

Article

Not peer-reviewed version

Assessment of Health Problems and Hazards Prevalent among Garment Workers in a Developing Country: An Approach using Risk Priority Number and Best-Worst Method

[Farzana Islam](#) *

Posted Date: 1 March 2024

doi: 10.20944/preprints202403.0066.v1

Keywords: Risk assessment, Garment industry, RMG, Health risks, Best-worst method, MCDM



Preprints.org is a free multidiscipline platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Article

Assessment of Health Problems and Hazards Prevalent among Garment Workers in a Developing Country: An Approach using Risk Priority Number and Best-Worst Method

Farzana Islam

Department of Industrial and Management Systems Engineering, West Virginia University,
Morgantown, WV 26506, USA; farz.tamy@gmail.com

Abstract: The contribution of readymade garment (RMG) industry is immense behind the rapid development of some countries with emerging economies. This industry is empowering these countries to provide employment opportunities for millions of people. However, the health as well as safety issues of the workers in this industry are often ignored, particularly in these developing countries. In recent times, because of the several undesirable and obnoxious conditions that exist in their working environments, they are vulnerable to various health related problems which are increasing at a staggering rate. The main purpose of this paper is to assess and prioritize the major health related problems faced by these garment workers in these countries where the economy is flourishing. In addition, the main hazards responsible for these health perils are also quantified. Data were collected from three different garment factories situated in different locations of Bangladesh. Thirty workers from each factory rated the frequency and severity of 14 health related issues. The health risks were then assessed and prioritized through risk priority number (RPN). Afterwards, three experts provided their opinion on the main hazards prevalent in the workplace of almost every garment factory in this country. These hazards were grouped into four main classes which are: 1) Physical 2) Ergonomic 3) Chemical and 4) Psychological hazards. The main classes were later divided into sub classes also. Best-worst method (BWM) was then applied to analyze these hazards by assessing their relative weights depending on the experts' judgement. The results showed that the health issues faced by the workers in three different garment factories varied to some extent. The results obtained from the experts' opinion indicated that physical hazards in the workplace are the most detrimental ones whereas the chemical hazards were the least harmful.

Keywords: risk assessment; garment industry; RMG; health risks; best-worst method; MCDM

1. Introduction

The textile and apparel industry is the major force working behind the rapid economic development of Bangladesh where Readymade garment (RMG) is accounted for the most significant amount of total merchandized export (Kathuria, 2013). Jute industry, once the biggest industry in the region has declined in Bangladesh as people-land ratio is very poor in this area and so, it is less likely to change the socio economic status depending upon agricultural growth which paved the way for garment industry (Yunus & Yamagata, 2012). RMG industry, currently the single dominant export earner, started to flourish in Bangladesh since 1980 as main driving force were the availability of cheap labor which worked as market force being fundamental to the competitiveness and government policy regarding export quota system. This economic boon, however, has not been without its costs, particularly in terms of the health and well-being of the workers at the heart of this industry. Although this sector resulted in a plethora of benefits starting from alleviation of poverty to foreign exchange earnings, women empowerment, export earnings, employment creation and

