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ResearchPaper

Ergonomics analysis of risk factors of welders duringmanual welding in manufacturing: A systematic literaturereview

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Abstract:
A static body posture increases job duration by employing traditional tools and pushing thelimits of thewelder's ability to handle material, which may induce ergonomic risk factors that can lead to work-relatedmusculoskeletal problems (WRMD). Musculoskeletal diseases (MSDs) are a widespread health concern on aglobal scale. The risk of injury from occupational risk factors is still quite high for the dangerous task ofwelding. Particularly, the uncommon nature of the jobs themselves and the workplace dangers that affect theprevalenceofMSDs.
In order to fill information gaps in this field, this study is focused on how ergonomic risk variables affectwelders' positions. This literature review's objective is to give a general understanding of the ergonomic riskfactors associated with welders' positions during various manual welding processes, techniques and positions.Fortheproductionoffinishedgoodsinthemanufacturingindustry,weldingisoneofthemostcrucialfabrication techniques.Theposturealters whenmanualhandling materialstask, whichisamustforwelders.
From 2016 to 2022, a systematic review of the literature was carried out and entered into the databases Scopus,PubMed,ResearchGate,andGoogleScholar.UsingthesearchtermErgonomicriskfactorsandwelder'position s, 384 articles that cited ergonomic risk factors were included in the first phase of the search. Using the2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA), each recordwas carefully evaluated based on the purpose and scope of the investigation, and the number of records waslimited to 28 publications along with other study sources that incorporated review work and analyzed throughqualitativerisk assessmentmatrix.
To understand the development of risk variables that have contributed to welder WRMD, such as incorrectwelding positions, manual material handling, force, extreme temperature and biomechanical exposures whichare associated to several risk factors. It was necessary to conduct a comparative analysis of independent riskfactors, considering their interactions with the main risk factors. According to several research, applyingergonomicdesignprinciplesmaylowertheriskofoccupationalrelated risksand musculoskeletalissues.
The topic of how to boost productivity and quality affects not just welder but also society as a whole and theorganization.Therefore,theessentialmethodsforpreventingmusculoskeletalproblemsareergonomicassessmentsf orprocesslayoutdesign, welding position, andmaterialhandling tasksaswell .
Keywords:ErgonomicRiskfactors,welders,manufacturing,work-relatedmusculoskeletaldisorders(WRMD)

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I. Introduction

Due to the nature of the welding process, the weldermust spend a lot of time in the same staticposition. Over the past few years, there has been a steady rise in thenumber of workers complaining ofmusculoskeletal disorders (MSDs), and research studies have been conducted to more thoroughly look at thecauses and frequencies of MSDs. Manufacturing, a growing economy sectors where number of welders who areexposed to work environment risk,especially ergonomic risk, increases. Welders in industrial industries aremost frequently injured at work due to musculoskeletal disorders (MSDs) [1]. Injury or disorder of the joints,muscles,tendonsandotherbodypartsare referredtoasMSD.

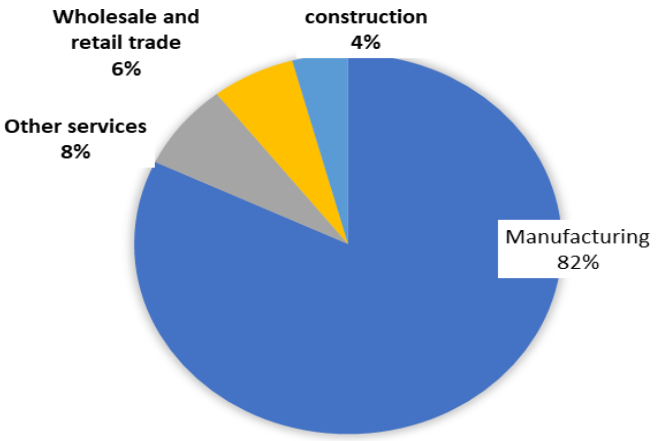

Fig1.1:Different sectors(welding22%highestof manufacturingsectors).

For instance, welders are typically more inclined to develop musculoskeletal problems connected tophysicalstrainatwork**(workload > capacity).** Assuming that very fewemployees perform thiswork. As per studies, the body's posture would become static after a certain period depending on the frequency,length,andintensityofthewelding-how hard.[2]

According to studies done by Sachin K. Malave, welder productivity is often poorer in industrializedcompanies, and they also are more likely to suffer from MSDs that affect operator comfort and performanceduringrepetitive activities.

