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Hazard Exposure with Health and Safety Outcomes Hinder the Work Ability of Salt Farm Workers in Thailand

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Abstract

Objective: Unsafe environments and occupational hazards have been documented and are contributing to health risks for salt farm workers in Thailand. Whether exposures with various health hazards and outcomes affect work ability among these workers is uncertain. This study aimed to examine the effects of hazard exposures with health risks and outcomes, including accidents, for work ability among salt farm workers.

Methods: A cross-sectional study was completed with 120 salt farm workers recruited from the largest salt farm company in Samutsakorn Province during January and February 2014. Face to face interviews were conducted using a structured questionnaire comprised of worker characteristics, working conditions, safety and health problems related to work, and a work ability index (questionnaire reliability =0.84) through a worksite visit. The MIMIC model was used to determine direct and indirect causal effects of work-related health hazards and outcomes on work ability.

Results: Among 120 salt farmers, 61% were female and 77% had primary educations. Average age and work experience was 49.5 years (SD = 13.7) and 23.7 years (SD = 13.5), respectively. 66% worked more than 5 days per week and 21.3% had at least one accident in the past 3 months. The results of structure equation analysis revealed that healthy skin was related to heat exposure ($\beta=.35$, $p=.01$) and directly influenced work ability ($\beta=.37$, $p=.01$), Eye irritation was influenced by length of work time ($\beta=.24$, $p=.05$), and harmonized the predictive value of the model at a high level ($\chi^2=94.51$, $df=73$, $p\text{-value}=0.05$, $\chi^2/df=1.29$. RMSEA= 0.066).

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Geolocation Information

Geographic coordinates of Samut Sakhon, Thailand Latitude: 13°32'51" N Longitude: 100°16'25" E Elevation above sea level: 14 m = 45 ftCoordinates of Samut Sakhon in decimal degrees.

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Conclusion: Results for the MIMIC model indicate that two factors, bright sunlight and strong wind exposure over an extended work period, could be having crucial impacts on skin and eye health of salt farm workers. These factors might be protected against using PPE and health examinations with positive health outcomes directly improving work ability. Substantial governmental action with community leadership is needed immediately so action plans are instituted to improve occupational safety and health.

Keywords

Salt farm worker; Health outcome; Safety; Work ability; Accident; Personal protective equipment

1. Introduction

Salt farming has long been a traditional livelihood for Thai people. This occupation is part of a traditional lifestyle and one which is valued more for its link with historical tradition than with the income it generates. Nevertheless, salt farming is declining in Thailand and across South East Asia. The Thailand National Statistical Office conducts an agricultural census every 10 years and reported that salt farms make up less than 1% (0.012%) of the total agricultural holdings in Thailand in 2013, with about 5.9 million workers. National Statistical Office [1] The decline in salt farmers is also seen in Bali, Indonesia, India, and the Philippines. Laquihon and Pagbilao [2] In Thailand, salt farming can only be done for six or seven months a year, since for the rest of the year the workers must leave the salt drying in the sun and open air. This means they must do other types of farming such as shrimp or chicken farming, or must work in local industries to fill the gap in their incomes. Salt farmers not only receive low incomes, they also suffer from ailments associated with poverty including malnutrition and anemia with vitamin B, A, and D deficiencies which cause aches and pains, poor night vision and accelerated aging [3, 4].

The working conditions on salt farms are harsh, with a clear health risk of heat stress resulting in heatstroke, heat exhaustion, heat cramps, and heat rashes. Heat is a crucial work hazard on salt farms and can also increase the risk of injuries as it may result in sweating that affects grip or impacts vision and causes dizziness that could increase the risk of accidents [5]. Those over the age of 65 are at the greatest risk of heat stress, as are those who are overweight, have heart disease, high blood pressure or take medications that may be affected by the heat [5].

