ejpmr, 2023,10(7), 474-480

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

PESTICIDE INDUCED OCCUPATIONAL INJURIES AND THEIR INFLUENCE ON HEALTH-RELATED QUALITY OF LIFE AMONG FARMERS IN BELAVANURU VILLAGE OF SOUTH KARNATAKA

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Article Received on 21/05/2023 **Article Revised on 11/06/2023** **Article Accepted on 02/07/2023**

ABSTRACT

Objectives Inappropriate use of pesticides has greatly increased the risk of occupational exposure and toxicities in farmers. Despite the high prevalence of occupational injuries, severe underreporting made to investigate toxic symptoms in pesticide exposed farm workers and to evaluate their health-related quality of life after pesticide exposure. **Methods** A community based prospective cross-sectional study was conducted for a period of six months. The well-structured questionnaire was developed and data was collected through face-to-face interaction and obtained data was analysed with the help of Statistical Package for Social Sciences 20 software by applying Chi square test. **Keyfindings** Out of 239 farmers majority of the farmers cultivated paddy alone and used moderately hazardous pesticide more during cultivation period. As a consequence of pesticide use, skin irritation, sneezing, numbness of hands, eye irritation and fatigue were the occupational injuries which made an impact on health-related quality of life after the pesticide use. **Conclusions** Although pesticides are used to increase the yield, certain concerned effects of pesticides are hazardous towards environmental and human health. Farmers are at increased risk due to occupational exposure. They must be aware of the toxicity of the pesticides and safe handling of them. In addition, proper training and management of pesticides can be executed by the government in order to create awareness among the farmers regarding the safe and effective use of the pesticides.

KEYWORDS: Pesticide, Occupational injuries, Farmers**,** Health Related Quality Of Life.

INTRODUCTION

The need to feed a growing world population is one of the most significant challenges modern agriculture faces. Since the agricultural land is limited to achieve this purpose, the use of pesticide in modern farming has become a necessity.[1] Pesticides are defined as common, diverse class of chemicals used in agricultural production to prevent or control pests, disease, weeds, and other plant diseases in an effort to minimise or completely eliminate yield losses and preserve high output quality.[2] Agriculture is the largest consumer (around 85% of world production) of pesticides to chemically control various pests.[3] Excessive use of chemical additives has greatly increased the risk of occupational exposure and toxicities in farmers.[4,5] India alone accounts about 20% of the total agriculture industry in the world.[6] Pesticide consumption in India on an annual basis from 2017 to 2022 as stated under the Ministry of Agriculture and Farmers Welfare Department of India's official database.[7] (Table 1)

According to WHO, occupational health is promotion and maintenance of the highest degree of physical, mental and social well-being of worker in all occupation. Pesticide exposure is regarded as one of the most significant occupational health injuries among farmers in developing nations.[8] In several countries the fatal accident rate in agriculture is double the average for all other industries. Out of a total 335,000 fatal work place accidents worldwide, there are about 170,000 deaths among agricultural works.[6] Pesticide preparation, mixing, loading, application, and cleaning of used equipment are few of the tasks that result in occupational pesticide exposure in the agricultural sector.[9] Further, the state of the pesticides whether presented as liquid, solid, or gas can affect the degree of exposure.[10] In addition, to that unsafe, unmanaged use of several hazardous equipment such as tractors, harvesters, cutting and piercing tools and unfavourable environmental conditions bring more risk to farmers health.[8, 11]

Many previous studies have shown a higher prevalence of physical health issues in farmers, including musculoskeletal disorders, respiratory conditions, hearing loss, epilepsy, endocrine disruption, congenital abnormalities, malformation of the deoxyribonucleic acid(DNA), sleep apnoea, mental health issues as well as cancers of the skin, stomach, liver, brain, prostate, nervous, and lymphohematopoietic systems, along with wide range of occupational injuries burns, shocks, cuts, fractures, puncture wounds, and lacerations, have also been associated with agricultural employment.[8,10]

Other than occupational injuries mismanagement of pesticides degrades the land, depletes groundwater resources and pollutes the air.[12] Repeated application of pesticides leads to loss of biodiversity and increased pest resistance.[3] These risks may be exacerbated by lack of information on pesticide hazards, the perception and attitude of farmers regarding risk from pesticide exposure, and to lack of education and poor knowledge and understanding of safe practices in pesticide use, including storage, handling and disposal.[13] According to the World Health Organization (WHO), an estimated 25 million farmers who experience acute pesticide poisoning [APP]. However, despite the high prevalence of APP there, severe underreporting suggests that the illness burden attributable to pesticide exposure is commonly underestimated.[9,14]