many more, the increased rate of garment workers who already fell a victim or prone to fall victim to various occupational health hazard tells a different story (Haider, 2007). Workers in this industry have to face manifold physical and psychological health hazard due to poor working environment and the repetitive as well as demanding complexion of the work. The relentless push for higher productivity has often led to negligence of basic safety measures and health standards, exacerbating the risk factors for workers. In addition, lack of ergonomic concern, abundant chemical and dust particle engender various health issues such as respiratory complications and musculoskeletal disorder. Moreover, continuous exposure to noise makes the workers vulnerable to diverse psychological disorders. This constant barrage of workplace stressors not only undermines the physical health of workers but also their mental well-being, leading to increased absenteeism and decreased productivity. As competitiveness issue has always been a top priority topic for Bangladesh to sustain in a global market and to compete India and China, the owners continuously try to reduce the lead time as much as possible and thus, bring out the maximum profit which eventually affects the health of the workers both physically and mentally. As international buyers are very particular about compliance with codes of conduct, garments owners are now left with no choice but to improve the work environment (Haider, 2007). This has spurred a slow but observable shift towards better working conditions, though the pace of change remains uneven across the sector. However, the measures taken to ameliorate the situation are amorphous at best as the concern mostly surrounds the workplace policies and practices regarding building and electrical safety, fire safety which apparently save lives but fail to consider the physical safety issues which make the workers suffer in the long run. There is a pressing need for a more holistic approach that encompasses both immediate safety concerns and the long-term health impacts on workers (Rahman et al., 2023). Recognizing these challenges, our research seeks to not only document the prevalent health hazards but also to propose viable interventions that could mitigate these risks. In this regard, this work serves two purposes. Firstly, this research aims to identify, categorize and rank the main health issues which are extracted from the garment workers of three different factories. Secondly, it also plans to evaluate the major health hazards existing in these factories taking opinions from experts (Ali et al., 2022). By leveraging expert insights and comprehensive field data, this study aims to contribute to a more sustainable and ethical development model for the RMG sector in Bangladesh.

2. Literature Review

Bangladesh, as a developing country, has shown remarkable progress in areas such as economic growth, social development, and poverty reduction, positioning itself as an emerging economy with a vibrant culture and resilient populace (Raihan et al., 2022; Roy et al., 2020). The RMG industry is the biggest earner of foreign currency in the history of this country and is of colossal importance to its economy as it dominates the export trade (Islam and Raihan, 2019). Though the industry's contribution was negligible to the country's total export earnings back in 1976, its share expanded to around 75 percent of those profit in 2005 which was approximate 2.5 percent of total value of global garment export and further developed by more than 15 percent per annum during last 15 years (Haider, 2007; Quddus & Rashid, 2000). Three potential strength worked behind the success of garment industry in this country's perspective which are market force, government policy and internal dynamism where the low labor cost is the most significant reason worked as market force taking the advantage of huge population density (Quddus & Rashid, 2000). The garment industry can be held accountable for 81% of Bangladesh's total export earnings and has been rated second largest exporter of garments in the world after China (Mahmud & Rajath, 2017; Theuws et al., 2013). Yet, garment workers here work approximately 9-12 hours a day, even 7 days a week at some factories, in cramped and noxious environments full of health hazards and even without adequate breaks (Farhana et al., 2015). This relentless demand on workers not only exacerbates existing health issues but also significantly increases the risk of developing new ailments, highlighting an urgent need for systemic change within the industry. Enormous work pressure along with poor work condition, procedure and facilities results in a number health issues (Mahmud et al., 2018). Even though recently the code of conduct regarding international business ensures protection against the

hazards such as building, electrical and fire safety, the workers are non-responsive regarding the physical hazards due to that the workers are not well informed and instructed about the hazards in working conditions (Khandker et al., 2016). Apparently, few disingenuous management thinks that providing healthy work environment through taking necessary steps to prevent the physical hazards will cost more money. But they forget to take into account that through preventing the occupational health hazards, we can ensure quality works will be done by the healthy, efficient and satisfied workers (Khan et al., 2015). Moreover, a healthy workforce is a fundamental component of sustainable business practices, contributing to higher productivity levels and fostering a more positive corporate image in the global market. Hence, identifying the health problems through rigorous survey and extensive literature review is not enough until the main causes are figured out. Furthermore, given that resources are consistently scarce and limited, prioritizing their allocation is crucial, which is the primary focus of our subsequent research.

3. Methodology

In this study, first of all, 14 health related risks are identified with the help of a thorough literature review, opinion from experts in relevant fields as well as talking to the garment workers directly. A simple risk analysis was later conducted taking the input from the workers on these 14 health issues and the risk priority number was determined. Data was collected from three garment factories located in Gazipur, Savar and Narayanganj area of this country. 30 workers with an experience of at least one year was chosen from each factory. The health issues faced by the workers in these three factories were then assessed and prioritized. Secondly, the causes responsible for creating the health problems of the garment workers were identified from the judgement of three experts, each having an experience of minimum 20 years in the garment sector. 4 primary hazards were pointed out which were in turn divided into secondary hazards. Best-worst method was implemented later to find out the relative weights of these primary hazards as well as the global weights and thus ranking of the secondary hazards.

