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Factors Affecting Sustainability of Employee's Health and Wellbeing in Public Sector Electronics Circuit Production and Repair Industry of Pakistan

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Abstract: Production and repair of electronic circuits play a critical role in the national defense, communication infrastructure, and economic development in Pakistan. Besides being critical in economic development, the industry poses various occupational hazards such as soldering fume, lead and tin exposure, ergonomic injury, and heat exposure leading to serious concerns for physical and mental wellbeing of its workers. The aim of this study is to empirically examine the critical aspects of the Sustainability of health and wellbeing for employees working in the electronics circuit production and repair in the government sector in Pakistan, particularly, in the metropolitan cities of Rawalpindi as well as Islamabad given that the majority of the government technical facilities of Pakistan exist in these cities. Primary data were collected using a structured Likert scale questionnaire distributed via HR Departments to technical, clerical, and supervisory employees in government sector electronic circuit manufacturing and repair units, using convenience and snowball sampling techniques. Statistical analyses were performed on a total of 413 valid responses. Results reveal positive significant association between the study variables. Overall, the model defines 62.1 percent of variance in employee wellbeing. The study highlights the need to conduct regular training sessions, implement ergonomic solutions, and other safety and wellbeing measures to ensure employee wellbeing in Pakistan's electronics industry.

Key Words: Sustainability of Employees' Health and Wellbeing, Occupational Health and Safety Measures, Growth Opportunities, Safety Measures, Physical Health Hazards, Electronics Circuit Production, Job Characteristics

Introduction

The electronics circuit and equipment's production and repairing industry contributes significant role in national defense and the economy of the country. This industry involves various activities or technical processes like designing, printing, assembling, mounting, Integrating, quality testing and repairing printed circuit boards (PCB's) which expose its workforce to various hazards like exposure to toxic fumes, tough work schedule, load lifting and other ergonomic issues. The wellbeing of employees (workers and technicians) is crucial for maintaining productivity and ensuring sustainable industry growth. Besides being a critical area of research specifically in context of Sustainable Development goals, least research is found specifically focusing on the on the sustainability of employees' health and wellbeing in electronics circuit and equipment's production and repairing industry of Pakistan.

The occupations of electronics manufacturing and servicing are most often associated with exposure to hazardous chemicals such as tin, lead, cadmium, fluxes, epoxy resins and Ferric chloride solvents, which are toxic and have severe

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health effects in the form of respiratory ailments, skin diseases, and neurologic impairment (WHO, 2021). Workers in circuit manufacturing units may also have repetition strain injury, ergonomics, and intense visual strain.

The existing studies on sustainability of employees' health and wellbeing in Pakistan have limitations such as lack of industry specific focus and insufficient considerations of the interplay between various factors affecting sustainability of employees' health and wellbeing. Most of the studies are conducted in the developed countries which may not accurately reflect the conditions in developing nation like Pakistan. Now, there is shortage of research that integrates both physical and psychosocial factors affecting sustainability of employees' health and wellbeing in the electronics production and repairing industry.

Employees in the electronics circuit production and repairing industry faces various challenges that can negatively impact sustainability of their health and wellbeing. These challenges include physical health like Exposure of Soldering Fumes, Heat Exposure from Soldering Irons, Load Lifting and Ergonomic Issues that causes ENT problems, respiratory problems, stress and musculoskeletal disorders. Besides, the physical hazards, certain factors also adversely affect employee's psychosocial wellbeing like job nature, workload, etc. There is lack of research focusing on the specific factors within electronic production industry that contribute these health problems addressing this research gap is essential to develop designated interventions that can mitigate health risks and improve workers wellbeing.

This study is important as it aims to fill the current research gaps by providing a comprehensive framework encompassing most of the potential factor effecting the sustainable sustainability of employees' health and wellbeing in the electronics circuit production and repairing industry in Pakistan. The results will give the stakeholders of the industry including the policymakers, the industry leaders and health practitioners an idea of how to adopt the right solutions in the workplace. The study might thus result in enhancing job satisfaction, minimizing health risks and enhancing output.

Aiming to identify particular workplace hazards and health risks experienced by employees in Pakistan's electronics circuit production and repairing industry, this study is critically significant. Highlighting the workers wellbeing challenges, empirically testing the key contributing factors, this study asserts the need for targeted safety practices and policies, and ensuring overall workplace safety standards. Understanding these issues can lead to the implementation of sustainable health and wellbeing interventions while controlling for the factors adversely contributing factors through effective preventive measures, thereby reducing the incidence of work-related illnesses and injuries.

Literature Review

The sustainability of employees' health and wellbeing in the electronics circuit production and repairing industry of Pakistan are influenced by various factors. Psychosocial work environment plays a crucial role in determining the overall health of workers, impacting their mental and physical wellbeing, as well as organizational outcomes such as motivation and performance (Christiansen & Chandan, 2017). Additionally, factors like psychological climate, psychological ownership, and self-efficacy have significant effects on employee performance and wellbeing in the banking industry of Pakistan, with employee wellbeing mediating the relationship between these factors and performance. Moreover, the lack of research on organizational health in educational organizations in Pakistan highlights a gap in understanding the positive values that a healthy organization can influence the wellbeing and growth of employees, highlighting the need for further exploration in this zone. (Chang, 2024).