The scale and severity of problems are frequently unknown, especially in a community that is underserved like farmers.[8] Considering the evidence that pesticides may be a significant risk to human health, evaluating the factors that contribute to the misuse of chemical pesticides in agriculture is particularly important.[13] So this study was conducted with the aims to 1) investigate toxic symptoms in pesticide exposed farm workers 2) Evaluate their health-related quality of life after pesticide exposures. 3) investigate the safety and protective behaviour of farmers using chemical pesticides. 4) to spread the awareness among the farmers regarding the handling of the pesticides.

METHODOLOGY

Study design: A prospective cross sectional study was conducted for a period of six months From February to July. The ethical clearance for the study was obtained from Institutional Ethical Committee of Bapuji Pharmacy College, Davanagere.

Study site: The study site includes **Belavanuru** village, which is located in Davangere taluk of Davangere district in Karnataka, India (Figure a and b). The selected village was typical of paddy grower along with other crops such as maize, betel nut with total geographical area of 967.13 hectors. It has a total population of 4,621 people living in this village, with literacy rate 64.14%.

Study size: The estimated sample size for the study was 280. It was calculated by keeping the margin of error 5%, confidence interval 95% and total population of farmers living in the village, that was 1034. Study includes all the farmers who were aged between 15 to75 years, who were using pesticides for the agricultural cultivation, extensive agriculture practicing farmers and farmers who were ready to give the consent.

Data source: The draft of the questionnaire which was used for collecting the data was developed after reviewing the literature followed by referring the guidelines stated under the ministry of agriculture. The questionnaire was shared with the team comprising of the general physician, guide and relevant areas for feedback, content validity and reliability were taken from them. The revised data collection form consisted of three section 1) Socio-demographic data, 2) agriculture profile, 3) evaluation on safe handling of pesticides. It also included a section according to short form health survey (SF 36) to gather information about any changes in health-related quality of life (HRQOL) after the pesticide use.

Socio demographic details included name, age, gender, education, social habits, medical and family history of farmers. The agricultural profile consisted of list of crops cultivated, state of pesticide used, increased in the pesticide use, occupational injuries after pesticide exposure, sick leaves taken and hospitalization after injuries. The evaluation section of the questionnaire includes safe handling of pesticides while purchasing, storing, transporting, preparing, selecting equipment, spraying and after spraying. The third section of the questionnaire was prepared using guidelines given by Ministry of Health and Agriculture, India. According to the guidelines, in each step if the farmer complies more than 50% of the time, he was considered as a good handler.

The permission from the Panchayat Officer of Belavanuru village was taken before proceeding the study. A questionnaire was designed in English but it was translated to Kannada, a local language that is understood by majority of the farmers. Data was collected through face-to-face interviews with 252 farmers (farm workers directly exposed to pesticide within one week period). Among 252 farmers 13 subjects were excluded as they didn't meet inclusion criteria. All self-reported data were collected appropriately with a help of structured questionnaire. Subjects were informed about the confidentiality and voluntary participation in the study. Informed consent was taken from each participant before starting the questionnaire.

Data management and analysis: Data obtained were coded, entered to Microsoft Excel Spreadsheet and analysed using the SPSS 20 software. Descriptive results were expressed as frequencies and percentages. To calculate the percentage and frequencies of the data set related to health-related quality of life, special online SF36 Orth toolkit developed by Dr. Cathy Sherbourne

was used. To score the SF-36, scales were standardized by the SF-36v2 scoring software to obtain a score ranging from 0-100. The farmers were categorised into five different sections based upon their scores, poor (0-20), fair (21-40), good (41-60), very good (61-80) and excellent (81-100). The normal distributions were plotted using Pie chart and histogram. The association between nominal variables were analysed using Chi square test. P value < 0.05 was considered as statistically significant.

Bias: Health related quality of life can be better assessed by using sf36 questionnaires before and after pesticide use. In this study HRQOL was assessed only after the use of pesticide.