There is evidence that heavy manual labor, awkward postures and a recent or existing injury are all risk factors in the development of musculoskeletal disorders (MSD) [6]. Statistics from the Thai labor force survey indicate that MSD cases, including those caused by manual labor, account for more than a third of all work related illnesses reported each year to enforcing authorities. Studies in other countries have established that workers of sea salt industries suffer from eye and skin problems [3–5, 7]. Since the salt farm industry is currently undergoing economic transition, it is an opportune time to evaluate how to protect the health and welfare of salt farmers still in the business.

This study focused on Samutsakorn province, the province with the highest number of salt farm fields and households in Thailand (41.8% of total salt farmers) [1]. It is adjacent to

Bangkok in Southwest Thailand and is undergoing transition. Much of the land that was previously used for salt farming has now been taken over by new landowners who are using the land for other types of businesses. To help preserve traditional salt farming, a strategic plan to ensure that the work is healthy, safe and economically viable must be put into place. Currently, there is little information about the accident and injury rates or the chronic disease experiences of salt farmworkers in Thailand. This paper reports results from a questionnaire designed to collect information on risk factors, health outcomes and work related issues among Thai salt farm workers.

1.1. Theoretical Considerations in Developing a Conceptual Framework

The work ability of an individual refers to the balance and interdependence of a person's resources and work demands. A person's resources consist of their health status including their biological characteristics such as age, sex, and underlying disease and their functional capacity (physical, psychological and social capacities/abilities). A holistic approach to work ability as a systematically-dynamic conceptual framework is an approach attributable to the investments of FIOH researchers in municipal public systems in Finland [8]. This new model reflects the establishment of a co-integrative relationship between all causes, variables or indicators; biological aspects, hazard exposure; and health risk (an indicator variable), to influence health outcome and interaction, with working conditions on job demand as the mediators of social context resulting in poor or good workers' abilities. Many studies present the relationship of health risk and hazard exposure in the workplace to work ability, but health conditions themselves impact work ability. Various hazardous exposures as part of working conditions and task demands in outdoor work not only harm informal sector workers' health and safety, but also decrease the enterprise's productivity, thus producing poor income due to poor safety and health, and the inability to work effectively. The model approach (that is, the MIMIC model), together with the direct approach (survey method) is used to estimate work ability effects on salt farm workers. In outdoor work, one growing fact about the measurement of the integrated size of the informal workers sector is that methods and data availability determine level of latent variable accuracy approximated by testing the Model. The MIMIC model consists of two parts: the structural equation model and the measurement model of the structural model describing the "causal" relationships between the latent variable and its causes.

To mirror context, activity patterns are used from the salt farmers' working life. A person's health is considered one of the main determinants of work ability which is based on self-health care individually and health safety organizational culture. However, recent research reports that good health does not guarantee good work ability because many people work in spite of some deterioration in their health. Work ability is not stable throughout the life course, nor is it identical for all individuals who have the same occupation. Work ability depends not only on individual characteristics but also on factors such as the nature of the work, demand of work, and job control and lifestyle outside of work Preibisch and Otero [9]. The new concept of work ability centers on a holistic perspective and aligns with the various theories that integrate social-psychological and biological approaches to explain the process of health and disease interaction as well-being at work as the new paradigm of quality in one's working life [10, 11]. It is important to highlight complex systems

theory, which proposes that the internal components of an organism or human characteristics and the external environment are interacting and woven together in each person's health and well-being. In working populations with healthy and safe conditions, safe workplace environments lead to safe practices and also reduce the adverse effects at work. Furthermore, health risks due to hazardous exposures that make workers become sick are related to direct and/or indirect causes, which are related in a non-linear way to directly and/or indirect causes of their health outcomes. Thus, it may not be possible to predict work ability at the individual or the population level without understanding the dynamic relationships between biological, physical function and the social interactions of working conditions, especially in outdoor work.

