of the female hormonal function. This has also been confirmed in our study where the agricultural workers showed an increase in the estrogens & progesterone levels and a decrease in the FSH level. Because pesticides comprise a large number of distinct chemical substances with dissimilar structures and diverse toxicity, several mechanisms are involved in the patho-physiological pathways explaining the role of pesticide exposure in ovarian cycle disturbances, ultimately leading to fertility problems and other reproductive effects. [15]

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Scientists have observed that most important routes to absorb pesticide are dermal route, respiratory route and oral route. On applying pesticides, exposure can be significantly reduced by protecting certain parts of the body where the skin shows increased absorption, such as the scrotal region, underarms, face, scalp, and hands. Use of chemical-resistant gloves, mask has been shown to reduce contamination. [16]

Considering the ergonomic posture analyses and predictive damage assessment some recommendation may be considered to protect and/or reduce the damages due to awkward work posture. A pilot study with 10 individuals following our recommendations for 1.5 months tenure showed significant development regarding their static work posture related damages. These are

- Compulsory observation of work-rest cycle during weeding, harvesting, lifting and carrying.
- Use of handcart in place of overhead load carrying.
- Regarding weeding by weekly activities for individual female farmer on field is recommended in place of everyday duties. Alternative field duties may be allotted. These showed be rotational duty roster for each individual.
- For harvesting as well as the same recommendation may be followed. However weeding and harvesting are generally not raking place.
- For lifting also if automation is not possible atleast manual hand cart may be used. Lifting of heavy sacks/goods showed accompany multiple individuals considering the load distribution.
- Routine kinds of job of specific types are not recommended at all everyday for a continuous time periods. Instead different kinds of jobs with rotational basis may be maintained for each individual worker.
- Use of hand gloves and masks over face should be mandatory while spreading manure and pesticides.

These may naturally ensure prevention from MSDs.

VII. CONCLUSION

From this study it can be concluded that agricultural female workers of potato and paddy production work continuously in a bent awkward posture that may create MSDs which is reflected in their posture analyses report. Furthermore, due to exposure to high levels of pesticide in the field and some malnutrition background status, their reproductive life seems to be highly affected due to hormonal dysfunctions. These results in premature shortening of their reproductive life along with menopause, which occurs generally within 40 years of age. Quantifying damage in terms of abnormal reproductive hormone status and possibilities of work related musculo-skeletal disorders (WBMSD) amongst female farmers of West Bengal – is the key feature of this study.

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