Based on Job Demands Resources (JD-R) theory, psychosocial safety climate theory, and literature on occupational stress, this paper will suggest that sustainability of employees' health and wellbeing is influenced by both physical demands (e.g., hazards, unsafe conditions) and psychosocial resources (e.g., support, growth opportunities, leadership).

Physical Environment Risks and Sustainability of Health and Wellbeing

Workers in the production and repair of electronic circuits handle long term exposure to toxic substances like lead solder, cleaning solutions, and flux fumes, most of which are recognized to have long term health effects like respiratory ailments, skin damage, and even damage to vital organs (ILO et al., 2020; WHO, 2018). In Pakistan, especially in the

state-owned workshops and electronics laboratories, these conditions are further aggravated by neglecting investment in proper ventilation, waste management, and general safety equipment.

Wide range of research studies suggest that physical work environment is critical in determining the outcome of the productivity of workers, as well as the short and long term health outcomes of workers (Hamed et al., 2023). In electronics circuit production and repair sector, the workplace environmental conditions are mostly ignored in the favor of efficiency in operations or cost management. but, low environmental quality such as high noise rates, the poor state of air quality, and unhealthy work environments may have a considerable negative impact on the wellbeing of workers, and job performance (ILO, et al., 2020).

Academics have long lasting debate on the proportional role of both the physical and psychosocial environmental factors. Although classical occupational health research focused on physical conditions as the major determinants of health outcomes, recent studies hold that psychosocial safety climate has an equally (even more) significant impact on the welfare of (Amoadu et al., 2025) has empirically evidence that the quality of the Physical work environment is a significant predictor of wellbeing, and psychosocial factors mediate the influence of physical conditions.

Considering that in production and repair industries, it can be derived that both physical and psychosocial environmental stressors are chronic to the overall employee wellbeing, and failure in addressing either aspect can result in partial explanations of the health outcomes of employees.

H_1: Physical work environment has a significant effect on sustainability of employees' health and wellbeing.

Job characteristic and Sustainability of Health and Wellbeing

Job characteristics are central components of the JD-R model and includes role clarity, autonomy task repetitiveness, and workload. Studies have evidence empirically that, paired with low autonomy excessive job demands leads to emotional exhaustion, burnout, and diminished wellbeing (Lesener et al., 2019; Bakker & Demerouti, 2017).

Jobs in electronic circuit's production and repair units have number of adversities that can affect both physical and mental health of the employees. Overwork is common across such units leading to emotional breakdown especially where issues are recurrent and the resolution of the problems is affected by bureaucratic red tape. Technicians are required to address the urgent service calls without appropriate rest and preparation resulting in increased error rates, and higher performance pressures causing both physical and mental stress. In contrast to the production or service centers in the private sector, numerous state-run technical units are on regular morning shifts (usually 8 a.m. to 4 p.m.), but overtime is common in such settings, especially in the departments that maintain vital infrastructure such as defense communication, traffic systems or emergency response electronics. Mostly, these overtimes are without prior notification or suitable remuneration and causes high level stress among workers.

Electronic circuit's production and repair settings are mostly highly standardized wherein cognitive strain may be lesser due to certain degree of task repetition. But, over time, prolonged monotony coupled with the performance pressure gradually erodes the psychological wellbeing of the workers (Lesener et al., 2019). This asserts context-specific investigation in the industry, where repetitive precision work dominates. Thus, evidence strongly suggests that poorly designed jobs in industrial environments amplify health risks raising concerns for workers overall wellbeing.

H_2: Job characteristics have a significant effect on sustainability of employees' health and wellbeing.

Growth Prospects and Sustainability of Health and Wellbeing

Career growth opportunities, being essential job resources, play critical role in nurturing future-oriented optimism, by fostering motivation and competence among workers. Self-determination theory based studies advocate that perceived development opportunities leads to enhanced wellbeing and resilience by satisfying workers' psychological needs, (Di Fabio, 2017).

In public sector electronic circuit's production and repair units in Pakistan vast majority of technicians are hired with only basic training in technical skills and hardly gets any chance of being upskilled later. In contrast to the private sector

where vendor led or in house workshops are a common practice, public sector does not spend sufficient budget or incentivize on conducting structured training although required as regulatory compliance.

The few trainings that are conducted, are mostly found general, ill-tailored, and highly theoretical. Such trainings have neither enable workers deal with ongoing field challenges, nor let them grow in their careers. Encountered by technicians at the field. It often complained by employees that these sessions are conducted by outsiders who are not aware of the reality of repair work in the public sector. Conversely, a pilot project experiment by the Ministry of Science and Technology (2021) revealed that simple monthly awareness on aspects such as circuit board innovations and safety standards resulted in a better attendance of the electronics staff, increased productivity, and enhanced team cohesion (Choudhry et al., 2024).

Lesener et al. (2019) and Schwatka et al. (2020) derived that the absence of career advancement is detrimental for workers, particularly in such industry where technology is changing swiftly. Growth opportunities are also not merely professional benefits associated with employee perception, but training and development provide the workers confidence in self to exploit their potentials (Ogbonnaya et al., 2018). Once given the ability to learn and develop, employees not only do better work, but they become more confident, more innovative and more dedicated to the greater good. In addition, the recent findings point to the opposite, suggesting that stagnation and underutilization of skills in bureaucratic environment deepen disengagement and mental stress, especially in technical workers (Lesener et al., 2019).