RESULT

Demographic characteristics A total of 252 participants responded to the questionnaire. Among them, 13 participants were excluded according to the exclusion criteria and a total of 239 participants were taken into the study and further analysed. The demographics are given in (Table 2) all participated subjects were male and majority of them belonged to the age group 30-40 years (33.5%). A total of 34.7% were illiterate, 10.5% were unmarried and drinking alcohol was commonly seen social habits among the subjects. Current, farmers were not having any past medical history and family history of illness.

Agricultural profile of study subjects Out of 239 farmers, 111 of them were having more than 2 acres of land and 162 (67.8%) members cultivated paddy alone. Majority of them were using pesticide in solid state (n=237) and liquid state (n=229) and approximately 112 farmers stated increase use of pesticide compared to previous year. The active ingredient most commonly used by farmers were belong to moderately hazardous (n=136), acute hazardous(n=134), slightly hazardous (n=62) and highly hazardous(n=54).

Evaluation of farmers knowledge Among 239 participants, (n=76) farmers didn't even know the names of the pesticides which they were using, they only recognize pesticides by container colour. (n=139) farmers know the names but not particular use and hardly (n=24) members knew about pesticides name and their particular uses in crop cultivation but not about adverse effect after the use of pesticides. On evaluation of safe handling of pesticides as shown in (Figure c) it observed that majority of the farmers were handling pesticide according to the guidelines while purchasing (n=203), storing (n=232), carrying (n=237), selecting equipment's(n=216), spraying solution(n=231) and after spraying the pesticides(n=208). **farmers behaviour while preparing the spray solutions were inadequate (n=132).** For response to acceptance of pesticide as a hazard 35.6% farmers strongly agreed, 46% just agreed, 34% disagreed and 10 % farmers not gave any response.

Occupation injuries A wide verity of occupational injuries were reported after pesticide use. Most often reported injuries were related to dermal, 43.9% reported skin irritation, 0.8% roughness of skin and 2.5% peeling of skin during and after pesticide use. Sneezing 6.3%, running nose 5% both running nose and sneezing in 0.4%, head ache 1.7%, dizziness0.4%, numbness of hands 6.7%, blurred vision 0.4%, eye irritation 9.2% and burning sensation 2.5%, fatigue 11.3%, body pain 5.9% were also reported. Approximately (n=82) farmers faced more than one types of injuries. However, most farmers reported taking no action fallowing occupational injuries. Only 3 members reported of hospitalizing and 8 members reported of sick leaves after pesticide use.

Health related quality of life When HRQOL were examined after use of pesticide as shown in (Figure d) energy/fatigue was highly affected (farmers lies in excellent category were only 0.8%) and role limitation due to emotional problems were least affected domain (farmers lies in excellent category were 83.3%).

Association of Pesticide Induced Occupational Injuries (PIOI) with age.

1) Out of all the different occupational injuries, **respiratory injuries** were more significantly associated with the **age group 41-50**, with **p value < 0.05**
2) **musculoskeletal injuries** were more associated with the **age group 30-40** with a **p value < 0.05.**

Association of Health-Related Quality of Life with Age

1. Among all the domains of health related quality of life physical functioning , social functioning and overall quality of life were significantly associated with the **age > 40** years with a **p value < 0.001.**
2. Emotional well-being and general health were significantly associated with the **age > 40** with a **p value < 0.01.**
3. The health change in farmers was significantly associated with the **age > 40** with a **p value < 0.05.**

Table 1: Pesticide consumption in India on an annual basis from 2017 to 2022.