3.1. Assessment of Health Issues

The steps involved in assessing and ranking the health problems are:

Step 1: Using a scale of 1-10, each worker from factory A rated the frequency of the occurrence of each of the 14 health problems in their factory.

Step 2: Using the same scale, each worker from the same factory rated the severity of each of the 14 health risks.

Step 3: Frequency and severity of these 14 individual risks were multiplied for each garment worker in factory A to get the risk priority number. The results ranged from 1 to 100.

Step 4: Steps 1-3 were performed for all the 30 selected workers from factory A. As a result, 30 sets of data were obtained for these 14 health issues. The average of these risk priority numbers from 30 workers was calculated and the health problems were ranked accordingly.

Step 5: Steps 1-4 were again performed for the workers of factory B and factory C.

3.2. Best-Worst method

The best-worst method (BWM) is a well-known MCDM method suitable for problems with multiple criteria. It is similar to analytic hierarchy process (AHP) as it also involves pairwise comparison of the criteria (Rezaei, 2016). This method is applied here because of two important advantages it possesses (Ahmadi et al., 2017). Firstly, it requires fewer number of comparisons. Secondly, the results obtained show a higher consistency than other MCDM techniques. BWM has been applied in many research as the preferred MCDM tool. Some research include supplier selection (Gupta & Barua, 2017), selecting suitable mode of transportation (Guo & Zhao, 2017), finding out the best configuration of freight bundling in airports (Rezaei et al., 2017) and so on. The steps involved are presented in Table 1.

Table 1. Steps Involved in Best-Worst Method along with Description.

Step	Performed Activity	Description
1	Constructing the decision criteria system	A set of decision criteria $\{C_1, C_2, C_3, \dots, C_n\}$ is determined for arriving at a decision.
2	Determining the best and worst criteria	Based on the expert's judgement, the best, C_B (most important) and the worst, C_W (least important) criteria are identified.
3	Determining the preference of C_B over all other criteria	A scale of 1-9 is used to execute this step. The best-to-others, A_B vector is determined and defined as: $A_B = (a_{B1}, a_{B2}, \dots, a_{Bn})$ Here, a_{Bj} indicates the preference of C_B over criterion j
4	Determining the preference of all the criteria over C_W	A similar scale is again used to perform this operation. The others-to-worst, A_W vector is identified and defined as: $A_B = (a_{1W}, a_{2W}, \dots, a_{nW})^T$ Here, a_{jW} indicates the preference of the criterion j over C_W
5	Determining the optimal weights	The optimal weights ($w_1^*, w_2^*, w_3^*, \dots, w_n^*$) are determined by minimizing the maximum absolute differences $\{ w_B - a_{Bj}w_j , w_j - a_{jW}w_w \}$ for all j . The formulation is: $\min \max_j \{ w_B - a_{Bj}w_j , w_j - a_{jW}w_w \}$ subject to $\sum_j w_j = 1,$ $w_j \geq 0, \text{ for all } j$ The above can be transferred into a linear programming problem as: $\min \xi^L$ subject to $ w_B - a_{Bj}w_j \leq \xi^L, \text{ for all } j$ $ w_j - a_{jW}w_w \leq \xi^L, \text{ for all } j$ $\sum_j w_j = 1$ $w_j \geq 0, \text{ for all } j$ Solving the above problem will give the optimal weights ($w_1^*, w_2^*, w_3^*, \dots, w_n^*$) and ξ^{L*} which is the optimal value of ξ^L , also known as the consistency ratio. A ξ^{L*} value close to 0 indicates a more consistent results.

4. Evaluating the Health Issues and Health Hazards in the Garment Industry

The evaluation is divided into two stages. At first, the health problems currently prevalent in the garment factories are assessed according to the steps mentioned in section 3.1. Afterwards, the primary and secondary hazards responsible are weighted and ranked applying BWM according to the steps discussed in section 3.2.

