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Musculoskeletal Disorders in Unstructured, Unregulated Work: Assessment Methods and Injuries

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Abstract

Unstructured and unregulated work is expanding fast among low- and middle-income countries (LMICs). Furthermore, accumulation of urban waste resulting from overconsumption is a global concern. Hence, waste management and recycling have received increased attention. One specific waste category pertaining to electrical and electronic waste (e-waste) is growing at a higher rate than other waste streams. Recycling of e-waste is largely informal and disproportionately relies on LMICs, exposing workers to various occupational and environmental health risks. In order to promote safer work practices and limit a broad range of occupational health and safety concerns associated with informal manual work, the broader psychosocial and sociocultural environment also deserves attention. This symposium will discuss contemporary issues in informal, unregulated, unstructured work in LMICs, primarily in Africa and South America. The goal of the symposium is to call attention to both, the unique occupational context of informal work, and the need for new ergonomics methods to address occupational exposure assessment and musculoskeletal injury prevention adapted to informal work in limited resource settings.

Keywords

Electronic Waste; Informal Work; LMIC; Musculoskeletal Disorders; Exposure Assessment

1 Introduction

The ILO estimates that nearly two billion people, or about 61% of the world's employed population, make their living in the informal economy [1]. Particularly notable is that LMICs and emerging countries employ 93% of the world's informal worker population. The informal sector makes up 85.8% of employment in Africa compared to 25.1% in Europe [1].

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Informal work is characterized by work conducted in unstructured and unregulated conditions, and is typically based on casual employment, kinship or personal and social relations rather than contractual arrangements with formal guarantees. This implies a lack of social protection, worker rights and decent working conditions. Specific to human factors and ergonomics (HF/E), this also means that informal work has little to no implementation of occupational health and safety (OHS) guidelines. Consequently, informal workers are exposed to significant risk for adverse health effects, including acute injuries, musculoskeletal disorders (MSDs) from cumulative trauma, and work disability through poor working conditions and environments.

1.1 Informal Waste Processing

Accumulation of urban waste resulting from overconsumption is a global concern. Informal workers mostly perform the collection, processing and recycling of urban waste in LMICs. This is a source of livelihood for low skill, low-wage workers [2].

Waste from used electrical and electronic equipment, commonly known as e-waste, is growing at a higher rate than the regular municipal waste streams. High demand and overconsumption of electronic and electrical appliances (e.g., computers, cellphones) has created a global crisis in e-waste management [3]. Globally, generation of e-waste in 2019 was 53.6 million tons (MT) and projected to reach 74.7MT by 2030 [3]. Recycling of e-waste disproportionately relies on LMICs [4,3]. Vast amounts of e-waste from Europe and North America make their way into LMICs each year disguised as donations that end up at dumpsites [3,4]. E-waste processing in LMICs is almost exclusively informal and conducted by low-skilled workers, with little attention to OHS practices, e.g., PPE use, proper work tools and/or workstations [2,5,6].

1.2 Goals of this Symposium

The goal of this symposium is to call attention to both, the unique occupational context of informal work, and the need for new ergonomics methods to address occupational exposure assessment and MSD prevention adapted to informal work in limited resource settings. The symposium will discuss contemporary issues in informal, unregulated, unstructured work in LMICs, primarily in Africa and South America.

The specific objectives of the symposium are to:

- Discuss specific examples and lessons from first-hand experience of conducting research with informal e-waste processing in Ghana, and waste collection in South Africa as case examples.
- Present the contextual factors that pose unique challenges to conducting ergonomic research in unstructured, informal work settings,
- Identify research needs and knowledge gaps related to MSD risk assessment and injury prevention specific to informal worker populations in LMICs.

2. Methodology

2.1 Overview of the Interdisciplinary Panel

This symposium brings together an interdisciplinary panel of researchers. The symposium organizers, Profs. Clive D'Souza and Bernard Martin are experienced in the field of occupational ergonomics, assessment of physical work exposures, and MSD prevention. Prof. Julius Fobil is an expert in environmental epidemiology, the exposure assessment, surveillance and control of environmental pollution, waste management research in LMICs, and co-leads the West Africa-Michigan CHARTER II for GEOHealth. Mr. Andrew Todd is a senior lecturer and experienced in embedding HF/E research within real-world contexts to ensure validity of findings. His particular focus is on the informal economy in South Africa, with an emphasis on understanding waste pickers and the challenges faced in their work. Prof. José Orlando Gomes conducts research on ergonomic work analyses in the wild/real-world in several domains including complex systems, with a particular focus on methodology oriented to reducing the gap between work-as-imagined versus work-as-done.