2. Material and Methods

2.1. Participants

In 2014, salt farmworkers were recruited as research subjects from the largest salt farm company in Samutsakorn Province after IRB approval (2014/). To be eligible the farmers had to be full or part-time and generate a major portion of their income from salt farming. We recruited 78 salt farm workers (total=120) who completed a 13 page questionnaire (reliability of questionnaire= .78). The questionnaire asked about health risks, demographics, work hazards, work environment, accidents, healthcare service utilization, general health status, medications used, and work ability.

2.2. Data Analysis

Descriptive statistics were employed for demographic analysis and described the nature of work, task demand, hazard exposure, health risk identification and work ability level. Structural Equation models play an important role in the estimation of pathways, wherein independent components are employed in estimating the interactions between latent variables for some observed variables such as worker characteristics: age, gender, work experience, worker perception of various hazardous tasks, job demand, and environmental conditions. The first wave of interesting research was triggered by the pioneering work of Kenny and Judd [12], who suggested that functions of observed variables mimicking functions of latent variables be integrated into measurement models. Methods for estimating the interaction model in the latest equation were comprised of workers' characteristics and their perception of hazards at work [13]. The hazards and health risk-indicators in this study were mainly focused on moderators, which were health examination and PPE use, as originally proposed by Kenny and Judd, and specifically used the unconstrained approach [14]. The latent variables were cross-health risks: healthy skin and eye capacity operationalized as mediators to estimate work ability among salt farm workers.

3. Results and Discussion

Demographic variables of study salt farm workers are shown in Table 1. Most salt farm workers were female (60.3%) and 77% had achieved primary education. They tended to work (75.5%) in only one field less than 5 kilometers from their home (97.2%). Their average age was 49.5 years old (SD 13.7, range 18 – 92), their average work experience

was 23.7 years (SD =13.5, range 2.1–53). Most of them were employed daily (67.5%). Most (66.4%) worked more than five days per week with an average of six days per week (SD 1.4, range 2–7). Having annual physical examinations was reported by 64.2%. Twenty one percent reported having at least one accident at work in the past three months. Forty four percent reported wearing some personal protective equipment such as gloves or safety glasses, with none reporting dressing in work uniforms or shoes while working.

The various occupational hazard exposures of salt farm workers were divided into two categories: safety hazards that cause reported accidents that physically injure workers (21.3%), and health hazards which result in the development of health risk with physiological signs and symptom related to occupational disease (mostly depression, allergy, musculoskeletal problems, and eye and skin problems as shown in Tables 1 and 2).

Many indicators of causes of health outcomes of salt farm workers determine work ability

The first set of models tested health outcome as the outcome latent variable and included a model with two latent variables: eye capacity and healthy skin as the independent mediating variables (IMV). Eye capacity consisted of three standardized variables: eye irritation, visibility and eye pain; the healthy skin indicators were dry or itchy skin (h4, h5 in the model).

The main findings are summarized in Diagram 1. The influence diagram illustrates the interaction of expected maximum potential hazard exposure as seen through monitor indicators which are associated with multiple health outcomes that are likely independent mediating variables to determine the values of work ability among salt farm workers. Measures include multi-level indicators. Specifically, worker characteristics (age, gender) are combined with not underlying disease, consisting of Diabetes Mellitus (DM) and Hypertension (HT), as well as interactions with work indicators consisting of work by hour/day/week and hot sunlight to be integrated with the monitoring indicators of health care represented by having an annual health examination, and the result of health outcomes, eye capacity and healthy skin quality. Including an accident at the work place is directly, negatively correlated with underlying disease (DM), and indirectly negatively correlated with worker's age on the pathway through work hours per week which is a statistically significant covariate with hot, sunny work and eye capacity. The harmonized value of the model is high: $\chi^2 = 94.51$, $df = 73$, $p\text{-value} = 0.05$, $\chi^2/df = 1.29$ with RMSEA = 0.066 (Root mean squared error of approximation with consideration of population error, size of residuals and SRMR = 0.098, (standardized root mean squared residual)) as is reflected in Figure 1.