4.1. Assessing the Major Health Issues through Risk Priority Number

There are a total of 90 garment workers employed in three different garment factories with an experience of minimum one year who participated in giving their feedback on the major health problems they have to deal with in their workplace. Each worker rated the frequency of occurrence and severity of each of the 14 problems. A scale of 1-10 was used for this purpose. A portion of the data obtained from 30 workers of Factory A regarding the frequency of the 14 health problems is presented in Table 2.

Table 2. Frequency of the Health Problems Rated by 30 Workers from Factory A.

Health Problems	Respiratory problems	Skin disease	...	Anxiety	Diarrhea
Worker 1	6	8		7	9
Worker 2	7	7		6	8
Worker 3	5	7		7	9
Worker 4	6	7		8	7
Worker 5	6	8		7	8
...					
Worker 26	8	9		5	9
Worker 27	6	8		7	7
Worker 28	7	9		6	8
Worker 29	7	7		5	9
Worker 30	6	6		7	8

In the same way, part of the data for 30 workers of Factory A regarding the severity of the health problems is given in Table 3.

Table 3. Severity of the Health Problems Rated by 30 Workers from Factory A.

Health Problems	Respiratory problems	Skin disease	...	Anxiety	Diarrhea
Worker 1	4	3		5	6
Worker 2	5	4		6	7
Worker 3	6	4		5	6
Worker 4	5	4		6	5
Worker 5	5	3		7	6
...					
Worker 26	6	5		4	9
Worker 27	7	4		6	6
Worker 28	6	3		7	7
Worker 29	5	5		8	6
Worker 30	6	4		6	7

The product of the frequency and severity of these health problems are taken to obtain the RPNs of all the 14 health problems from 30 workers of factory A. Finally, taking the average of the RPNs from 30 workers, the health problems are ranked. These are presented in Table 4 and Table 5.

Table 4. RPNs of the Health Problems Obtained from the Workers of Factory A.

Health Problems	Respiratory problems	Skin disease	...	Anxiety	Diarrhea
Worker 1	24	24		35	54
Worker 2	35	28		36	56
Worker 3	30	28		35	54
Worker 4	30	28		48	35
Worker 5	30	24		49	48
...					
Worker 26	48	45		20	81
Worker 27	42	32		42	42
Worker 28	42	27		42	56
Worker 29	35	35		40	54
Worker 30	36	24		42	56

Table 5. Ranking of the 14 Health Problems in Factory A.

Health Problems	Summation	Average	Final Rank
Respiratory problems	1032	34.40	8
Skin disease	922	30.73	9
Eye strain	393	13.10	13
Pain in shoulder	637	21.23	11
Pain in the lower back	766	25.53	10
Headache	1498	49.93	5
Gastric pain	1626	54.20	2
Hepatitis (Jaundice)	594	19.80	12
Loss of hearing capacity	291	9.70	14
Insomnia	1182	39.40	7
Fever	1730	57.67	1
Pain in the abdomen	1512	50.40	4
Anxiety	1236	41.20	6
Diarrhea	1543	51.43	3

Finally, similar calculations were performed for 30 workers of factory B and 30 workers of factory C. The results are summarized in Table 6.

Table 6. Ranking of the 14 Health Problems in the Three Factories.

Health Problems	Final Rank		
	Factory A	Factory B	Factory C
Respiratory problems	8	11	2
Skin disease	9	12	6
Eye strain	13	13	14
Pain in hands	11	2	10
Pain in the lower back	10	3	11
Headache	5	6	5
Gastric pain	2	1	8
Hepatitis (Jaundice)	12	10	12
Loss of hearing capacity	14	14	13
Insomnia	7	8	3
Fever	1	5	4
Pain in the abdomen	4	7	7
Anxiety	6	4	1
Diarrhea	3	9	9

4.2. Evaluating the Health Hazards using Best-Worst Method

The health hazards prevalent in majority of the garment factories of Bangladesh are first identified with an extensive review of recent literature and opinion from both experts and experienced workers. The hazards have been categorized into four primary groups which are later sub divided into secondary hazards. Table 7 shows the classification of these hazards.

Table 7. Primary and Secondary Classification of Health Hazards.