H3: Growth opportunities contributes to sustainability of employees' health and wellbeing.

Peer Relations and Sustainability of Health and Wellbeing

Ditton, (2009) found lower perceived stress and increased job satisfaction in settings with more informal peer relationships, despite lack of good equipment and facilities. The bond between peers in these situations turned out as a coping mental health tool. Technicians themselves form their micro cultures, share jokes, nicknames about tools, lunch rituals, and rage against the administrative establishment. These cultural things render the work human, provides psychological safety and team spirit.

According to Khan et al. (2023), such mentoring relationships assist new technicians to get integrated at a quicker rate, lowering anxiety and increasing their confidence. Despite institutional flaws, unofficial mentorship, perhaps, is the most valuable asset in such high precision demanding settings. Experienced and aged technicians will often support their less experienced or younger colleagues demonstrating how they do things and how to survive the bureaucracy, customer expectations, and how to remain safe. These informal networks form a strong foundation of office strength especially in those units where the formal training does not exist. Empirical research always shows that positive relationships with colleagues correspond to reduced levels of anxiety, emotional exhaustion, and psychosomatic complaints (Nielsen et al., 2017).

H4: Peer relations contribute to sustainability of employees' health and wellbeing.

Supervisor Behavior and Sustainability of Health and Wellbeing

It is also not very unusual in the majority of electronics manufacturing and repairing operations around Pakistan that employees are subjected to working conditions that are physically demanding and mentally taxing. It is through this type of adversity that the supervisory behavior becomes a determining factor to the kind of work life that employees have. Positive and supporting supervisor behavior plays critical role in the distribution of tasks, provision of technical advice, or just listening to a grievance by an employee thus setting the emotional nature of the whole unit. Behavior of supervisors is often overlooked in policy circles, but it has a direct effect on mental health, job satisfaction, and even physical wellbeing. It may either improve or deteriorate the health of technicians who have to deal with high-risk work, time constraints, and manual repetitive work (Sommovigo et al., 2021). By addressing this aspect, one can provide an environment that enhances employee wellbeing and has sustainability in the workforce (Arshad et al., 2023). As one

of the psychosocial predictor supervisor behaviors has strongest influence on employee wellbeing. Fair, supportive, and ethical leadership styles were previously demonstrated to alleviate stress, improve mental health outcomes thus ensuring sustainability of employees' health and wellbeing (Inceoglu et al., 2018)

H5: Supervisor behavior significantly contributes to sustainability of employees' health and wellbeing.

Physical health and Sustainability of Health and Wellbeing

Physical health risks including frequent electrical hazards, chemical exposures, and repetitive injuries are the most prevalent issues in electronics manufacturing and maintenance. The classical occupational health studies have firmly established the relationship between exposure to hazard and physical sickness, but recent researches have focused on the psychosomatic effects of continued exposure to physical risks (Grimani, 2016).

Electronics repair is done by soldering, which is an expensive process. The fumes emitted particularly using lead based solder and flux, include the toxic substances such as rosin, lead oxide, and formaldehyde. Unprotected and unventilated work may lead to asthma like symptoms, respiratory irritation and long term lung damage as a result of continuous exposure. Most of government departments lack ventilation systems or have obsolete ones, and soldering is carried out in cramped and closed areas. (Mohammadyan et al., 2019) reported that over 60 percent of the interviewed technicians reported a high level of coughing, along with irritation of the throat, especially after several hours of soldering.

Raza et al. (2022) found that more than half of the government workshop electronics workers that they surveyed had experienced lower back pain in the previous year with most of them still working without medical care because of job insecurity or because they had a culture of no leave taking. The welding done with the soldering irons also exposes the technicians to the local heat and the risk of skin burns or skin irritation. Thermal stress and fatigue can also be experienced due to long term exposure to high temperatures without an adequate rest break or thermal insulation. Additionally, there are indications that physical risks indirectly worsen mental health by heightening perceived job threat and stress, which also proves the argument in favor of physical-psychosocial models asserting incorporation of physical hazards as a direct predictor of wellbeing in general (Markham, 2009).

H6: Physical health have a significant effect on sustainability of employees' health and wellbeing

Safety and Occupational Health Measures and Sustainability of Health and Wellbeing

Occupational health and Safety measures are technical controls and psychosocial indicators. Studies have shown that when organizations have strong safety systems, the rates of injuries and psychological wellbeing are lower, which is explained by the fact that such organizations have better organizational support perceptions (Panaccio & Vandenberghe, 2009).