AccordingtoBharatSinghetal.(2016),thetechniqueofweldingpositions,workplacefeatures,andenvironmentalfactorsallplayavitalroleinwork-relatedmusculoskeletalproblems.PoorlytrainedweldersaremorelikelytoexperienceWMSDswhilewelding.Akeypartoftheergonomicprocessisaregularreviewofthefacility,especiallyprocesslayoutdesignsandworkpractices,tooldesignfromanergonomicsperspectivethroughanErgonomicchecklist,andQuestionnairetoprovideasafeandcomfortableproductiveworkplaceThisstudydoes notdiscuss manufacturing;rather,itdiscussesergonomicsriskfactorsinwelding-relatedtasks.

"Some researchers have extensively analyzed that if anthropometric data do not match the plant processlayout, the plant may operate at a lower efficiency. Welders are aware of WMSD and they need to be trained toreportWMSD symptomsearly[1].

Ergonomics involves making the workplace fit the needs of workers. It does not simply try to makeworkersadjusttotheworkplace.

Eventhoughthematerialshandlingfacilitiesareequippedwithcutting-edgetechnology,manualmaterials handling jobs including lifting materials, transporting tools and equipment are frequently used in theproductionindustrynowadays,changingneutralwelderpostureswhileweldingindifferentpositions[8].Mostofthe chronic ergonomiceffectsare theresultofprolongedexposure [5].

Symptoms of MSD are very common and can occur in welders primarily in the hips, neck, hands, andsoft tissues (muscles, tendons, ligaments, and joints [20]. Poor posture can lead to work-related musculoskeletaldisorders. WRMSD is caused by a complex interplay of factors related to professional activity, physiology,environment,technology, management,sociology,andnon-work-relatedactivitiesandenvironment[26].

There is no unique cause related to thesedisorders, however literature shows that various job factorscancontribute tothe developmentofMSDs.[5]

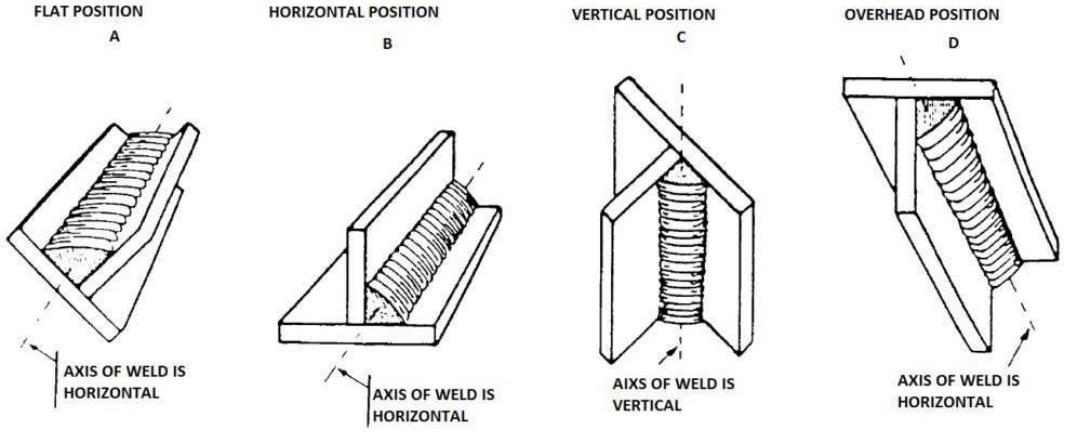

Fig1.2:Different weldingposition

Therefore, if the welder is not in the right condition and in a comfortable reach zone, the quality andstrength of the weld can also be affected, which can affect the quality of the product according to ISO standards.Welds have external or internal defects such as porosity, excessive spatter, incomplete penetration, lack ofpenetration, incomplete fusion, slag entrapment, burn- through, etc., due to reduced strength and quality of theweld. Reworking component or part increases the level of energy (resulting in discomfort, stress, failure), thelevel of cost, the level of materials, the level of time, etc. Proper ergonomics design for different weldingpositionsrequire.[1]

