

Pesticides and Cancer amongst Farmers in Richard-Toll, North of Senegal

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Abstract

Cancer has the most devastating economic impact of any cause of death in the world. Whereas, pesticides represent a potential public health hazard of note in farming communities. In Senegal, the lack of pesticides management data constitutes a major problem. Thus, the aim of this prospective study is to determine cancer frequency amongst farmers in Richard-Toll. A total of 3423 medical records were consulted. A questionnaire has been used for collecting data from Patients' registries presented medical biological diagnosis and/or clinical diagnosis with suspicion of precancerous lesions or invasive cancer. Biostatistics indicators allowed verifying the relationship between pesticides risks exposures and cancer. 263 (7.68%) were suspected to present precancerous lesions or invasive cancer according to the requested analysis. However, 10 medical records were excluded because lack of some data. The remaining shown that 86 (33.99%) of patient analysis were in majority famers, 34 (13.45%) were family member of the CSS personnel employ and 133 (52.57%) were none employed by the CSS. Moreover, the means of age was 52 years with a number of 25 (9.89%) women and 228 (90.11%) men. 19 (7.51%), of 253 medical records suspected, were proved invasive cancer and 15 of them were in the agricultural estate, suggesting that pesticides exposure. Amongst patients who had cancer that's rate of pesticides exposures were 83%, the cancer prevalence were 12%, and were more higher than the others where the cancer prevalence were 2.17%. $X^2 = 9.93$ (significance point = 3.84) and the Q coefficient of Yule test were 0.72. Pesticides utilization can raise 6 times the risk of cancer (Odds Ratio: 6.14). Cancer is frequent amongst famers in Richard-Toll and that's a major problem of public health.

Keywords: Pesticides; Cancer; Farmers; Senegal

Abbreviations: CSS: Senegalese Sugar Company; WHO: World Health Organization; MRL: Maximum Residue Limits; EU: European Union; MSMA: Monosodium Methyl Arsenate.

Introduction

Cancer has the most devastating economic impact of any cause of death in the world [1]. Projections based on the International Agency for Research on Cancer/World Health Organization estimates predict a substantive increase to 19.3 million new cancer cases per year by 2025 [2-4]. Rates of cancers common in Western countries will continue to rise by 2035 in developing countries if preventive measures are not widely applied. It is estimated that more than half of all cancer cases and deaths worldwide are potentially preventable [2,3,5], whereas, chemical pesticides play an important role in improving crop yield in modern agriculture [6]. Indiscriminate use of pesticides in farming is an emerging problem resulting in increasing health and environmental risks in developing countries. In many parts of Sub-Saharan Africa, usage is on the increase. Pesticides represent a potential public health hazard of note in farming communities. Despite such a growing evidence base, pesticides remain the preferred method of pest control in agriculture worldwide [7]. However, many nations lack common pesticide maximum residue limits (MRLs) in many commonly consumed foods and other human exposure pathways, such as soil, water, and air were not considered [8].

Senegalese farming used annually a means estimate of 1,900 tons of pesticides with maximum until close to 3000 tons of pesticides. Laws were been fixed to exert a strict control in this field [9]. Pesticides importations in Senegal were done with 2 channels; the state channel which makes generally by the state structures, by the agricultural development societies. And none state channel that represent the agro-pharmaceutical firms, the privacy consumer or distributor societies of pesticides, and the agro-industrial societies as Senegalese sugar company (CSS) [10]. However, pesticides importation circuit didn't be under control; thus, the total quantity imported was not known. This situation was encouraged by the big border permeability, by the many weekly local markets, by the population ignorance to the extremely dangerous active products and the easy accessibility of these products in comparison to the authorized pesticides. The lack of pesticides management data (importation, consumption...) constitutes a major problem [11]. More than 300 commercial specialties were present or used versus 200 authorized by the permanent comity inter-state of fight against drought in the Sahel (CILSS).

These 300 specialties have been interested by close to 80 actives matters. Thus, among 10 most threat pesticides on reproduction and development, 3 were used in Senegal (Benomyl, Myclobutanil and Thiophanate-methyl). Among 10 pesticides of acute blood poisoning, 5 were used in Senegal (1, 3 Dichloropropene, Paraquat Dichloride, Methomyl, Aldicarbe and Methamidophos). Among 10 most carcinogenic pesticides, 7 were used in Senegal (1, 3 Dichloropropene, Manebe, Diuron, Chlorothalonil, Mancozebe, Iprodione and Metamsodium). Among 10 pesticides most inhibitor of the cholinesterase, 5 were used in Senegal (Chlorpyrifos, Diazinon, Methomyl, Malathion, and Aldicarbe). Among 10 most pesticides that contaminate the water table, 5 were used in Senegal (Diuron, Aldicarbe, Metolachlore, Hexazinone and Atrazine [12].