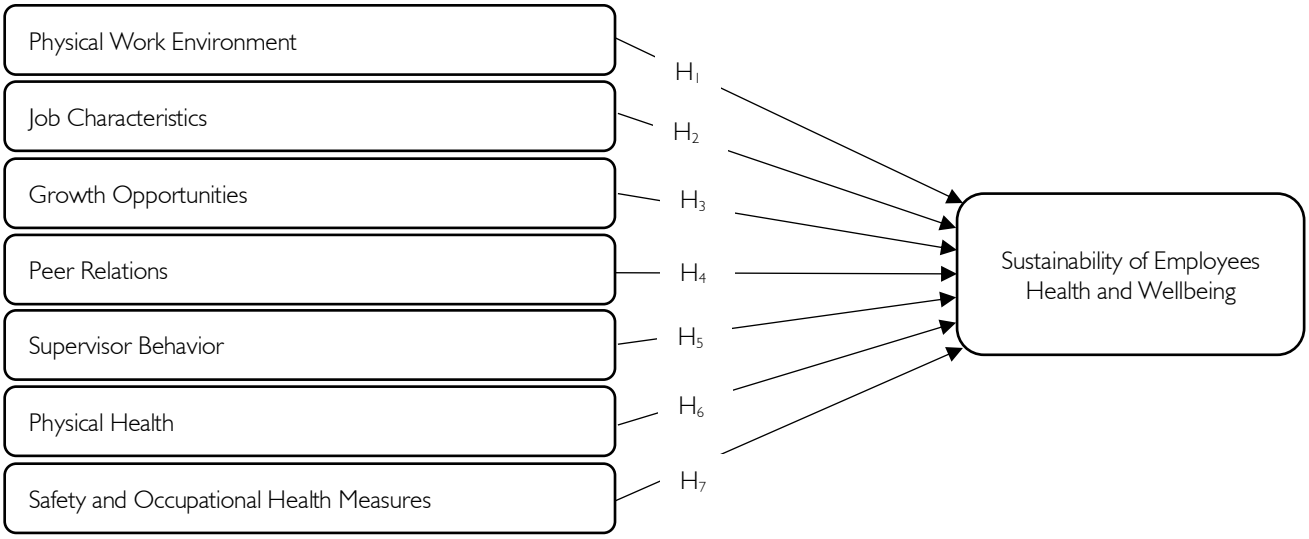
Personal Protective Equipment (PPE) is the last line of defense with respect to the different kinds of hazards present in electronics circuit manufacturing and testing environments. Personal protective equipment such as gloves, masks, safety glasses and hearing protectors is essential in preventing employees from sustaining physical and chemical injuries. Despite this, lack of usage of PPE still remains a critical issue in government electronic repair workshops in Pakistan. "While PPE protects you, workplace safety methods are comprehensive guidelines intended to mitigate dangers and ensure the availability of a safe work environment. They should include safe tool usage, periodic safety inspection, emergency evacuations, and instruction on how to manage electrical hazard or chemical exposure" (Jovevski, 2021).

According to Chen et al. (2009) many firms are now prioritizing the establishment and certification of occupational health and safety management systems. This study examines the current state of occupational health and safety management system (OHSMS) implementation and examines key performance indicators for OHSMS performance evaluation in Taiwan's printed circuit board (PCB) industry. Eleven PCB manufacturers who have all been certified as compliant with the Occupational Health and Safety Assessment Series (OHSAS) 18001 OHSMS guidelines and 26 academic OHSAS specialists were given a survey. Significant performance indicators for condition, management, and

operation aspects of OHSMSs include the frequency of unsafe employee behavior, the level of commitment from top management, the completion rate of corrective and preventive measures, the frequency of subcontractor rule violations, and the quality of the firefighting system.

H7: Safety and occupational health measures have a significant effect on employee health and wellbeing.

Theoretical Framework



Methodology and Methods

Aiming to examine the wide-ranging physical and psychosocial factors affecting employee wellbeing, this study adopted a cross sectional survey design to collect primary data from employees of government-sector electronics circuit production and repair organizations. Study inclusion exclusion criteria is given as follows

Inclusion Criteria	Exclusion Criteria
Full-time employees (permanent/ contract based having at least 3 years contract)	Part time, temporary/ad hock employees
holding technical, operational and/or technical supervisory role	holding managerial or clerical roles
directly involved in production, testing, maintenance, and/or repairing activities	not directly involved in production, testing, maintenance, and/or repairing activities
Have at least 6 months of job tenure.	having job tenure less than 6 months
Work in organization situated in Twin cities i.e. Rawalpindi and Islamabad	Work in organization situated in other cities of Pakistan

Inclusion criteria based selected employees draws an occupational group that is highly study relevant, yet under-researched specifically in Pakistani context. The conditions that make this population highly relevant includes 1) job nature characterized with repetitive Technical work requiring high precision, 3) job structure is highly rigid and bureaucratic 4) frequent exposure to both ergonomic and electrical hazards 5) hierarchical supervision, and 6) limited growth opportunities. Such job resources and demand dynamics makes the population a pertinent case for examining physical and psychosocial factors affecting employees' well fulfilling in the understudy domain of electronics industry.

Primary data were collected, objectively, from a carefully selected sample of 413 employees working in production and repair departments using convenience and snowball sampling techniques. The sampling technique was opted due to non-availability of the sampling frame, specialized nature and access limitations of the population. The overall design

used to test the hypothesized relationships in this study is coherent with prior occupational health research (Bakker & Demerouti, 2017; Nielsen et al., 2017).

The structured questionnaire used in this study was designed to measure the validated constructs from existing literature and established occupational health instruments. The items were primarily taken from the NIOSH Worker Wellbeing Questionnaire (NIOSH,2024) , which comprehensively assesses multiple domains of worker wellbeing across organizational, environmental, and individual dimensions (Chang et al., 2024). The responses were measured on five point Likert scale, with 1 = Strongly Disagree, to 5 = Strongly Agree for being recognized to obtain perceptions and attitudes related data in a stable and statistically analyzable form (Nunnally & Bernstein, 1994).