Primary health hazards	Secondary health hazards
Physical hazards (A)	Noise pollution (A1)
	Non-availability of safe drinking water (A2)
	Absence of proper lighting (A3)
	Shortage of sufficient restrooms (A4)
	Over-crowded workplace (A5)
Ergonomic hazards (B)	Awkward posture (B1)
	Lifting of heavy loads (B2)
	Repetitive movement (B3)
	Problems in tools (B4)
Chemical hazards (C)	Presence of particulate matters (C1)
	Fumes from dyes (C2)
	Handling of chemicals (C3)
	Fabric dust (C4)
Psychological hazards (D)	Monotonous work (D1)
	Fear of accidents (D2)
	Long working hours (D3)
	High pressure from work (D4)

The hazards are evaluated using the steps mentioned in the following.

Step 1: According to step 1 of Table 1, the set primary criteria is {A, B, C, D} whereas the sets of secondary criteria are expressed as {A1, A2, A3, A4, A5}, {B1, B2, B3, B4}, {C1, C2, C3, C4} and {D1, D2, D3, D4}.

Step 2: The best and the worst criteria from the opinion of the three experts are then obtained. The results are shown in Table 8 and Table 9.

Table 8. Best and Worst Criteria for the Primary Hazards Given by Three Experts.

Criterion	Identified as Best by Expert No.	Identified as Worst by Expert No.
Physical hazards (A)	1, 2, 3	
Ergonomic hazards (B)		
Chemical hazards (C)		1, 3
Psychological hazards (D)		2

Table 9. Best and Worst Criteria of the Secondary Hazards Indicated by Three Experts.

	Criterion	Identified as Best by Expert No.	Identified as Worst by Expert No.
A	A1		3
	A2	1, 3	
	A3		1, 2
	A4	2	
	A5		
B	B1	1, 2, 3	
	B2		1, 3
	B3		
	B4		2
C	C1	3	
	C2		
	C3		1, 2, 3
	C4	1, 2	
D	D1		3
	D2		1, 2
	D3	1	
	D4	2, 3	

Step 3: The best-to-others vector identified by the three experts for the 4 primary hazards are shown in Table 10. Similar calculations were also executed for the secondary hazards.

Step 4: The others-to-worst vector are then obtained from the judgement of the 3 experts for the same 4 primary hazards. This is shown in Table 11. The others-to-worst vectors for the secondary hazards are also obtained in the similar manner.

Step 5: Using the procedures described in Table 1, the weights of the primary and secondary hazards are calculated. Since there are three experts, a simple average of the weights is determined. The weights of the 4 primary hazards and the secondary hazards along with their rankings are shown in Table 12 and Table 13 respectively.

Table 10. Best-to-Others Vectors for the Primary Hazards Rated by Three Experts.

Expert No.	Best	Physical hazards	Ergonomic hazards	Chemical hazards	Psychological hazards
1	Physical hazards	1	3	6	4
2	Physical hazards	1	4	6	5
3	Physical hazards	1	4	7	3

Table 11. Others-to-Worst Vectors of the Primary Hazards Rated by Three Experts.

Expert No.	1	2	3
Worst	Chemical hazards	Psychological hazards	Chemical hazards
Physical hazards	5	5	7
Ergonomic hazards	4	4	3
Chemical hazards	1	2	1
Psychological hazards	4	1	3

Table 12. Average of the Relative Weights and Ranking of the Primary Hazards.

Primary Criterion	Symbolic Form	Relative Weights	Relative Rank
Physical hazards	A	0.564	1
Ergonomic hazards	B	0.190	2
Chemical hazards	C	0.092	4
Psychological hazards	D	0.154	3

Table 13. Average of the Relative Weights and Ranking of the Secondary Hazards.