Unfortunately, few information were available, in Africa generally and particularly in Senegal, about the implementation of these products in carcinogenesis. Thus, the aim of this prospective study is to determine cancer frequency with biostatistics indicators amongst farmers in Richard-Toll according to the medical records provided.

Materials and Methods

Study population

Richard-Toll is a town in the department of Dagana in the region of Saint-Louis (North of Senegal). It is built in a border of the Senegal River. In 2007, according to the official estimation, the number of population was 48,968 persons [13]. Most of the professional activities were around agriculture. Sugar cane and rice were the most important agricultural products. Thus, the Senegalese sugar company (CSS) employed close to 10,000 seasonal personnel each year. However, a few traditional farming were also done in some zones.

The evaluation of Human pesticides exposure consist, in one site to produce descriptive data on peoples as ages, sex, physiologic characteristics, pathologies, sensitivity..., and the penetration of toxics agents pathways. In another site, frequency quantified, duration and the intensity of pesticides exposure by the daily means proportion. A questionnaire of two pages has been used for collecting data from medical records provided. Patients' registries, which have been consulted in CSS medical laboratory in 2006-2011, were putted on our disposition. All information of medical records has been taken. That's contained some information as ages of the patient, the sex, the number of the patient (for the personnel employ by the CSS) and the medical diagnosis requested. All medical records presented medical biological diagnosis and/or

clinical diagnosis with suspicion of precancerous lesions or invasive cancer were considered, as the principal biomarkers PSA, CA 125, CA 19.9 and AFP, respectively for diagnosing Prostate, Ovary cancer, Pancreas cancer and Liver cancer. Others biomarkers appeared rarely, T4 N0 M0, beta HCG, gamma GT and CA 15.3, respectively for diagnosing Maxillary sinus, ovary cancer, Liver and Breast cancer. Some Anatomy-pathologic diagnostic of Skin, Lung and Stomach were noted. After medical records analysis, we took data about kind of pesticides used in CSS in 2004-2012.

Results

Years	Number of Diagnosis patients	Suspected cancer cases	% of Suspected cancer cases
2006	644	44	6.83%
2007	413	21	5.08%
2008	578	57	9.86%
2009	799	54	6.76%
2010	618	53	8.58%
2011	371	34	9.16%
Total	3423	263	7.68%

Table 1: Number of diagnosis patients by register in 2006-2011.

The number of total consultations in the CSS laboratory was close to 278,400. However, the number of personnel employ consultations of the CSS was close to 244,800 and the number of consultations none employed by the CSS was close to 33,600.

The number of total medical records consulted was 3423. Of them, 263 (7.68%) were suspected to present precancerous lesions or invasive cancer according to the

Statistical analysis

Pesticides exposure levels were established on professional activity sectors. Biostatistics indicators allowed to verify the relationship between pesticides risks exposures and cancer (X^2 test), to measure the intensity of the link between cancer and pesticides exposures (Q coefficient of Yule test), and the evaluation of cancer frequency relative risk amongst agricultural workers (Odds ratio). The *Student t test* had permit when necessary to compare the value between different groups.

requested analysis. However, 10 medical records were excluded because lack of some data. The 253 remaining shown that 86 (33.99%) of patient analysis were CSS personnel employ and suggesting in majority famers. 34 (13.45%) were family member of the CSS personnel employ and 133 (52.57%) were none employed by the CSS. Moreover, the means of age was 52 years with a number of 25 (9.89%) women and 228 (90.11%) men.

Diagnosis	Type of lesions	Suspected cancer cases		Proved cancer cases		Proved/ Suspected	Death cases/ Proved cases	
		Nbr	%	Nbr	%	%	Nbr	%
PSA	Prostate	139	54.94	7	36.84	5.03	1	14.59
CA.125	Ovary	16	6.32	1	5.26	6.25	0	0
CA.19.9	Pancreas	7	2.77	1	5.26	14.29	0	0
AFP/Echography	Liver	47	18.58	5	26.32	10.63	4	80
Others*	Others**	44	17.39	5	26.32	11.36	2	40
Total		253	7.39	19	0.55	7.51	7	36.84

*Ag HBs, CA 15.3, B HCG, gamma GT, T4 N0 M0; **Breast, Maxillary sinus, Skin, Lung, Stomach

Table 2: Suspected and Proved cancer cases in 2006-2011.

19 (7.51%), of 253 medical records suspected, were proved invasive cancer and 15 of them were in the agricultural estate, suggesting that pesticides exposure.

The relationship between pesticides risks exposures and cancer indicated $X^2 = 9.93$ (significance point = 3.84). That's showed the existing link between pesticides exposures and cancer risks. Also, the relationship intensity between pesticides exposures and cancer were

very strong as showed by the Q coefficient of Yule test that were 0.72. Amongst patients who had cancer that's rate of pesticides exposures were 83%, the cancer prevalence were 12%, and were more higher than the others where the cancer prevalence were 2.17%. Our study revealed that pesticides utilization can raise 6 times the risk of cancer (Odds Ratio: 6.14).