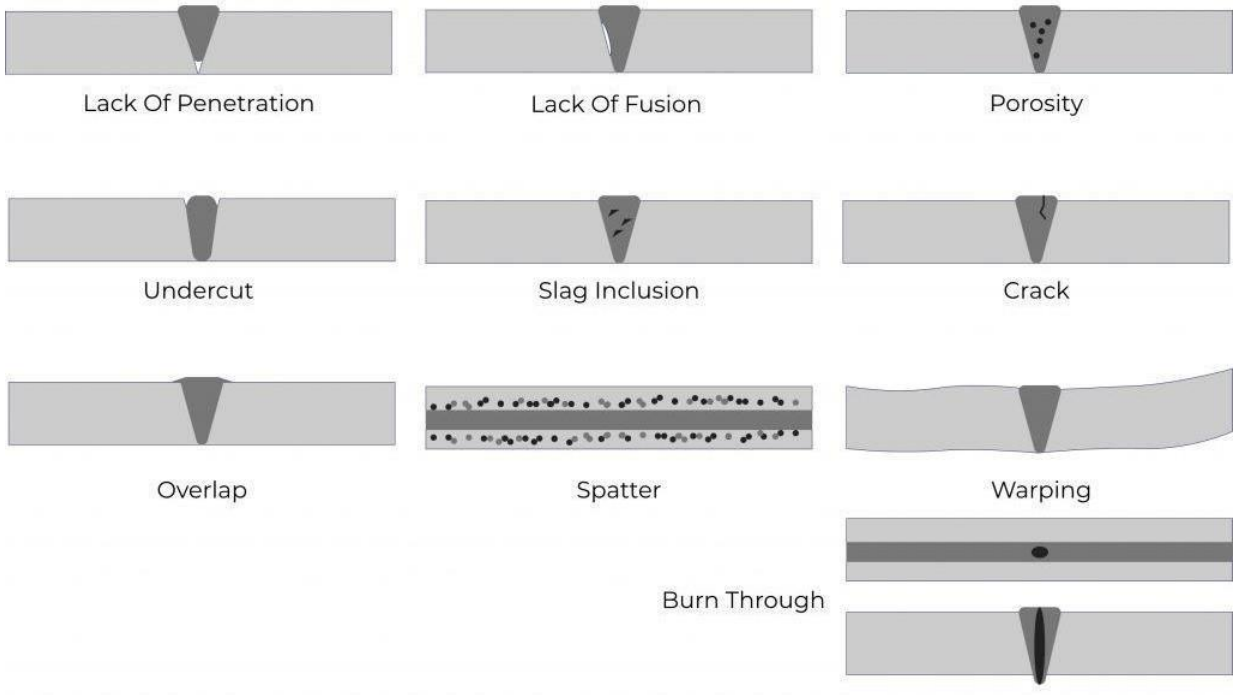

Fig1.3:Weldinginternaland externaldefects.

According to C. Weyh et al(2020), physicalworkload and risk factor reduction, job rotation, andweldertraining may emerge as important approaches to work-in-progress or finished products in the manufacturingassemblysector.
Thepurposeofthis workistoliteraturereviewrevealedagapintheexistingriskfactors.

II. Methodology

Onthisbasis,asystematicliteraturesearchwasconductedfrom 2016to2022andindexedthedatabases Scopus, PubMed, ResearchGate and Google Scholar. In the first phase, 384 articles mentioningergonomic risk factors were included in the search using the ergonomic risk factor and welder location searches.Ignorereviewarticles, conference papers, andnon-Englishpapers

to ensure the quality of the paper. After careful evaluation of each dataset based on the purpose and scope of thestudy,itwas reduced to 31 articles and includedin a 2020 systematic review andmeta-analysis, alongwithother methods from research sources, including review work after exclusion of screening. Applied using therecommended reportitemforthe data.AnalysisProtocol(PRISMA).