The results of structure equation analysis in the diagram revealed a potential significant correlation of multi-indicators on health outcomes and many causes determinant of the work ability pathway as follows:

First, personal characteristics (worker's age) had a positive direct effect on health examination annually ($r = .258$; $p = .05$) and direct and indirect negative effect through underlying disease, that is, non HT and PPE used ($\beta = -.341$; $p = .01$), direct negative effect on non-Hypertension ($\beta = -.331$; $p = .001$) and an indirect negative effect through health annual

examination and eye capacity on accident at work ($\beta = -.152$; $p = .01$), and an indirect negative effect through PPE used and healthy skin on work ability ($\beta = -.263$; $p = .001$). Worker's sex also had a direct negative effect on non-Hypertension ($\beta = -.24$; $p = .05$)

Second, underlying disease, non-Diabetes mellitus (DM) had positive direct effect and indirect positive effect through non-Hypertension and PPE-use (as the first indicator of a monitoring factor) and healthy skin ($\beta = .264$; $p = .01$, $r = .015$; $p = .05$ and total effect = .280; $\beta = .05$), and had positive direct effect on non-Hypertension (HT), negative direct effect on accident ($\beta = .356$; $p = .001$, $\beta = -.303$; $p = .001$ respectively), and included positive indirect effect on eye capacity via health annual examination (second indicator of monitoring factor) ($\beta = .176$; $p = .001$).

Finally, for health outcomes, the latent factors comprised of healthy skin and eye capacity: healthy skin (as an independent mediating variable) had direct negative effect on work ability ($\beta = -.375$; $p = .01$). Eye capacity (as another independent mediating variable) had direct and indirect effects on accidents at work and work ability, but was not statistically significant at $p = .05$. Therefore, worker characteristics and underlying disease of salt farm workers had both direct and indirect effects on healthy skin while PPE-use as a protective factor or moderators combined with annual health examination of salt farm workers had a positive direct effect on healthy skin, and healthy skin had statistically significant direct negative effects on work ability ($\beta = -.375$; $p = .01$) as seen in Table 3.

3.1. Discussion

The aims of this study were to determine the work ability of salt farm workers and to investigate direct and indirect effects influenced by hazard exposure via pathways of working conditions and task demands (work hours per week and hot, sunny work conditions) and health outcomes (healthy skin and eye capacity) or accident through PPE use and annual health examination. The main result presented influence of 4 indicators: worker characteristics, underlying disease, annual health examination, and PPE use, that interact with hazard exposure in outdoor work on salt farms. Workers face hot, bright sunlight conditions or heat exposure in their working conditions, combined with long working hours per week that produce cumulative adverse effects. They must perform heavy manual handling tasks of dragging and lifting a heavy sea salt basket. These factors affect their healthy skin, and with the interaction of occupational hazards, poor PPE use and poor health care protection exacerbate health, as seen in previous studies in India, The Philippines, and Kenya [2, 15, 16].

Additionally, there is a tendency for workers to underreport accidents at work because of negative perceptions and specific concerns with serious accidents. This is consistent with findings by Swaminathan [4]; Jacklitsch [11] who explain that the main job characteristics of salt farm workers is outdoor work and they usually have solar ultraviolet radiation (UVR) exposures all or part of the day. This results in a dose-response for worker health outcomes for the health of the skin with workers' exposures for all or part of the day producing health risks of skin cancer because of solar radiation that is carcinogenic to humans and skin damage is permanent and irreversible and increases with other health risks. One of the major constraints to development policymaking and economic management in developing country

is the paucity of credible statistics and systematic evidence on the informal sector. Due to the potential health risks from sea salt exposure, some workers had chronic and severe itching feet. Actually they were exposed not only to bright sun light but also to wind blowing on the pile of white salt which passed into and through their bodies whether with or without suitable clothing and PPE use. Moreover, there are many consequences from heavy manual work in the salt fields, the bright sunlight and wind affects the eyes due to reflected light and dust leading to premature loss of vision and growths in the cornea of the eye called pterygium [11, 17]. Eye damage is due to acute effects of exposure to solar UVR on the eye, including photo keratitis (inflammation of the cornea and the iris) and photo conjunctivitis (inflammation of the conjunctiva, the membrane that lines the inside of the eyelids and white of the eye).