A sampled data of 35 respondents was pilot tested to ascertain the quality of the adapted measures. Three experienced occupational health and organizational behavior industry professionals and academicians were consulted to ensure the face and content validity of the scales. Internal consistency of the measures was checked through Cronbach (Nunnally & Bernstein, 1994) to ensure each scale's reliability. Finally, the collected data were statistically analyzed using version 25 of the Statistic package of Social Sciences (SPSS) software. Both descriptive and inferential analysis were performed for respondent profile (based on demographic data) and for hypotheses testing based on measurement data respectively (Hair, 2014; Hayes, 2017)

Results & Analysis

Table 1

Response Rate

Questionnaire distributed	Questionnaire received	Questionnaires Rejected	Questionnaires Finally accepted	Response rate (%)
530	435	22	413	77.92

"Table 1" shows that in total 530 questionnaires were distribution online as well as in hard copies both directly and through researcher's direct and indirect references in the selected organizations. Total 435 questionnaires were voluntarily filled and sent back by the selected respondents. A total of 22 received back questionnaires were rejected for not fulfilling the minimum acceptance criteria i.e. at least 70% questionnaires must be properly answered. Finally, 413 questionnaires were accepted for further analysis representing a response rate of 77.92% which is an appreciating response rate besides being a population of specialized nature having access limitations.

Table 2

Respondent Profile

		Count	Column N %
Age	Less than 25 years	10	2.42%
	25-35 years	93	22.52%
	35-45 years	209	50.61%
	45 years plus	101	24.46%
Gender	Male	391	94.67%
	Female	22	5.33%
Qualification	Matric or less	33	7.99%
	Intermediate	65	15.7%
	Bachelors	202	48.91%
	Masters	92	22.28%
	Others(specify)	21	5.08%
Work Experience	1-3 Years	35	8.47%
	4-7 Years	101	24.46%
	8-11 Years	198	47.94%
	12-15 Years	69	16.71%
	More than 15 Years	10	2.42%

		Count	Column N %
Job nature	Permanent	324	78.45%
	Contract Based	89	21.55%
Daily Exposure to Hazards	Less than 2Hrs	258	62.47%
	2-5Hrs	85	20.58%
	More than 5hrs	70	16.95%
Job Role	Machine operators	75	18.16%
	Technicians	295	71.42%
	Technical Supervisors	30	7.26%
	Quality/testing Staff	13	3.15%
Organization	Organization (D)	125	30.27%
	Organization (N)	189	45.76%
	Organization (A)	99	23.97%
Pay Scale	BPS 1-5	48	11.62%
	BPS 6-10	146	35.35%
	BPS 11-16	174	42.13%
	BPS 17-20	45	10.89%

The "table 2" shows demographic dynamics of the selected sample. In terms of age distribution, the results show that the workforce is largely concentrated in 35–45 years' group, which accounts for 209 employees (50.6%). The 25–35 years' group follows with 93 respondents (22.5%), The 45 years and above group makes up 101 respondents (24.5%), Only 10 respondents (2.4%) were below 25 years.

The gender profile of the workforce is highly male dominated with 391 respondents (94.7%) being men and only 22 respondents (5.3%) being women due to highly technical and demanding natured job where limited number of women work.

The educational background reveals that the largest group of respondents holds a bachelor's degree, with 202 employees (48.91%), 92 respondents (22.28%) have completed a master's degree, 65 respondents (15.7%) are intermediate pass, and 33 (7.99%) have matriculation or less. A small portion, 21 respondents (5.08%), falls under the "Other" category, representing diverse or specialized educational backgrounds. the educational profile represents organizations' preferences for a workforce having higher levels of education.

The majority of respondents were engaged as permanent staff, with 324 employees (78.5%), 89 employees (21.5%) were on contract, while no respondents were working on a daily-wage or internship/trainee basis as it was preset in inclusion/exclusion criteria.

The work experience profile in given clustered column chart shows that employees with 8–11 years of service form the majority, with 198 respondents (47.94%). 101 employees (24.46%) reported 4–7 years of experience, while 69 respondents (16.7%) had 12–15 years of work background and 8.47% are 1–3-year experience. Very few, only 10 respondents (2.4%), had more than 15 years of service.

The daily exposure levels indicate that most employees (258 respondents, 62.5%) reported exposure to hazardous materials (soldering fumes, chemicals, radiation, etc.) for less than 2 hours per day, 85 respondents (20.6%) face exposure of 2–5 hours daily, while 70 respondents (16.9%) work under exposure conditions for more than 5 hours.

The job role distribution highlights that the largest group of respondents are technical staff such as engineers and technicians accounting for 295 employees (71.42%). Management staff, including supervisors and department heads, make up 30 respondents (7.26%), while machine operators form 75 respondents (18.15%). A small portion, 13 respondents (3.14%), falls under the Quality/testing Staff category.

When categorized by organization, the largest representation comes from Organization (N) with 189 respondents (45.8%), followed by Organization (D) with 125 employees (30.3%), and Organization (A) with 99 employees (24.0%).