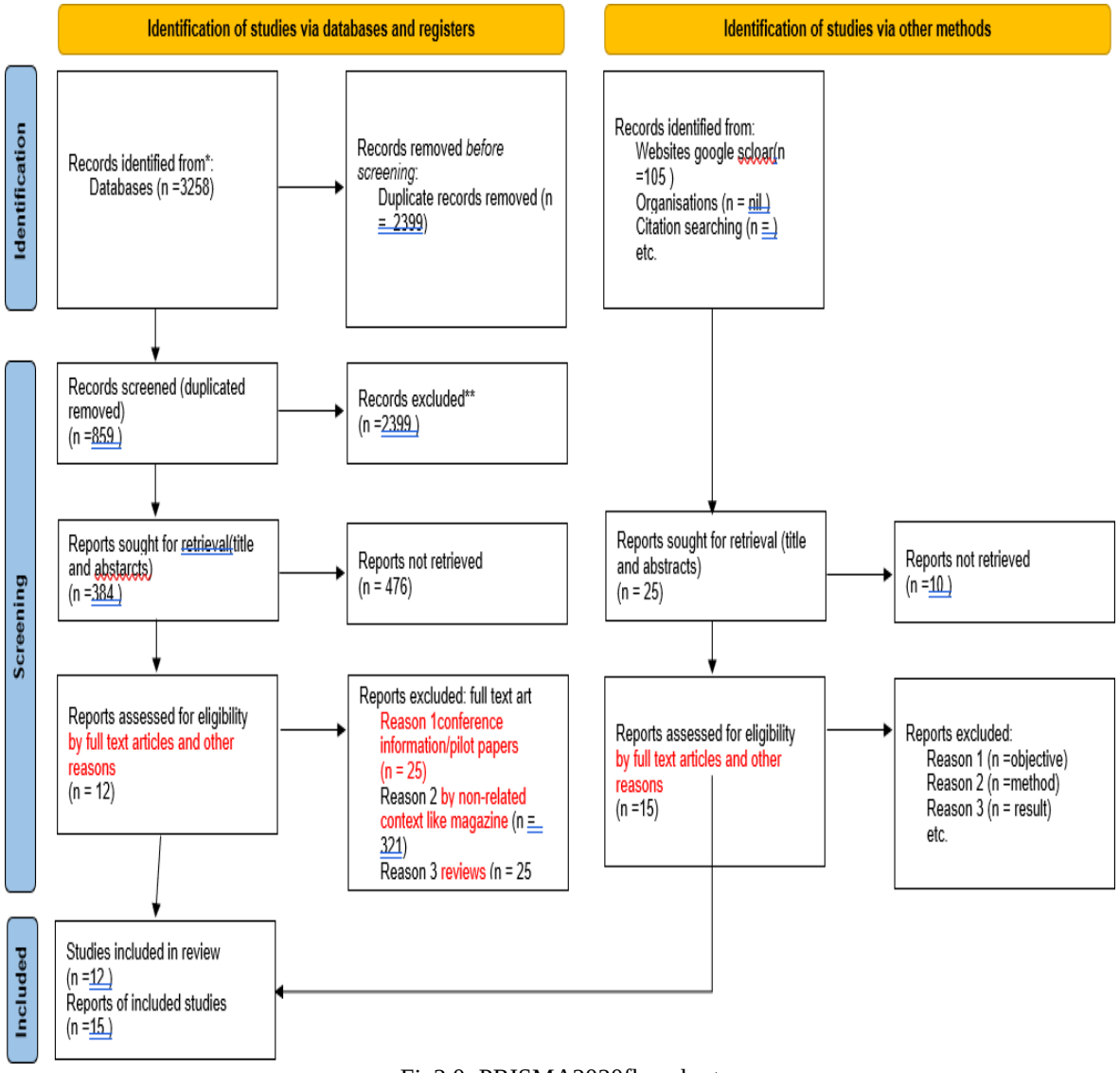

Fig2.0 :PRISMA2020flowchart

TABLE2.1-Theselectioncriteria

NO	CRITERIA
Inclusion	● Studiespublishedoverthelastsixyears, between the years2016to2022 ● MostlyJournalarticles ● Studiesperformed inthemanufacturingindustrycontextandtheeffectsofriskfactors ● Researchrelatedtoergonomicsriskfactorsformusculoskeletaldisorderstomitigate ergonomicsolution
Exclusion	● Before2016 ● Duplicatepapers ● Excludestudiesnotassociatedwiththeeffectsofriskfactors ● Researchfocusedonlyoncommonworker tasks,notproductionenvironments,and noautomation ● Excludestudiesnotassociatedwithmusculoskeletaldisorderswhereweldingtechnologyisnot involved.

III. Literaturereview

According toa literature review thathasbeen conducted,this systematic reviewwillhelp analyze ergonomicrisk factorsforweldersinmanufacturingjobs.

ERGONOMICS

Most researchers define ergonomics in different ways that absorb the conceptin a meaningful state. BelowTable3-1showssome definitionsofergonomicsfrompreviousstudies.

Table3.1:Ergonomics

RESEARCHERS	DEFINITIONOFERGONOMICS
BharatSinghandPiyush Singhal[1]	Ergonomicsisconcernedwiththedesignandsequencingofwhatworkersuse,soitcanreduce humanfatigueandincreaseefficiency.
HamizatunBintiMohdFazi1[4]	Knowledgeofdesigningofahealthyworkplaceconsideringthecapabilitiesandthelimitationsof workers
Sanders&McCormick	Applyinformationabouthumanbehavior,capabilitiesandlimitationstodesigntools,machines, tasks,workplacesandenvironmentsforproductive,safe,comfortableandeffectivehumanuse.

RiskFactorsamongweldersin manufacturing environments

A risk factor is a risk character that appears to be associated in some way with the development of a disease. Ifthese risk factors are present, developing the disease is more likely but not certain to develop the disease. Riskfactors are primarily categories such as biomechanical exposures, psychological stressors, and individual riskfactors.[2].

Biomechanics is the study of forces acting on the human body and their effects, describing properties ofbiologicalsystemssuchasrepetitiveforcesandforce exertion

Psychological stressors are social and external physical environmental stressors that challenge the capacity andlimitsofhealtheffects.