2.2 Informal, Unstructured Work Settings

A growing number of studies call attention to the musculoskeletal health effects of informal, unstructured work encountered in manual processing/recycling of municipal solid waste, medical waste, and e-waste. The informal waste processing sector is plagued by high rates of MSD symptoms, particularly in the low back, shoulders, neck, and knees [7]. A survey of 340 solid waste collectors (e.g., sweepers, garbage collectors, garbage van and tricycle drivers) in Accra, Ghana found high pain prevalence in the back (73.5%), wrist (48.2%) and neck (44.7%), with 80 to 90 % of the respondents developing pain symptoms subsequent to joining their current job [8]. Studies from India, Egypt, Colombia, Philippines, and Iran indicate similar MSD trends among urban waste workers [7–9]. These studies also identify potential risk factors including heavy material handling (e.g., lifting, carrying, pushing-pulling), bending and repetitive tasks, and prolonged sitting and standing, environmental factors (e.g., heat, harsh outdoor conditions), personal factors (e.g., low literacy, smoking, drug use) and psychosocial factors (e.g., work stress, poor job security) [7].

Case Example: Informal E-Waste Processing in Ghana: Agbogbloshie is the largest dumping grounds for e-waste in sub-Saharan Africa and among the busiest informal e-waste recycling sites in the world [4,3]. Multiple recent studies conducted at Agbogbloshie report high rates of work-related MSD symptoms, e.g., chronic body pain, discomfort, from informal e-waste recycling [6,5,10]. Studies on e-waste workers in other LMICs suggest similar trends [11,12]. Studies also report high rates (96%) of acute injuries e.g., cuts, lacerations, and scars among e-waste workers [10].

Most e-waste workers in Ghana are young, typically between 14 to 40 years old. They regularly work between 10 to 12 hours per day or 300 to 360 hours per month, [5,4]. Work continues every day of the week, with workers taking either Fridays or Sundays off based on religious affiliation [13,6]. These conditions suggest limited rest/recovery, increased cumulative fatigue and MSD risk. Not surprisingly, workers at this dumpsite have a short work tenure (i.e., high turnover) of 3 to 7 years [4].

E-waste workers at Agbogbloshie also self-medicate on painkillers, traditional medications, and other substances (e.g., smoking cannabis) to treat body pain [5,14,10]. Overuse or abuse of such treatments may potentially mask symptoms of underlying work-related MSDs reported in some studies.

The majority of studies on exposure assessment in the informal waste sector are based either on observational or self-reported data. Observational methods used in ergonomics are mostly suited to repetitive jobs with structured sampling. Adaptive sampling methods suited to informal work settings are few [13]. Body-worn video cameras are another option, but labor intensive to code video and/or image stills, may not capture all of the relevant work methods (e.g., hand tools) and body postures, and potential privacy concerns. Understanding cause-effect relationships between exposures and MSD causation from informal work needs prospective studies, however, these methods require extensive resources and trained personnel – which is scarce.

Informal waste recycling worksites present challenges to research, such as difficulties in collecting work-related, time-varying, job-specific exposure data and guide the design of locally-adapted strategies for injury prevention. Overcoming these research challenges will require new ergonomics perspectives, exposure assessment tools and methods suited to informal work settings.

2.3 The Big Picture: Effects on Environmental Health

Lessons learnt from the GEO-Health Project include the many studies conducted assessing health effects of exposure to particulate matter, rare metals and toxic chemicals associated with informal e-waste processing in Ghana and other countries in Africa [6,14,10]. Some key findings include:

- High levels of particulate matter affecting lung function and respiratory ailments
- Traces of aluminum, copper, iron, lead, and zinc in soil and/or air samples
- Toxic chemicals in the soil and vegetables resulting in non-communicable diseases
- Cancer, asthma, neurodevelopmental conditions, obesity, and chronic diseases due to noxious exposure in early childhood
- Restricted thyroid function, cellular expression and function, adverse neonatal outcomes, changes in temperament and behavior.

Environmental health challenges within the informal sector economy are pervasive, largely understudied and may require simple innovative methods for resolution compared to the formal sector while amendable to the application of interdisciplinary collaborations and broader systems approaches. The HF/E community could benefit from learning about these research experiences in allied OHS professions in terms of research methodology as well as identifying opportunities for taking a systems approach to OHS in the informal work sector.

2.4 Cultural Sensitivity, Trust and Community Embedded Research

Informal worker populations and stakeholder audiences can be very diverse in terms of linguistic, cultural, and economical background. Researchers administering questionnaires may need to be fluent in multiple languages to provide explanations in the local dialect to minimize translation errors and information loss. For example, in a study with e-waste workers, questionnaires were administered in English, with explanations given in Dagbani – the local dialect spoken by e-waste workers [13]. Similarly, in the South African study on waste pickers, questionnaires needed translation from English to isiXhosa. The lead researcher being a native English-speaker and unable to speak isiXhosa necessitated use of translators. Significant barriers were uncovered in translating ergonomics terminology into isiXhosa. Achieving consistency and reliability may need careful adaptation and piloting.