The distribution of the pay scale suggests that the highest percentage of employees is situated in the range of BPS 11-16 (174 respondents 42.13%) which is a strong focus of mid-level to upper-mid-level employees. BPS 6-10 follows with a 146-employee population (35.35%), with a significant proportion of junior to lower-mid-level jobs. The respondents in BPS 17-20 control 45 employees (10.89%) which is a smaller proportion of senior-level and managerial workforce. Comparatively, there is, however, a relatively small presence of lower-grade support staff at BPS 1–5, which has 48 employees (11.62%). Generally, the distribution indicates that the workforce is made up of mid-level employees with a relatively lower number of staff in top management and lower-paying scales.

Table 3

Reliability of Data

Variables	alpha	Items
Physical work environment	0.904	4
Job Characteristics	0.871	4
Growth Opportunities	0.901	7
Peer Relations	0.872	4
Supervisor Behavior	0.883	5
Physical Health	0.876	5
Safety and Occupational health measures	0.932	6
Sustainability of Health and Wellbeing	0.856	7

"Table 3" showed that the study variables have a high internal consistency with Cronbach alpha values going between 0.856 to 0.932 and exceeding the recommended alpha of 0.70 (Nunnally & Bernstein, 1994). Safety and Occupational Health Measures (α=0.932), Physical work environment (α = 0.904) and Growth Opportunities (α =0.901) had the best reliability, which means that their items showed strong internal consistency. Similarly, Job Characteristics (α = 0.871), Peer Relations (α = 0.872), Supervisor Behavior (α = 0.883), and Physical Health (α = 0.876) also demonstrated high reliability. The construct sustainability of Health and Wellbeing with alpha of 0.856 was within the acceptable range. All in all, these findings affirm that all the scales are psychometrically sound meaning that the items that are used to gauge each construct are consistent and reliable, therefore, providing a good foundation of continuity in future statistical and inferential analysis of the study.

Table 4

Descriptive Statistics and Correlation Analysis

Variables	n	M	SD	1	2	3	4	5	6	7	8
Physical work environment	413	4.23	.90	1							
Job Characteristics	413	4.13	.68	.544**	1						
Growth Opportunities	413	4.03	.62	.578**	.539**	1					
Peer Relations	413	4.30	.69	.552**	.504**	.622**	1				
Supervisor Behavior	413	4.20	.90	.566**	.468**	.628**	.666**	1			
Physical Health	413	4.07	.68	.524**	.507**	.599**	.562**	.605**	1		
Safety and Occupational health measures	413	4.21	.93	.571**	.496**	.504**	.444**	.484**	.554**	1	
Sustainability of Health and Wellbeing	413	4.06	.67	.753**	.534**	.719**	.533**	.652**	.648**	.624**	1

**. Correlation is significant at the 0.01 level (2-tailed).

In "Table 4" The descriptive results show that employees report generally positive perceptions of workplace conditions and sustainability of their health and wellbeing, with mean values ranging from 4.03 to 4.30. Peer relations, work environment, and safety measures receive the highest ratings, while growth opportunities and the sustainability of employees' health and wellbeing, although slightly lower, remain favorable. The standard deviations indicate moderate and acceptable variability in responses.

Correlation analysis reveals that all variables are positively and significantly related. Sustainability of employees' health and wellbeing shows moderate associations with all physical and psychosocial factors, particularly, Physical work environment and growth opportunities are strongly associated with sustainability of employees' health and wellbeing. The moderate inters correlations among predictors suggest conceptual distinctiveness and provide preliminary support for the proposed research framework.

Table 5

Simple Regression Coefficients of Predictors on Sustainability of Employees' Health and Wellbeing (Outcome)

Variable	Constant	B	Adj. R^2	F	Sig	T	Sig
Physical work environment	0.988	0.727	0.567	537.217	<.001	23.178	<.001
Job Characteristics	1.466	0.628	0.402	275.803	<.001	16.607	<.001
Growth Opportunities	0.985	0.764	0.517	439.271	<.001	20.959	<.001
Peer Relations	1.411	0.617	0.401	274.821	<.001	16.578	<.001
Supervisor Behavior	1.426	0.627	0.426	304.512	<.001	17.45	<.001
Physical Health	1.457	0.640	0.419	296.988	<.001	17.233	<.001
Safety and Occupational health measures	1.619	0.581	0.390	262.534	<.001	16.203	<.001

N=413, ***p<.001, Outcome: Sustainability of employees' Health and Wellbeing

In "Table 5" The simple regression models show that, all the independent variables are positively and statistically related to sustainability of employees' Health and Wellbeing. The significance of T test for all models indicate each predictor has statistically significant association with the outcome variable i.e. $p<0.001$. Similarly, the results of the f test indicate that all the simple regression models are good fit for being significant (i.e. $p<0.001$). The adjusted R^2 values of the models indicate that the Physical work environment (B = 0.727, Adj. R^2=0.567) exerts the highest influence on the employee wellbeing which accounts to 56.7% of the variance. Sustainability of employees' health and wellbeing is also strongly and significantly affected by Growth Opportunities (B = 0.764, Adj. R^2 = 0.517) defining 51.7% of the total model variance. Supervisor Behavior explains 42.6% of the variance in the sustainability of employees' health and wellbeing based on its adjusted R^2 value. Physical Health accounts for 41.9% of the variance in the outcome variable. Job Characteristics explains 40.2% of the variance in employees' health and wellbeing. In general, the findings support the hypothesis that the increase in these work variables results in substantial gains in the Sustainability of employees' health and wellbeing of the employees and all the models are statistically significant (p =.001 N =413).