Secondary Criteria	Relative Weight	Relative Rank	Global Weight	Global Rank
A1	0.094	4	0.053	6
A2	0.371	1	0.209	1
A3	0.072	5	0.041	10
A4	0.311	2	0.175	2
A5	0.152	3	0.086	4
B1	0.540	1	0.103	3
B2	0.102	4	0.019	15
B3	0.223	2	0.042	8
B4	0.136	3	0.026	13
C1	0.335	2	0.031	11
C2	0.132	3	0.012	16
C3	0.077	4	0.007	17
C4	0.457	1	0.042	9
D1	0.192	3	0.030	12
D2	0.139	4	0.021	14
D3	0.284	2	0.044	7
D4	0.385	1	0.059	5

5. Results and Discussion

In this research work, the 14 health problems are first identified and then ranked according to their risk priority number. A total of 90 garment workers from three different factories (A, B and C) participated by giving their opinion about the health problems they are susceptible to every now and then. The results obtained show that there is a variation of the health problems in these three factories (Table 6). In factory A, fever, gastric pain and diarrhea occupy the first three positions respectively. Gastric pain, pain in hands and pain in the lower back are the major health related problems in factory B. Finally, the major health issues faced by the workers in factory C include anxiety, respiratory problems and insomnia. From these variation, it can be understood that the prevalence of the health issues varies from factory to factory. Some conjecture can also be made about these factories. It can be surmised that factory A had issue with scarcity of pure drinking water, unclean environment, shortage of toilets and so on. Workers of factory B, on the other hand had issues with the ergonomic risks in their workplace. Similarly, factory C could have dusty workplace as well as high pressure from work which resulted in breathing problems, anxiety and sleeplessness of its workers.

The hazards present in the workplace of the garment factories were also evaluated using best-worst method which incorporated the judgement from three experts (Table 12). The 4 primary hazards were ranked and it was found that physical hazards (A) are more prevalent and harmful in most of these factories whereas the effects of chemical hazards (C) are minimum. When the secondary hazards are ranked (Table 13), it was found that non-availability of safe drinking water (A2) occupied the first place and the risks associated with handling of chemicals (C3) were positioned in the last place.

6. Conclusion

This work attempts to evaluate the health related issues and the major hazards existing in the workplace of the garment workers in three different factories of this country. A different approach is taken while conducting this research. Unlike the works currently found in the existing literature, the health problems are assessed with the help of the risk priority number where the workers directly participated providing their opinions. In addition, the health hazards are assessed implementing best-worst method which also required judgement of experts from the garment sector. The outcome of this study could play a crucial role when taking steps in dealing with the current scenario of the garment factories. These results can assist the top management and owners to take effective measures by rectifying those issues that occupy the top positions in the ranking. In this way, this study will not only help the managers to take correct decisions but also will save time, money and resources of the factories.

The study would have been more effective if there had been more participation from the garment workers and experts. Besides, by taking data from more than three factories, the results could be generalized for the entire garment industry of this country. This work can be extended in future by incorporating greater amounts of data and finding correlations among the health risks and hazards with improved numerical models.

Acknowledgments: This research work could not have been completed without the cooperation of the experts who, in spite of their tight schedule, did not hesitate to offer their valuable opinions. The authors also acknowledges the support received from all the garment workers as well as the authority of the factories to carry out this research successfully.

References

- Ahmadi, H. B., Kusi-Sarpong, S., & Rezaei, J. (2017). Assessing the social sustainability of supply chains using Best Worst Method. *Resources, Conservation and Recycling*, 126, 99–106.
- Ali, S. M., Belal, H. M., Roy, S., Rahman, M. T., & Raihan, A. S. (2022). Examining the role of soft dimensions on the implementation of ISO 14000 environmental management systems: a graph-theoretic approach. *Annals of Operations Research*, 1-26.
- Farhana, K., Syduzzaman, M., & Munir, M. S. (2015). Present status of workers in ready-made garments industries in Bangladesh. *European Scientific Journal*, 11(7).