They were also at higher risk for hypertension (high blood pressure) presumably because of the higher salt content in their blood from inhalation of salt aerosols, combined with direct negative effects from the influence of older age. More than 46.3% of them reported health problems including eye pain and eye irritation with 36.3% reporting loss of visibility. The signs and symptoms of eye problems ranged from mild irritation to severe eye pain. The harmful health effects of solar exposure through solar ultraviolet radiation (UVR) is known to cause adverse health effects on the skin, eyes and immune system [16]. There is evidence that chronic exposure to solar UVR contributes to age-related macular degeneration and cataracts, both a cause of blindness. Long-term effects may also include pterygium (white or creamy opaque growth on the cornea), squamous cell carcinoma of the conjunctiva and cancer on the skin surrounding the eye. The Cancer Council Victoria [17] salt farm workers face significant health risks from these occupational hazards, as observed in previous studies in India Swaminathan [4], Kenya Ocholla, *et al.* [7], and The Philippines Laquihon and Pagbilao [2].

Healthy skin is the second mediating indicator in the pathway which is directly, negatively correlated with work ability of salt farm workers also due to the important role healthy skin has to protect workers from their hot, bright sun environment with PPE used appropriately [10], but often workers were not accustomed to following safety regulations. Moreover, they had underlying chronic diseases (DM and HT), and more than 45% of them did not attend the annual health examination (as self-health awareness and a protective factor or moderator factor) because of lack of time to do so. As a result, their work ability, which is the ability to stay in employment and to meet physical and mental demands with functional abilities for their work was reduced. The greater the demands on their work ability, the further their health outcomes declined. Implementing a comprehensive sun protection program, which includes a range of simple protective measures, can prevent sun-related skin and eye injuries and reduce the suffering and costs associated with skin cancer and positively increase work ability [18–20].

These findings can be used as preliminary data to develop innovative and effective harm reduction programs for salt farm workers. The Ministry of Labour in Thailand has proposed “Decent Safety and Health for Workers” as part of their national agenda, with the Labour Ministry’s work security plan promoted under the National Master Plan on Occupational Safety, Health and Environment. Workers are to be protected under an effective health and

safety surveillance system, and a safety culture is to be built among workers to strengthen the economic system and ensure active trade liberalization with security by 2016 Bureau of Labor Statistics [21]. Therefore, authorized officers and employers should be considering steps to reduce this risk and protect employees from ongoing exposure to solar UVR that can lead to skin cancer. An integrative, comprehensive model would include the combination of “a safe work pattern” and “safe working conditions” based on worker age, underlying chronic disease, annual health examination, appropriate PPE use of self-protective measures with steps for workers cooling their body temperature in accordance with CDC, NIOSH guidelines [17]. The worker who works in a hot environment or with high heat exposure has the potential for effective reengineering of their work ability since it is positively correlated with their health outcomes in performing salt farm work. There are just a few tasks where precautions should be taken to prevent sun over-exposure and to ensure safe manual labor activities while spending all or part of their time working outdoors. This includes the provision and monitoring of safety uniform and regular PPE use to protect workers from threats to health and safety. Employees also have a duty to be aware of their own self-care and safety activities and cooperate with employers’ efforts to improve health and safety. To work safely when in the bright sunlight and when performing heavy manual work, employees must follow workplace sun protection policies and procedures and complete annual health examinations seriously. This study adds to a better understanding of the mechanisms of hazard exposure on health outcomes by which key indicators of persons such as age and sex interact with underlying disease and monitoring indicators, from annual health examinations and PPE use positively influencing healthy skin and indirect effects on accidents via adverse working conditions and eye capacity. These new insights on work force work ability of salt farm workers should be employed to improve protective indicators like appropriate PPE use and annual health examinations to affect healthy skin and eye capacity. Establishing an effective, innovative monitoring program is important to ensure positive health outcomes through improved work ability fostered by the Thai Government and internationally. Work health and safety policy implemented through strategic operations and practices will increase the quality of the working life of salt farmers leading them to stay in this occupation. This increases the Thai Government’s likelihood of revitalizing this traditional and culturally-prized occupation so local people stay part of the salt farm community.