YEAR	2017-18	2018-19	2019-20	2020-21	2021-22
PESTICIDE CONSUMPTION	63,406MT	59,669MT	61,701MT	62,193MT	58,720MT

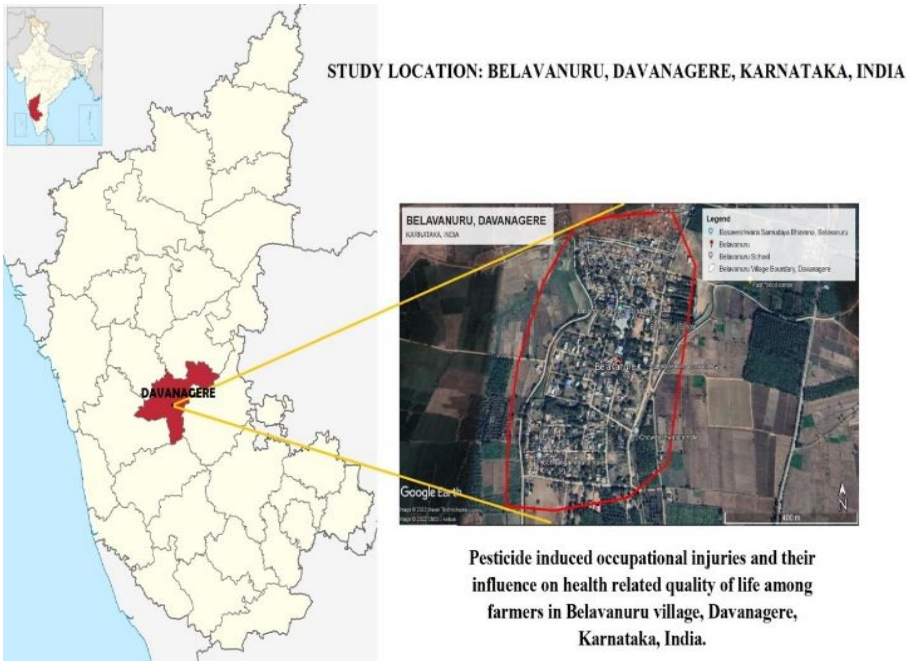

Figure a: Study site.

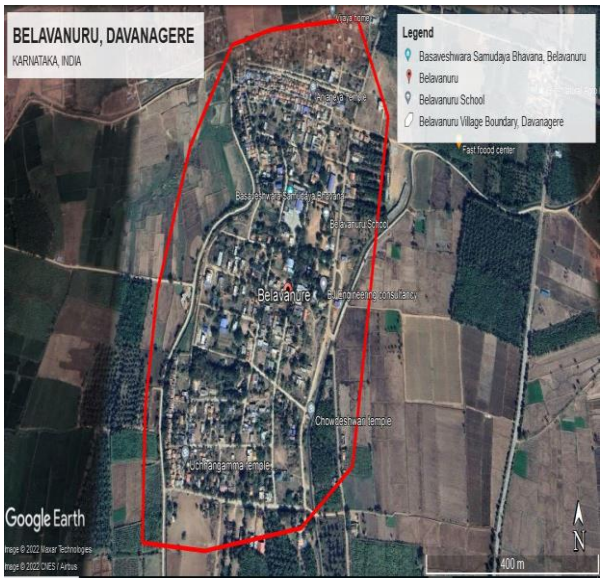

Figure b: Study site.

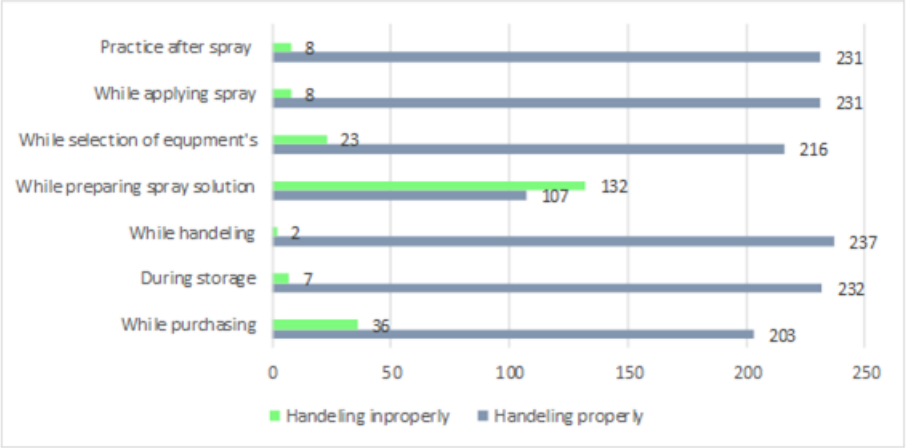

Figure c: Evaluation of Safe Handling of Pesticides.