Certain worker groups in Africa still maintain a strong ethnic/tribal identity with a hierarchical structure, tribal Chiefs and noblemen. Research conducted with such worker populations requires approval and buy-in from tribal leaders. For example, research conducted at the Agbogbloshie e-waste dumpsite was preceded by a durbar (i.e., public gathering) with tribal leadership, representatives of the scrap dealers association, and available e-waste workers. The research team explained the study objectives and procedures in order to obtain buy-in from local/tribal leaders [13].

In post-apartheid countries like South Africa, low wage informal worker populations still bear a distrust of white-majority academic institutions. The distrust may stem from the long history of oppression and inequality [15]. Rhodes University (where the current research was undertaken) was initially established as an "Oxford in the bush" based on imperialistic western values [15]. Within this context there is need for carefully consideration of ergonomics methods for assessing exposures and MSD risk that rely on direct observations, video and/or photographs of workers and what this means on the part of communities in relation to academic institutions. Research with informal traders and waste pickers in South Africa reported reluctance to study participation due to data privacy concerns, i.e., unsure of where the data would end up and if it could be used against them at a later time [16]. These issues present challenges to obtaining reliable and valid data on exposure to potential MSD risk factors, hinders the embedding of researchers within the system, and impedes efforts to understand work-as-done vs. work-as-described or work-as-imagined. This made it difficult to gain a systemic understanding of the interactions leading to MSDs in waste pickers.

Stakeholder engagement is critical to conducting participatory research. Wilson (2014) warned against the charlatans of manual handling research of the past who took a narrow non-systems approach [17]. He contended "….a musculoskeletal disorders (MSD) investigation or improvement which does not account for psychological/emotional/social influences, on MSD causation or success of solutions, is not properly E/HF" [17]. Accordingly, good ergonomics research requires a systems approach focused on understanding interactions holistically within context whilst acknowledging emergence. To achieve this, Wilson (2014) argued an embedded approach as necessary, suggesting that any research not conducted "in the wild" should not have a primary role in HF/E [17]. Engagement with stakeholders should focus not just on external research goals but also align with internal objectives of the stakeholders. Workplace interventions focused on worker

safety but perceived as reducing earnings/employment may get disused or abandoned. For example, adoption of a newly introduced powered wire-stripper/shredder at Agbogbloshie to isolate metal from insulated cables/wire required e-waste burners to fundamentally alter their work behaviors and overcome concerns of lower yield and decreased income – aspects that relied on mutual trust. From a South African research perspective, a key lesson learnt was to shift the focus from doing research *on* people to doing research *with* people. This strongly aligns with principles of both sociotechnical systems theory and participatory ergonomics that emphasize valuing all stakeholders within the system [18,19].

2.5 Ergonomics and the Global Divide

Outreach and communication strategies with informal worker populations need to consider the context and purpose of the interaction. Informal workers may be hesitant to seek information about safer working conditions due to language barriers and low agency. Hence, outreach is critical. The design of communication products needs to follow principles of plain language and effective design, writing, and translation. Engagement of stakeholders such as community leaders and/or local health workers can also benefit in translating and communicating OHS research into prevention practices. The HF/E community needs to develop innovative approaches for action-oriented research and for disseminating case studies on the successes/failures of engaging informal worker communities to prevent workplace injuries and illnesses.

The lack of trained HF/E researchers and practitioners also hampers research on MSD causation and prevention. This spans formal and informal work settings, and government and regulatory agencies. Lack of HF/E training opportunities, for students in university curricula and for working professionals in government and industry, often results in a limited use or even misuse/misapplication of HF/E methods, analysis tools and workplace interventions borrowed from developed countries. Cross-country collaborations and research partnerships can help to build capacity for training-the-trainers in LMICs and address some of these gaps in HF/E education, training and practice.

3. Conclusion

Informal waste workers face substantial risk from hazardous exposures and work conditions. The high rates of MSDs and work disability among informal workers is likely a confluence of multiple factors, including high physical work demands, young worker population, long work hours, low literacy, polluted work environment, limited PPE and work tools, and psychosocial stressors [13,5–7].

New ergonomics methods are required to address risk assessment and injury prevention adapted to informal work in limited resource settings. The HF/E community needs to foster international collaborations to help address some of the disproportionate OHS burden experienced by workers in the informal sector, particularly in LMICs. Interventions aimed at MSD prevention needs to consider the six key HF/E components proposed by Wilson (2014), namely, a systems focus, concern for context, interactions, holism, recognizing emergent properties, and embedded HF/E practice [17].

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