Table 6

Multiple Regression Coefficients of Predictors on Sustainability of Employees' Health and Wellbeing (Outcome)

Variable	B	β	SE	T	p
Constant	0.560	—	0.145	3.674	0.000
Physical work environment	0.475	0.492	0.055	8.449	0.000
Job Characteristics	0.047	0.048	0.051	0.930	0.043
Growth Opportunities	0.330	0.310	0.071	4.462	0.000
Peer Relations	0.030	0.031	0.068	0.442	0.049
Supervisor Behavior	0.071	0.073	0.075	0.936	0.039
Physical Health	0.143	0.145	0.064	2.244	0.025
Safety and Occupational health measures	0.186	0.200	0.075	2.498	0.013

R^2 = 0.421, F(7, 405) = 94.558, p < .001, N = 413

In "Table 6" The multiple regression results indicate that the overall model is statistically significant, $F(7, 405) = 94.558$, $p < .001$, explaining a substantial 42% variance in sustainability of employees' health and wellbeing ($R^2 = .421$). This suggests that the set of physical and psychosocial workplace factors jointly defines 42.1% variation in sustainability of employees' health and wellbeing in the studied context.

Among the predictors, Physical work environment emerged as the most influential factor ($B = 0.475$, $\beta = 0.492$, $p < .001$), indicating that favorable physical conditions, facilities, and organizational climate significantly enhance sustainability of employees' health and wellbeing. Growth opportunities also showed a strong and positive effect ($B = 0.330$, $\beta = 0.310$, $p < .001$), underscoring the importance of career development and advancement prospects. Physical health was a significant positive predictor ($B = 0.143$, $\beta = 0.145$, $p = .025$), suggesting that employees with better physical health report higher overall wellbeing. In addition, safety and occupational health measures demonstrated a significant positive relationship with wellbeing ($B = 0.186$, $\beta = 0.200$, $p = .013$), highlighting the role of effective safety policies and protective measures in supporting employee wellbeing.

In contrast, job characteristics, peer relations, and supervisor behavior exhibited relatively weak standardized effects (β values below .10) and limited practical influence on sustainability of employees' health and wellbeing, despite marginal statistical significance. This indicates that, within this government-sector electronics industry, structural and environmental factors play a more decisive role in shaping employee wellbeing than interpersonal or task-related factors. Overall, the findings emphasize the predominance of Physical work environment quality, growth opportunities, physical health, and occupational safety practices as key determinants of sustainability of employees' health and wellbeing.

Multiple Regression Equation

Multiple Regression Equation thus derived is given below:

H&W= 0.56 + 0.475(PWE) + 0.047(JC) + 0.33(GO) 0.03(PR) + 0.071(SB) + 0.143(PH) + 0.186(OHS-M)

Results Summary table

Hypothesis	Hypothesis	Status
H_1	Physical work environment has a significant effect on sustainability of employees' health and wellbeing.	Supported
H_2	Job characteristics have a significant effect on sustainability of employees' health and wellbeing.	Supported
H_3	Growth opportunities contributes to sustainability of employees' health and wellbeing.	Supported
H_4	Peer relations contributes to sustainability of employees' health and wellbeing.	Supported
H_5	Supervisor behavior significantly contributes to sustainability of employees' health and wellbeing.	Supported
H_6	Physical health have a significant effect on sustainability of employees' health and wellbeing	Supported
H_7	Safety and occupational health measures have a significant effect on employee health and wellbeing.	Supported

Discussion

The results in this research give a detailed insight into the variables that affect the sustainability of employees' health and wellbeing in the electronics circuit production and repair sector in the government sector of Pakistan. The findings are quite solid to assume that both physical and psychosocial working conditions have a powerful impact on the health outcomes of employees, thus, justifying the research goals and hypotheses, which were formulated at the outset of the study. The large response rate of 82.4 also enhances the credibility of the findings and indicates the capacity of the employees to be open to give their work experiences.

The findings indicate that the physical work environment is the strongest leading factor in defining employee wellbeing. The regression findings showed that the Physical work environment was found to significantly and positively influence the sustainability of employees' health and wellbeing (56.5% variance). This implies that elements like cleanliness, ventilation, noise, and ergonomic fittings are important determinants to the wellness of employees. The findings are in line with the prior studies that indicated that respiratory, muscular, and mental exhaustion in an electronics repair environment can be caused by poor ventilation, fume exposures, noise, and improper workstation design (Raza et al., 2022; WHO, 2018). The outcomes also indicate the JDR Model, which assumes that negative job demands and lack of environmental resources negatively affect employee wellbeing directly. This is further upheld by the demographic picture which indicates that 78 percent of the respondents were permanent workers and over 70 percent had more than 10 years of experience implying that they were long term victims of the physical environment related risks. This reiterates the fact that cleanliness, ventilation, noise, and ergonomic fittings over time cause cumulative health effects unless done properly.

job characteristics to wellbeing hypothesis received partial support as job characteristics showed a moderate positive correlation with wellbeing and a strong effect in case of simple regression but, the influence remained minimal in combination with other predictors in case of multiple regression. This indicates that job characteristics i.e. workload, the shift arrangements, job clarity and job security, as perceived by the target population, indirectly influences on the sustainability of employees' health and wellbeing besides being significant determinants of employee outcomes.