4. Conclusion

This SEM model attempts to construct and test an explicit model of working conditions of salt farm workers to reveal the mechanisms by which salient factors contribute toward a pathway of health and safety for them in the workplace. These factors included perceived severity of health and safety at work as signs and symptoms from exposure to hazards from the heat of bright sunlight and strong wind conditions as direct effects influencing their work ability and quality of life. Also, a perceived underestimate of the severity of underlying disease (Hypertension & Diabetes Mellitus) was lacking through absence of annual health examinations and influences of work injuries as an indirect effect through the cumulative influence of other mediating factors such as lack of personal protective equipment use. Therefore, involved government officers should urgently take responsibility to improve the

safety, health and security of salt farm workers in order to raise their quality of life and that of other informal workers assisting them in their occupation.

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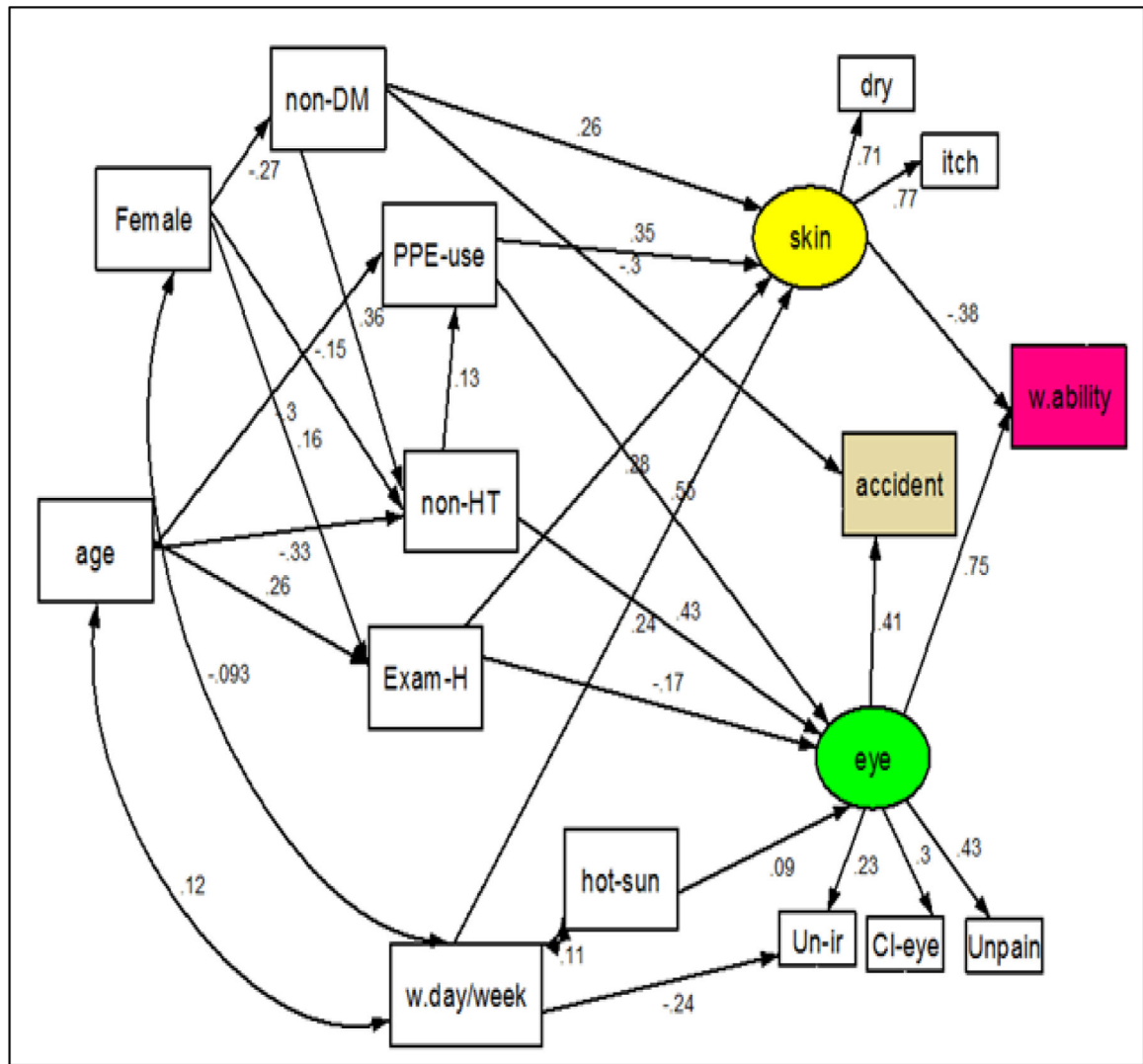