Individual risk factors include demographic parameters such as age, gender, inadequate leisure activity andadditionalworkload.[3]

For example, not everyone who welds develops MSD, and not everyone with MSD is a welder, but weldingactivitiescreate ergonomic riskfactorsfor MSD.

Specially welders from industries may experience different types of musculoskeletal symptoms (MSDs) andnumberofreportedcasesarestillincreasingduetoinappropriatemethods,demandinghigherthecapabilitiesand limitation,mentalworkloadand improper ergonomicsformingawkward postures.

Past years risk factorshave affected the ergonomic context by increase in musculoskeletalhealth problems andthe research focus of finding the gap [4]. Many welding-related accidents, such as UV and IR radiation,occupational heat stress, welding fumes, and particle generation, have much higher particle concentrations inenclosed spacesthaninthe openair.[5].

Most symptoms include discomfort, pain, swelling, sensory disturbances, tingling, limited range of motion, anddecreased motor control. High working conditions and environments may cause to develop MSDs, consideredthe greatest cause of lost working hours, increased costs and suffering from human violence, and the greatestoccupationalhealthprobleminthe developedworld.[2],[6],[7].

There may be associations between occupational risk factors and the prevalence of MSDs affecting differentparts of the body, with some of the most important major risk factors being poor posture, repetitive is the use offorce,overuseofforce,andhand-armvibrationsthatleadtoanincrease.atMSD.Recentstudieshavefocusedontheimpactofriskfactorsinthelumbar zone thatmayaffect qualityoflife aswellaswork.[8].

3.0.1 AWKWARDPOSTURE

When welders need to perform tasks in unusual postures as squatting, bending, kneeling, straightening,flexion/twistingoftheneckandhandsthroughimproperworkpositioningorimproperperformanceoftask s

.Static when the welder stays for a long time, often done manually in different welding positions /techniques andjob rotationtoensurehighqualitystandardsaccordingto ISO standards[9].

Awkwardpostureisavitalergonomicriskfactorofwelderswhichcanleadtowork-relatedMSD.

Low back pain causes flexion, hip and pelvic tilt during forward bending due to increased tensileloading of the lumbar spine [17, 18, 19]. Wearing underwear with high Clo values (synthetic materials with lowpermeability of perspiration) while squatting reduces the concentration of sperm production in welders, whichcanleadtodelayedfertilizationandinfertility[10].

Unfavorable posture during static and dynamic work strains the muscles. A static position in which the musclesare held for more than 4 seconds is considered tiring and ergonomically unhealthy for the welder,

leading tomusculoskeletal problems and widespread discomfort throughout the body. These diseases are categorized
frommminortoseverechronicdiseases.i.e.Slightbodypaintoseverechronicdiseasesofthemusculoskeletalsystem.

Without proper ergonomic improvements, the effects will continue to affect both individuals as a consequenceorganization.

3.0.2 Repetition:

Repetition is the average number of periodic and repetitive movements per unit time. Repetitive movements areespecially dangerous when they consistently use the same joints, body connections, and muscle groups, andwhen they perform the same movements often, frequently, and for long periods of time. Repetitive motionsalways require interactions with other risk factors such as awkward static postures and application of force(welders shoulders position, wrists and neck in static positions to apply external forces). A common cause orincidence of causes is complaints in the neck, lumbar spine, hips, shoulders, and wrists. The force is exerted onthe filler rod in form of lateral pinch and welding torch in palm grasp when handling manual arc welding bothhands are used in a repetitive form and neck flexion is continuous throughout the weld. Hence neck pain is alsoan independent ergonomic risk factor [11]. Ingeneral, the higher the number of repetitivemotions, the higherthe risk associated with the welder's risk factors and the relative stress associated with neuropathy (diseases ofthecentralandperipheralnervoussystem) dueto nerve entrapmentwithinthe carpaltunnel.