- Guo, S., & Zhao, H. (2017). Fuzzy best-worst multi-criteria decision-making method and its applications. *Knowledge-Based Systems*, 121, 23–31.
- Gupta, H., & Barua, M. K. (2017). Supplier selection among SMEs on the basis of their green innovation ability using BWM and fuzzy TOPSIS. *Journal of Cleaner Production*, 152, 242–258.
- Haider, M. Z. (2007). Competitiveness of the Bangladesh ready-made garment industry in major international markets. *Asia-Pacific Trade and Investment Review*, 3(1), 3–27.
- Islam, F., & Raihan, A. S. (2019). Fuzzy AHP-based Study of Barriers to the Implementation of Cleaner Production in Textile Industry. In *Proceedings of the International Conference on Industrial Engineering and Operations Management* (pp. 518-528).
- Kathuria, L. M. (2013). Analyzing competitiveness of clothing export sector of India and Bangladesh. *Competitiveness Review: An International Business Journal*.
- Khan, N. R., Dipti, T. R., Ferdousi, S. K., Hossain, M. Z., Ferdousi, S., Sony, S. A., ... Islam, M. S. (2015). Occupational Health Hazards Among Workers of Garment Factories in Dhaka City, Bangladesh. *Journal of Dhaka Medical College*, 24(1), 36–43.
- Khandker, S., Ahmad, S. A., Khan, M. H., Faruquee, M. H., Yasmin, R., Dutta, S., ... Sarwar, A. F. M. (2016). Perceived workplace hazards and health problems among the workers of garment factory in Dhaka. *JOPSOM*, 35(2), 1–9.
- Mahmud, M. S., & Rajath, V. D. (2017). Safety issues of female workers of garment industry in Gazipur District, Bangladesh. *Journal of Applied and Advanced Research*, 2(4), 265–269.
- Mahmud, S., Mahmud, R., & Jahan, M. N. (2018). Health issues of female garment workers: evidence from Bangladesh. *Journal of Population and Social Studies [JPSS]*, 26(3), 181–194.
- Quddus, M., & Rashid, S. (2000). Entrepreneurs and Economic Development: the remarkable story of garment exports from Bangladesh. *University Press*.
- Rahman, M. H., Ghasemi, A., Dai, F., & Ryu, J. (2023). Review of Emerging Technologies for Reducing Ergonomic Hazards in Construction Workplaces. *Buildings*, 13(12), 2967.
- Raihan, A. S., Ali, S. M., Roy, S., Das, M., Kabir, G., & Paul, S. K. (2022). Integrated model for soft drink industry supply chain risk assessment: implications for sustainability in emerging economies. *International journal of fuzzy systems*, 1-22.
- Rezaei, J. (2016). Best-worst multi-criteria decision-making method: Some properties and a linear model. *Omega*, 64, 126–130.
- Rezaei, J., Hemmes, A., & Tavasszy, L. (2017). Multi-criteria decision-making for complex bundling configurations in surface transportation of air freight. *Journal of Air Transport Management*, 61, 95–105.
- Roy, Sanjeeb, Miki Das, Syed Mithun Ali, Ahmed Shoyeb Raihan, Sanjoy Kumar Paul, and Golam Kabir. "Evaluating strategies for environmental sustainability in a supply chain of an emerging economy." *Journal of Cleaner Production* 262 (2020): 121389.
- Theuws, M., van Huijstee, M., Overeem, P., & van Seters, J. (2013). Fatal Fashion Analysis of recent factory fires in Pakistan and Bangladesh: a call to protect and respect garment workers' lives.
- Yunus, M., & Yamagata, T. (2012). The garment industry in Bangladesh. *Dynamics of the Garment Industry in Low-Income Countries: Experience of Asia and Africa (Interim Report)*, Chousakenkyu Houkokusho, IDE-JETRO, 6, 29.

Biographies

Farzana Islam is a master's student in the Department of Industrial and Management Systems Engineering at West Virginia University. She graduated from Bangladesh University of Engineering and Technology with a major in Industrial Engineering and has two years of work experience in the manufacturing and service industries. She previously worked in the service industry as a project coordinator for human resources transformation projects such as ERP implementation and competency frameworks roll-out projects. She has led projects that promote sustainability through the reduction of carbon footprint generated by the supply chain network in her role as a planning officer in the manufacturing industry. She has also received several best paper awards in the tracks of sustainability, lean six sigma, optimization, and supply chain at the Industrial Engineering and Operation Management conferences. Her current research focuses on adding new dimensions to the sustainable approaches used by industries by leveraging her prior experiences and education.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.