Figure-1.

Diagram of Occupational hazard indicators, health outcome indicators determine work ability of salt farm workers

Notes: Sex: Male, DM= Diabetes mellitus, HT=Hypertension, Exam H: Health annual examination, workdays per week: work hours per week, skin: healthy skin, age: age (yrs.), Hot -sun: Work under bright sunlight, eye: eye capacity (un-ir= not irritation eye, Cl-eye=clear eye, and Unpain=not pain), dry=dry skin, itch = not skin blisters, W ability: work ability,

Table-1.

Severity perception of health problems and safety at work of salt farm workers in the last 3 months

Salt farm health	N	Mean	SD
Musculoskeletal problem	62	4.24	4.16
Skin problem	25	1.83	1.06
Neurological	53	2.29	1.27
Allergy	67	1.33	0.50
Gastrointestinal problem	33	1.67	0.65
Nonspecific illness	23	1.56	0.59
Depression	106	2.92	0.312
Respiratory	28	2.25	1.58
Gastrointestinal problem	24	1.29	0.62
Hearing loss related work	8	62.50	23.15
Eye problem	40	1.78	1.05
- Eye capacity	24	46.35	
Eye pain	37	46.3	
loss vision	29	36.3	
- Eye irritation			
Non-specific illness	23	1.57	0.59
Accident Injury at work	17		

Table-2.

Specific signs and symptom related to work on salt farms over a 1 month period (%)

Salt farm health	Everyday	Some day	Never
1.heat stoke	0.0	6.6	93.4
2 heat cramps	0.9	15.1	84.0
3.heat rash	0.9	20.8	77.4
4.heat exhaustion	0.0	49.1	50.9
5.headache	4.7	50.0	45.3

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Table-3.

The correlation between standardized direct, indirect and total effects of worker characteristics, underlying disease, annual health examination, PPE use, working conditions, health outcomes and work ability in the path model

Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
Heath examination	age	0.027	.258	-	-	0.027	.258
no eye irritation	DM	-	-	0.001	.041	0.001	.041
	eye Working hours/day	- 0.037	-.234 -.243	- -	- -	- 0.037	.234 -.242
PPE use	DM	-	-	0.001	.045	0.001	.045
	age	0.014	-.299	0.319	-.041	0.003	-.341
Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
accident							
	DM	0.012	-.3037	0.001	.072	0.060	-.231
	age	-	-	0.018	-.152	0.018	-.152
Healthy skin							
	DM	0.052	.2645	0.001	.0158	0.040	.280
	Health Examination	0.031	.279	-	-	0.031	.279
	PPE use	0.008	.352	-	-	0.008	.352
	sex	-	-	0.551	-.037	0.551	-.037
eye							
	DM	-	-	0.001	.176	0.001	.176
Not skin blister							
	DM	-	-	0.040	.215	0.040	.215
	Health annual examination	-	-	0.031	.215	0.031	.215
	PPE used	-	-	0.008	.271	0.008	.271
	skin	-	.769	-	-	-	.769
Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
Not dry skin							
	DM	-	--	0.040	.198	0.040	.198
	Health annual examination	-	-	0.031	.197	0.031	.197
	PPE used	-	-	0.008	.2495363	0.008	.249
	skin	0.000	.707	-	-	0.000	.707
Work ability							
	DM	-	--	0.663	.027	0.663	.027
	Health examination	-	-	0.039	-.235	0.039	-.235
	skin	0.011	-.375	-	-	0.011	-.375
	age	-	-	0.001	-.263	0.001	-.263
No eye pain							
	DM	-	-	0.001	.075	0.001	.075
	age	-	-	0.010	-.159	0.010	-.159

Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
	Work under bright sunlight	-	-	0.470	.038	0.470	.038
	DM	-	-	0.001	.052	0.001	.052
	age	-	-	0.053	-.110	0.053	-.110
	work under bright sunlight,	-	-	0.485	.026	0.485	.026
Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
DM							
	sex	0.020	-.273	-	-	0.020	-.273
HT							
	DM	0.001	.356	-	-	0.001	.356
	sex	0.162	-.150	0.057	-.097	0.026	-.248
	age	0.001	-.331	-	-	0.001	-.331
Heath examination	age	0.027	.258	-	-	0.027	.258
no eye irritation	DM	-	-	0.001	.041	0.001	.041
	eye	-	.234	-	-	-	.234
	Working hours/day	0.037	-.243	-	-	0.037	-.242
	DM	-	-	0.001	.045	0.001	.045
	age	0.014	-.299	0.319	-.041	0.003	-.341
accident							
	DM	0.012	-.3037	0.001	.072	0.060	-.231
	age	-	-	0.018	-.152	0.018	-.152
Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
Healthy skin							
	DM	0.052	.2645	0.001	.0158	0.040	.280
	Health Examination	0.031	.279	-	-	0.031	.279
	PPE use	0.008	.352	-	-	0.008	.352
	sex	-	-	0.551	-.037	0.551	-.037
Eye							
	DM	-	-	0.001	.176	0.001	.176
Not skin blister							
	DM	-	-	0.040	.215	0.040	.215
	Health annual examination	-	-	0.031	.215	0.031	.215
	PPE used	-	-	0.008	.271	0.008	.271
	skin	-	.769	-	-	-	.769
Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
Not dry skin							
	DM	-	--	0.040	.198	0.040	.198
	Health annual examination	-	-	0.031	.197	0.031	.197
	PPE used	-	-	0.008	.2495363	0.008	.249

Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
	skin	0.000	.707	-	-	0.000	.707
Work ability							
	DM	-	--	0.663	.027	0.663	.027
	Health examination	-	-	0.039	-.235	0.039	-.235
	skin	0.011	-.375	-	-	0.011	-.375
	age	-	-	0.001	-.263	0.001	-.263
No eye pain							
	DM	-	-	0.001	.075	0.001	.075
	age	-	-	0.010	-.159	0.010	-.159
	Work under bright sunlight	-	-	0.470	.038	0.470	.038
Dependent Variable	Independent Variable	P -value	Direct Effect	p-value	Indirect Effect	p-value	Total Effect
	DM	-	-	0.001	.052	0.001	.052
	age	-	-	0.053	-.110	0.053	-.110
	work under bright sunlight,	-	-	0.485	.026	0.485	.026
DM							
	sex	0.020	-.273	-	-	0.020	-.273
	DM	0.001	.356	-	-	0.001	.356
HT	sex	0.162	-.150	0.057	-.097	0.026	-.248
	age	0.001	-.331	-	-	0.001	-.331

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