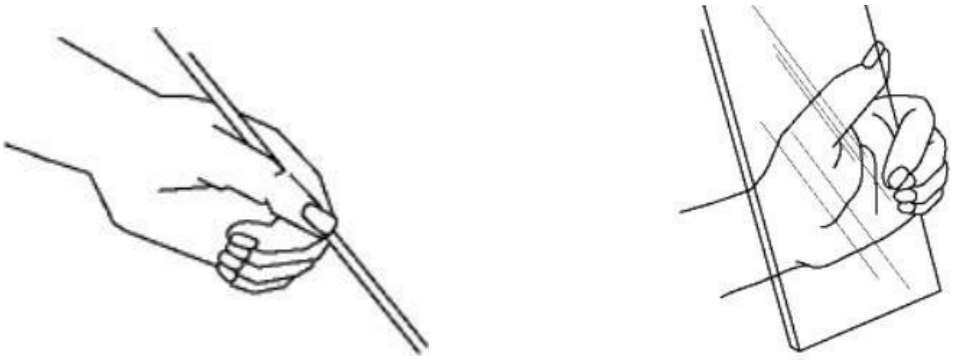

Fig3.1: LateralpinchandPalmpinchrespectively

3.0.3 FORCE

Power is the mechanical or physical effort the human body must exert to accomplish a particular task,movement, or effort such as lifting objects, using tools and equipment, grasping holders, or moving muscles,tendons,andligamentsbeyondforcewillresultin inadequaterecovery timeandincreasedwork fatigue.Therefore, stress fatigue occurs when force is applied.[12]. Overexertion force in hand is hazardous practiceeventually fatigue loading.Overexertion force includes in lifting , palm pinch and lateral grasping ,bending forforward reachwhichmayalsocontribute inthe prevalance ofMSD.

Vibrating tools such as grinders, drills, etc. affect muscle parts of the welders' body, subjected for longexposure to perform necessary tasks[2]. It has also been suggested that welding equipment produce vibrationsthat cause damage to the soft tissues and circulation of the fingers in the hands and arms, a condition known ashand-arm vibration syndrome (HAVS) that mimics Raynaud's disease [13] , resulting in discomfort and causepaininthe upperextremitiesandjoints.

Excessivemanualloadhandlingbylifting,holdingandloweringcreateoverexertionwhichhasgreaterprevalencetoweld ers'complaints.

3.0.4 WeldingHazardousFumes

Welding in manufacturing is most often done in closed confined spaces. In this space, exposure tochemicals and inhalation of fumes and fine particles can cause inflammation in the lungs and organs throughoutthe body, and metal accumulation can lead to respiratory diseases such as asthma, tuberculosis, mild cough,wheezing,andmildrespiratoryillnessmayIncreasetheincidence ofcoughand lungdisease.

According to Firouz Amani et.al, toxic chemical particles in base metal and filler metal welding aredependent on open or closed chamber welding techniques, if adequate ventilation isprovided, and exposuretime, frequency, type of welding technique/procedure. , conditions, and poor safe PPE practices pose a healthhazard. Many chemicals in the air we breathe in high concentrations may damage the lungs and cause humancancerousdiseaseinbothweldersandnon-

welders(microbesattackmoreeasilyandultimatelycausinginflammation)[5]. Some evidence suggests that some people are allergic to welding fumes and exposure tochemicals,causingonlyskinrashes[5].

3.0.5 ExtremeTemperature

It is not surprising thatwelding temperature in relation to thermal energy affectswelder and non-welder risk factors. Exposure to this extreme temperature can cause discomfort, alter static posture, and lead tofatigue stress and body pain[13]. Findings show that contact muscle strained due to increasing of lactate andphosphate in the muscle and positively induces muscular stress. These hazards may have an immediate effect orbecome apparent only overthe long term. [13] On theotherhand,workingin extreme cold induces coldstressors and hot environments induce heat stressors. As a result, heat stressors from excessive heat can lead toheat stroke if PPE is not appropriate for safety reasons or if natural ventilation is not well established or doneproperly. May reduce effects associated with heat exhaustion, heat cramps and heat exhaustion (physical-mentalworkbalance).Poorergonomicdesignandworkplacehazardsconstraintsmayincreasethelikelihoodofmusculoskeletal injuries[12]. For prolong exposure the eye irritation, discomfort, skin rashes are other causeswhile awkward issharply observed. This incidentwas causedby avoidingwearinggoggles to protect eyesduring welding work. This indicates a lack of awareness of the seriousness of occupational hazards that inducedhealthdamage andphysiologicalstressorsandreducesqualityoflife.

Maleinfertility is an increasingproblem globally.Accordingtoarecentstudy byAstridSkovmandandcolleagues, conducted studies state that poor semen quality may lead to male infertility, but exposure to heavymetalcontaminants,heat,soundandchemicalfumes,butthemainvariableisoccupationalexposuretotemperature extremes, dependingonthe concentration.andexposuretime.[10]

Long-term exposure to welding heat exposure had a significant effect on sperm concentration, but short-termexposurehadnoeffect[10].