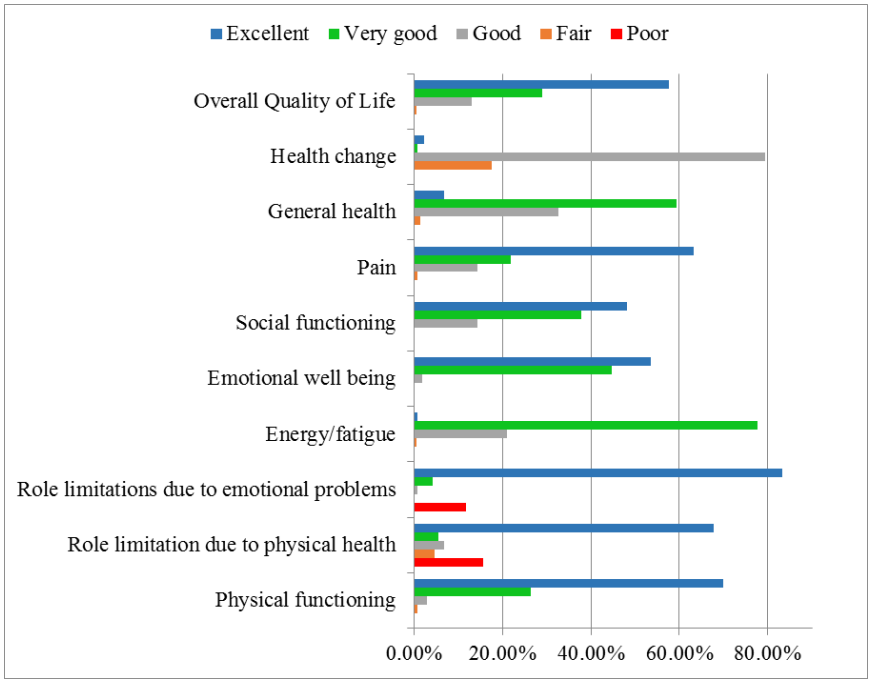

Figure d: Evaluation of HRQOL after use of pesticide.

Table 2: Demographic characteristics of farmers.

A) SECTION 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS	
Demographic	**% (n)**
Age (years)	
30	16.7 (40)
30-40	33.5 (80)
41-50	25.1 (60)
More than 50	24.7 (59)
Gender	
Male	100 (239)
Female	0 (0)
Marital status	
Married	89.5 (214)
Unmarried	10.5 (25)
Family history	
Yes	5.9 (14)
Nil	94.1 (225)
Educational status	
Illiterate	34.7 (83)
Primary school	26.4 (63)
High school	23.0 (55)
University	15.9 (38)
Social habits	
Alcoholism	61.5 (147)
Smoking	31.4 (75)
Chewing tobacco	59 (141)
Medical history	
Yes	15.4 (13)
No	94.6 (226)

DISCUSSION

A number of epidemiological studies have been conducted worldwide on the pesticides induced occupational injuries with different research designs and methods but only few studies were related to the health-related quality of life among farmers. The present community based prospective cross-sectional study was conducted among the farmers of Belavanuru, a small village in Davangere district Karnataka and it elucidates the occupational injuries in pesticide exposed farm

workers and their health-related quality of life after pesticide use.

All the farmers included in the study were male as pesticides were mostly handled manually and requires lot of energy. When educational status was examined, 34.7% famers were illiterate and 26.4 were primary school graduates which hindered the ability of the farmers to read and understand pesticide labelling and most of them stated of buying pesticides based upon other farmers recommendations and advices from the agrochemical vendors which was similar to the study conducted by Gholamhossein Abdollahzedeh et al.[15] In this study 31.8% of the farmers didn't even know the name of the pesticide, 58% were knowing the name but not the uses and10 % were knowing the name and the uses but were unaware of the adverse effects which is comparable to the study conducted by Alhaji I et al[16] where 52% of the respondents didn't even know the name of the pesticide. The reason for this was majority of them were illiterate and they were not educated enough to understand instruction written on the labels.