Recent studies have also similar findings, indicating that the impact of job design characteristics remains contingent to broader organizational resources and environmental dynamics (Bakker & Demerouti, 2017; Lesener et al., 2019). limited flexibility in task design, often declines the salience of job characteristics relative to more tangible factors such as physical working conditions and career prospects particularly in highly structured public-sector settings,

Sustainability of employees' health and wellbeing had a significant correlated relationship with other psychosocial factors including growth opportunities, supervisor behavior and peer relations. The findings indicate that growth opportunities significantly and positively influence sustainability of employees' health and wellbeing. The correlation and simple regression findings also retained a robust effect in the multiple regression model for growth opportunities asserting their importance as a key psychosocial resource. The critical role of growth opportunities in wellbeing identified in this study is quite in line with the self-determination and career sustainability perspectives signifying that perceived development opportunities plays vital role in augmenting motivation, purpose, and psychological wellbeing in workers' life (De Vos et al., 2020; Van der Heijden et al., 2018) while protecting against stress and disengagement.

On the other hand, peer relations, and supervisory behavior, besides showing positive significant bivariate association and strong contribution in simple regression, but their impartial contribution to the outcome variable got minimized. This indicate that these variables are beneficial but might have indirect contribution to the wellbeing, as they got overshadowed by other strong structure organizational factors. The findings retain their significance being in line the findings of previous researches suggesting that rather than a direct predictor of wellbeing, social support at work often functions as a buffer or mediator (Karanika-Murray et al., 2015; Nielsen et al., 2017). In selected task-intensive industrial context, strength collegial relationships with peers and supervisor may enhance daily functioning but might not be enough to counterbalance the effects of limited growth prospects or adverse physical conditions. Skakon (2016) asserts that supervisor behavior matters a lot in corporate cultures, but, may have constrained discretion in bureaucratic public-sector contexts, wherein their capacity to independently influence employee wellbeing outcomes becomes limited (Inceoglu et al., 2018).

The physical health exhibited a high level of significant correlations being a strong predictor of the sustainability of employees' health and wellbeing. This finding confirms that employees in the electronics repair laboratories are exposed to fumes, heat, load lifting and ergonomic stress leads to the development of chronic injuries and fatigue. Despite the positive descriptive findings suggesting that employees positively contributed to safety and occupational health measures ($M = 4.21$) with the moderate correlation between the two variables, the implementation gaps are indicated. This

means that there can be safety policies that are in place but there can be no regular enforcement and resource allocation. Biopsychosocial models also assert the significance of the physical health parameters conceptualizing it as a foundational personal resource influencing emotional resilience and psychological wellbeing (Hämmig, 2017).

The hypothesis on the association between "Safety and Occupational Health Measures" and Wellbeing is also supported with moderate correlation and strong effect in simple regression. In case of multiple regression, the positive effect endorses the critical role of protective equipment, effective safety policies, and hazard management systems. Inadequate safety measures particularly in high-risk technical environments, not only surge chances for physical harm but also seed psychological insecurity, thereby eroding wellbeing (Jain et al., 2018).

On the whole, the discussion shows that there is more to a healthy workplace than safety equipment. The approach consists of a holistic structure, encompassing environmental enhancements, supportive leadership, professional growth, and positive peer culture. The results validate the literature and theoretical basis of this study which showed that wellbeing is not a solo decision but rather a composite interaction of physical, psychological, and organizational factors. The research thus fills the research gap in Pakistan by availing empirical data on the sector-specific health hazards and also by emphasizing how the combined approach of occupational health and wellbeing methods is urgently required in the government-operated electronics repair facilities.

Conclusion

The paper at hand has affirmed that physical, organizational, and psychosocial factors influence the sustainability of employees' health and wellbeing of workers in the government run electronics circuit production and repair industry in Pakistan. The physical work environment (ventilation, noise, hygiene, and exposure control), job design (workload, shifts, and job security), growth and development opportunities, supervisor behavior, physical health hazards, and safety and occupational health measures were identified to have significant impact on the wellbeing. The results render it obvious that the health of employees cannot be explained by the presence of single hazards, yet outcomes of the interaction of workplace hazards, organizational practices, and offered support. On balance, the study comes to a conclusion that the wellbeing of employees is significantly predetermined by the quality working conditions, the balance between job demands and resources, and the degree of an effective application of the occupational health and safety in these units of government.

Overall, the study suggests that the most decisive determinants of wellbeing are physical work environment, growth opportunities while other structure factors having mild effect. Additionally, in the studied context, interpersonal or job-design factors have relatively lesser contribution besides being significant contributors. The psychosocial relationships were also important contributors, but their effect is contingent upon the presence of adequate organizational and environmental resource.

Offering public sector industrial context specific empirical evidence, this study contributes to occupational health literature asserting the need for career development policies and infrastructural improvements to sustain employee wellbeing.

In future, the study can be extended to encompass different regions in Pakistan for enhanced generalization and reflect the differences in the workplace. To measure the long term impact of work environment, growth opportunities and physical health intervention to the employee wellbeing, longitudinal studies are required. The qualitative or mixed method methods can be employed to get deep insights on the perceptions of the employees, safety culture, and psychosocial interactions. Lastly, interventions applied to ergonomics, ventilation, safety measures, and structured career development are to be evaluated in an empirical manner to establish their efficiency to enhance health and organizational performance.

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