3.0.6 LightIntensityandRadiation

The electromagnetic field including visible light , utravoilet and infrared rays .Welding arc emits veryhigh intensity of UV radiation where welders and non-welders who are close to theworking spot may getexposed .Some reseachers identified that not only very frequent welders get affected but also occasional welderand non-welder who are close to the exposure of extreme UV radiation [6].When detecting quality of theweldment, gamma radiation is carried out to inspect the internal welding defect (non destructive testing)wherethewelderexposed tothis vicinityleadto severemuscoloskeltaldisorder

Similarly expose to high intense arcfor less than 60 secondsmay cause or incidence for the cause ofeye blindness which affects the retina of the eye.Most of elderly welders of age above 50 get affected with thistypeofdiseasewhichimpair eyeand formpoorqualityin weldmentresultinglowerproductivity[7,27]

3.0.7 Psychologicaleffects

Several studies suggest a relatively high prevalence of cognitive disorders among welders. [14]. Thismay be for various incidence of cause reasons as lack of regular work and rest periods, attempts to prepare forurgent work, lack of proper sanitation and equipment, exposure to direct lighting glare, lack of discipline in theworkplace,violence,poorawarenessof weldinghazards,lackofproperergonomicconditionsinindustry.

But it is mainly due to high stress felt at work, fatigue when demands are higher than abilities and limitations,stress due to tight schedules, lack of social support and high emotional stress. Shift work and fewer breaks aresomeoftheassociatedfactorsleadingtocognitiveimpairment.

[13]Allthese factorsswellpsychologicalstressandcause musculoskeletaldisordersinwelders.[4]

It has been proven that awelder's strength remains thesamewhilehe is awake.Italso depends on theenvironment,thephysical (physiology)andcognitivestate oftheenvironment.

3.0.8 Noiselevel

Further stated that the welders are also exposed to audible sounds of up to 120 decibels (dB), which areextremely dangerous to the hearing system. Exposure to high noise levels (>90 dB) for more than 8 hours likelycausesnoise-inducedhearingloss(NIHL),whichdamagessensoryhaircellsinthecochlea,leadingtopermanenthearingloss, increasepsychologicalfatigue, andnervousness.sometimes.

3.3<u>Approacheson methodsforevaluatingtheriskfactors</u>

Previous studies haveusedergonomic assessments such as QEC, Rapid Upper Limb Assessment (RULA),Rapid Whole-Body Assessment (REBA), and Whole-Body Complaint Map (WBDM) to assess welder's humanto parameters of working conditions. Assess engineering ergonomic risk factors and check correlations betweenrisklevelsandrisk factorstocheck severitytoimproveergonomics.

Demographic variables such as age, height, weight, education, and work history have been shown to playimportantandeffective rolesinassessingergonomicriskfactorsforwelders.

Table3.2:Approachesappliedonmethodsforevaluatingthe ergonomicriskfactors

Researchers	**Methodology**	**Contributiontotheresearch**
[15]	Descriptive and empirically - QEC andREBAmethods	Demographicvariablessuchasage,height,weight, education and work history play important andeffectiverolesinexplainingergonomicriskfactors.
[2]	Descriptive–analyticalstudythrough PATHmethod	Trainingonhowtocarryloadscorrectlytoreduce disorientationalsoseemseffective
	Descriptive -questionnaire was used toinquiretheage,durationofwork,smoking, chewing,andhealth-relatedissue.	
[7],[11]	MSD (Nordic questionnaire) and LTPA(InternationalPhysicalActivity Questionnaire	demographics, health behaviors), work-related factors(weldingprocess,hoursofweldingperday,yearsof service,shiftwork,ergonomictools)
[5]	Texturedquestionnaire	Inquireaboutworkinghours,smoking,chewingand healthrelatedissues.
[16]	interviewandquestionnaire	