Discussion

There were more men than women because in Richard-Toll, famers were principally men. It's a prospective study that's take account only the medical records. Some of them were incomplete and were the origin of exclusion, by the lack of evidence biological data and/or echographic, by the insufficient clinical information. This work doesn't represent the general population. Methods sideway as recruitment linked or information collect can be happen. However, this work has permitted to raise important facts going to the problematic sense.

Epidemiologic particularities

Our results show that cancer was frequent in Richard-Toll zone (7.51%). In comparison with Senegal cancer epidemiology from Globocan 2008, some cancers were more represented. In Senegal, according to the International Agency for Research on Cancer, the most frequent cancers were cervical cancer (18%), liver cancer (15.8%), breast cancer (12.8%), and the prostate (5.4%) [14]. These results contrast with our work. In Richard-Toll, the most suspected cancers were the most frequent cancers, with prostate (36.84%), liver cancer (26.32%), ovary cancer and pancreas (5.26%) each one. However, in European continent, amongst famers, the most frequent cancers were hematologic, prostate, brain, lip and skin [15]. The high number of prostate cancer can be explained by the use of Malathion. A new evaluation of the International Agency for Research on Cancer has classified that as a probable carcinogenic to humans (Group 2A), and positive associations have been observed with non-Hodgkin lymphoma and cancer of the prostate [16].

Risk factors

Positive associations have been observed between pesticides and many diseases as cancer [17-23]. Some of them are classified by the International Agency for Research on Cancer as carcinogenic to humans (Group 1), probable carcinogenic to humans (Group 2A) and possible carcinogenic to humans (Group 2B) [16,24,25]. While, the number and identity of substances composing environmental mixtures such as waste water treatment plant effluents is typically unknown [26]. The major risk factor found is the pesticides exposure. The proved cancer

cases were aged around 52 +/- 2 years, with a major of men (90.11%) that's resulting to the high rate of prostate cancer. Generally, they were famers or agricultural civil servant. The women were low represented (9.89%). Most of them were famers. 15 of 19 proved cancer cases were in agricultural estate and were highly or moderate exposure to pesticides. Among pesticides used in CSS in 2004, many of them are classed carcinogenic to humans [16,24,25]. Senegal has ratified many international accords about pesticides management and that's inducing many radical suppression since 2009 [9,11]. Despite the highlight data, MSMA (Group 1), which is classed as carcinogenic to humans, continued to be used in Senegal in 2012. Farmers often did not adopt the appropriate safety measures when handling pesticides sighting the constrained perceived barriers, such as feeling uncomfortable and the unavailability of safety measures [27]. Also, the cause of late onset Parkinson's disease remains unknown. Evidence suggested that lifelong exposure to pesticides might contribute to the development of neurodegenerative diseases, but the results were controversial. However, the 5 and 10 years of duration pesticide exposure were associated with a 5% and 11% augment in the risk of Parkinson's disease [28]. Accumulating evidence indicates that some pesticides used in agriculture act as hormone disrupters, with the potential to result in chronic health effects [7]. Nevertheless, a total of 114 nations (58% of the total nations in the world) and two international organizations, including the European Union (EU) and Codex (WHO) have regulated at least one of the most currently used pesticides in at least one of the most consumed agricultural commodities. It was concluded that unifying strict pesticide maximum residue limits (MRLs) by nations worldwide could significantly skew the distribution of the computed pesticide TMDI values to the right, lower the legal exposure to pesticide, and effectively control human health risks [8].

Conclusion

Cancer is frequent in Richard-Toll zone. The means of age was 52 years and generally pesticides exposure that are classed carcinogenic to humans (Group 1), probable carcinogenic to humans (Group 2A) and possible carcinogenic to humans (Group 2B), by the International Agency for Research on Cancer/World Health Organization. The follow patient medical records were incomplete. Some patients were lost before the biological analysis. It seem evident that genetic play a role in the happening of cancer. Also, viruses, microorganisms, behavior and diet factors don't be neglected. Cancer is frequent amongst famers in Richard-Toll and that's a major problem of public health. Our study revealed that pesticides utilization can raise 6 times the risk of cancer.

Dangerous pesticides for human health must be abandoned and the reduction of pesticides use would play an important role in food safety and environmental safety in agricultural sector. Training and awareness programs addressing safe handling practices and safety measures as well as education concerning the long-term risks of pesticide exposure on health and the environment, through radio, television and posters, may improve the safety behavior of farmers and retailers. However, precise studies must be taken for determining the role of pesticides in carcinogenesis, by samples for biological analysis.

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