The farmers in this study majorly cultivated paddy (67.8%), followed by maize, betel nut, sugarcane and vegetables and were having a land area of less than 2 acres which specifies low socioeconomic status of the farmers which indirectly influenced hospital care after pesticide exposure. When the occupational injuries of the farmers were examined, majority of the famers experienced one or other complications like skin irritation (43.9%), roughness of the skin (0.8%) and hardening of skin (2.5%), sneezing (6.3%) and running nose (5%) which simply can be limited by using precautionary measures like using hand gloves, face mask, washing hands after pesticide use which were not observed in the farmers. This might have hampered significant exposure to pesticide and leading to higher prevalence of occupational injuries. Other injuries were numbness of hand (6.7%), headache (1.7%), dizziness (0.4%), fatigue (11.3%) and body pain (5.9%) also observed. These findings were supported by the study conducted by Mustapha F.A. Jallow et al.[13]

Around 22.6 % farmers were using highly hazardous pesticides and 56.9% of the farmers were using moderately hazardous pesticides. Less formal training in potential pesticide handling and more frequency of use of different toxic classes of pesticides was the reason for experiencing more than one type of occupational injuries. In this study It was found that the moderately hazardous pesticides and highly hazardous pesticides were having significant association with the severity of injuries (p value <0.05 and p value <0.001 respectively). It was reported that most of the study subjects relayed on their own knowledge, perceptions ad past experience. During the evaluation of safe handling of pesticides, all the areas of pesticide handling were practiced properly except during the preparation of spray solution. Only 44.8% of the farmers practiced preparation of spray solution properly whereas in the study conducted by Ratna Sapbamrer et al[17] 84.1% people practiced good protective behaviour before, during and after the application of pesticides.

Even though the farmers confronted the occupational injuries, majority of the farmers didn't take sick leave and were not hospitalized, which illuminates the burden of disease due to acute pesticide poisonings were frequently underestimated and neglected by farmers. This finding shows ineffective involvement of government and importance of surveillance in pesticide poisoning area.

When the domains of health-related quality of life was analysed among the farmers who participated, it was noticed that majority (83.3%) of the farmers didn't limit their role due to emotional problems. 69.9% were having excellent physical functioning and 17.6% were having fair health change.57.7% of the farmers were having excellent overall quality of life. In this study an association of health-related quality of life with age, marital status and social habits of the farmers was seen similar to the study conducted by Xiaofang Liu et al[18] which shows association of health-related quality of life influenced by age and marital status.

STRENGTH AND LIMITATIONS

This observational study provides a clear picture of the handling of the pesticides among the farmers. Study and data collection design made it possible to record all self-reported symptoms, and their impact on farmers. Secondly this study strictly assessed adherence of farmer towards guidelines while pesticide handling to evaluate farmers knowledge.

The lack of interest put forward by the farmers acted as a barrier during the face-to-face interview. The information regarding the farmers' experience with the toxic symptoms due to pesticide exposure was insufficient. When asked about the past medical history, its retrospective nature possessed recall bias. The study couldn't meet the required sample size for the data collection. The family history of medical illness acts as cofounding factor.

CONCLUSION

In many developing countries where widespread use of pesticides has emerged as a prevalent trend within agriculture in recent years. There is no doubt that pesticide misuse is a serious threat to the environment as well as to the farmers and ultimately to the public consumers. Farmers are at increased risk of different types of occupational injuries due to consistence exposure and overuse of pesticides. The most common occupational injuries were found to be dermal, respiratory, eye, CNS and musculoskeletal injuries associated with the age, past medical history of illness among and toxicity of the pesticides. According to these results, we need to plan and implement interventions in

order to promote reporting, prevention, control, and treatment of occupational injuries, as well as to increase the safety of farmers' work environments in future. In addition, proper training and management of pesticides can be executed by the Government in order to create awareness among the farmers regarding the safe and effective use of the pesticides. Future work on the basis of various theoretical frameworks and theories like Theory of Planned Behaviour (TPB), Healthy Belief Model (HBM) and Health Action Process Approach (HAPA) would be interesting to further clarify factors influencing safety behaviour in pesticide use. Further studies should also be focused on understanding the reasons behind the associations between sociodemographic factors and HRQOL.

Data availability: The author confirms that the data supporting the findings of this study are available within the article and its supplementary material. Raw data that support the findings of this study are available from the corresponding author, upon responsible request.

ACKNOWLEDGEMENT

We thank all the farmers who participated in this study. We are thankful to our senior Ms. Sinchana Bojamma P. K for all the support and valuable feedbacks. We wish to express our gratitude towards Dr. G L Prabhushankar, Head of the Department, Department of Pharmacy Practice for providing us with all the facilities and encouragement throughout our study. We would like to convey our sincere thanks to our Principal, Dr. A. P. Basavarajappa for guiding us in this study.

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