Table3.3:QualitativeRiskassessment matrixthroughothersliteraturereviewsstudy

Challengesforrisk factors	References	Complaints	Likelihood	Impacteffects	Riskfactors
Biomechanical Exposures (Awkward posture/Repetitivef orce)	(SajadZareetal.,2016) :(Lilian Lourenco t al .,2021):(C.Weyhetal. ,2020) : (EhsanAsivandzadehet al.,2018) : (Firouz Amani eta,2017):(Uday V. AswalekarVinodB. Tungikar,2017) :(BharatSingh and PiyushSinghal,2016):(KhairulFahzan bin Salleh etal.,2020) :(StephenBaoetal.,2019) :(Satish B Mohan,2018) :(KristīneBokše,2018):(AnwarJohari1 ,2019):	Body pain discomfort/MSDproblems / fatigue /cognitiveloading	48%	0.8	0.384
Welding temperature	(N.S.M.D.K. Nanayakkara,2017): (Sunil Kumar et al.,):(StephenBaoetal.,2019) (AstridSkovmandetal .,2020):(KhairulFahzan binSallehetal.,2020):(StephenBaoetal.,2019)	Allergictothe heat sensation Abnormal fertility /eye damage/body discomfort and pain	26%	0.9	0.234
Weldingfumes	(BharatSinghandPiyushSinghal,2016):(Ar shadHusainArshadHusainRahmanietal.,2 018):(AdelMazloumietal.,2016):(Astrid Skovmandetal.,2020):(RejoJacobJosephet al.,2018)	Respiratoryproblem allergic issuesChroniceffect	10%	0.75	0.075
Psychologic aleffects	(Yetunde O. Tagurum etal.,2018):(Zeinab Almasi et al.,2020):(KristīneBokše,2018):(MOHAMMA DHOSSEIN BEHESHTI1 ,2016):(HélèneSultan-Taïebetal.,2017)	Cognitivedisorder	14%	0.6	0.084
SoundEffects	(MartinD.Gwomson:2018):):(KristīneBokše,2018)):(KhairulFahzanbinSalle h etal.,2020)	Exposureto highn oise levels (>90 dB) for more than 8hourslikelycauses noise-	03%	0.8	0.024

		induced,fatigue			
Demographic effects	(N.S.M.D.K. Nanayakkara,2017):(Adel Mazloumieal.,2016):(UdayV.AswalekarVinod B. Tungikar,2017):(Satish B Mohan,2018)	more absenteeism's,Poorproductivity,mo	01%	0.6	0.006

Probability	**Impact/riskfactor**
0-25% Unlikely	Minor <0.05
26-50% Possible	Moderator0.05-0.075
51-75% likely	Major0.075-0.1
76-100% Verylikely	Critical>0.1

IV. DiscussionandConclusion

This systematic review focuses on reviewing ergonomicrisk factors.Critically evaluated on theseliterature reviews through Qualitative Risk assessment matrix according to Table 3.3 . The majority of theliterature revealed that the higher risks are due to biomechanical stressors (awkward posture, repetitive forces,)and welding temperature which are comparatively higher than other risk factors. Meantime periodical medicalrecordsreveallong-termpotentialhashigher riskeffectsonwelders'healththanshort-termexposure.

Welding is a highly skilled job that takes years to complete. Welding is a precision job that requires thewelder to remain in a stationary position for a relatively long time to complete the job. Risk factors may increasethe welder's risk level, which may lead to a possible or disorder of the musculoskeletal system. Risks varyaccordingtoweldtype,frequency,duration,fillermaterial,electrodefluxandbasematerial,workingconditions,and layoutinconfinedspaces.

The ergonomic risk factor considered in this study was clumsy posture, and the high prevalence of MSDis due to biomechanical force exposure resulting in postural changes and also extreme temperatures from radiantheat from arcs and ambient temperatures in confined spaces can cause attitude changes. Personal protectiveequipment also another factor which may be welder's negligence in using PPE without realizing the seriousnessof these ergonomic problems. Discomfort in the human body therefore ultimately increases the likelihood offatigueor injurythat triggersWRMD.

Thermal comfort is an effective powerful force in reducing fertility rates among male welders heavilyinvolvedinweldingcomparedtofemalewelders.Thiscansignificantlyincreasethegrowthofspermconcentratio n in the male reproductive system. In-depth studies have shownthat even squatting and low-permeability underwear are as effective in slowing the production of sperm fertility in welders as they are innon-welding. Longerexposuretoradiant weldingheatcancauseeyediscomfortandretinaproblem.

A recent study found that fixed process layouts in welding shop floor, which may appear to suffer fromergonomic aspects of reducing injuries and disabilities from WRMD. During the inspection of welded structuresfor quality control, a vital task that unwittingly hazardously exposes the welder or non-welder to non-destructivetestingmethods(dyepenetration test,gammatest).Working in uncomfortableposturesduetoprolongedexposureaffectsworkerwell-beingandproductivity,resultinginlowerproductivity,reliability,andqualityoflife.These welding activities human health in improving welder's working posture and preventingwelder fatigue and injury, as well as ergonomic analysis to improve correction and reduction of future MSDproblems.canbeapplied,butalsodevelop researchideasto promotesafetyfromanergonomicspointofview.

Some SuggestionsforFutureStudies

- Toincludesomesocialdemographicfactorsandidentifyindependentriskfactorsthatcause MSDs.
- To investigate further why welders still suffer work-related injuries (reduce or prevent strategy) andincidencefor otherindependentrisk factors.
- To investigate the determinants of financial outcomes of prevention related to the implementationprocess (which are seldom) for prevention-oriented decision-making in the occupational health and safety ofwelders.

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