Occupational Diseases and Environmental Medicine, 2025, 13(4), 241-269
https://www.scirp.org/journal/odem
ISSN Online: 2333-357X
ISSN Print: 2333-3561

Long-Term Morbidity among Medical Imaging Workers in Republic of Benin through a Retrospective Cohort Study from 1972 to 2019

Ibrahim Mama Cissé[1*], Alfred Arnaud Gbétchédji[2], Cocou Hubert Hounsossou[3], Daniel Sabi Takou[4], Ahotondji Bertin Gbaguidi[4], Marc Comlan Thierry Médéhouénou[4], Sako Alphonse Avocèfohoun[4], Daton Médénou[4], Sètchéou Rodrigue Allodji[2]

[1]Faculty of Medicine, University of Parakou, Parakou, Benin
[2]National Institute of Health and Medical Research, Radiation Epidemiology Team, Villejuif, France
[3]Gustave Roussy Institute, Department of Clinical Research, Radiation Epidemiology Team, Villejuif, France
[4]Polytechnic School of Abomey-Calavi, University of Abomey-Calavi, Cotonou, Benin
Email: *onjourna@gmail.com, galfredarnaud@yahoo.fr, hchube1963@gmail.com, sabitakoudaniel11@gmail.com, bgbaguidi2001@yahoo.fr, tcm.medehouenou@gmail.com, alsakoav@gmail.com, medenou@yahoo.com, daton.medenou@epac.uac.bj, Rodrigue.ALLODJI@gustaveroussy.fr

How to cite this paper: Mama Cissé, I., Gbétchédji, A.A., Hounsossou, C.H., Sabi Takou, D., Gbaguidi, A.B., Médéhouénou, M.C.T., Avocèfohoun, S.A., Médénou, D. and Allodji, S.R. (2025) Long-Term Morbidity among Medical Imaging Workers in Republic of Benin through a Retrospective Cohort Study from 1972 to 2019. *Occupational Diseases and Environmental Medicine*, **13**, 241-269.
https://doi.org/10.4236/odem.2025.134017

Received: July 5, 2025
Accepted: October 31, 2025
Published: November 3, 2025

Abstract

Introduction: A large number of studies indicated that ionizing radiation exposure is a risk factor for some cancers and non-cancer diseases. However, hypothesis supported by the literature of knowing whether protracted exposure to external ionizing radiation like in radiology services could induce other cancers and non-cancers diseases is unclear. The aim of this study was to assess the long-term morbidity among medical X-ray workers in Republic of Benin, from 1972 to 2019. **Methods:** Exposed (335) and unexposed workers (193), first employed between 1972 and 2019 were included in a cohort study in 2019 at Republic of Benin. Information on morbidity, personal and medical history, lifestyle, and socio-professional characteristics was retrieved from self-reported data. Spearman and Chi-square test were used to analyze the distribution of demographic characteristics in cohort. Cox proportional hazards regression was used to estimate hazard ratios (HRs) for the development of eye diseases (ED) and skin mass, adjusting for age, sex, smoking, alcohol drinking, occupational time, and year of employment. **Results:** The exposed workers had a higher risk of occurrence of ED and skin mass with the adjusted HRs (aHR) of 2.3 (95% CI = 1.4 - 3.9) and 3.3 (95% CI = 1.2 - 12.7) respectively, after adjusting for relevant variables. Heavy alcohol drinking had an increased risk of skin mass compared to those who did not drink (aHR, 7.6;

95% CI = 2.2 - 22.5). **Conclusion:** Association between radiation exposure and ED and skin mass was significant. Radiation exposure on the skin mass formation provides a basis for further studies.

Keywords

Morbidity, Long Term, Medical Imaging Professionals, X-Ray, Benin

1. Introduction

Overall, there are over 2.3 million medical radiation workers, and during half of their work time they are exposed to human-made sources of low-dose radiation [1]. Radiologists and radiotherapists were one of the earliest occupational groups to be exposed to external radiation, according to Berrington [2]. This external radiation is the cause of some health effects. The health effects of acute, moderate to high radiation doses are well characterized [3], and detailed in the basis of data from the Japanese atomic bomb survivors and for patients treated with radiotherapy [4]. But according to study carried out by [5] Azizova *et al.*, the risk estimates remain unclear for prolonged exposure at low dose rates (Azizova *et al.* 2018), as medical workers. In additional, uncertainties persist regarding quantification of risks of adverse events associated with protracted exposure to low doses at low dose rates of radiation, which are typically encountered in environmental and occupational settings [6]. Within radiology, occupational health and safety are important issues because of the very large number of exposed workers [7]. Few studies non cancer diseases hazards of human induced by low radiation doses, had been summarized by UNSCEAR [8] and other authors [9]. However, there is an association between exposure to ionizing radiation and health events such as cataracts [10] and opacities of the lens [11].

In Africa, they are a limited number of epidemiology studies about effect's radiation ionizing among medical workers. Maalej [12] in Tunisia, carried out studies which showed radio-induced late effects with exposures at ionizing radiation doses, such as squamous cell carcinoma. In Republic of Benin, the only article found was this of Dossou *et al.* [13] which concluded an increasing of chromosome aberrations in different shapes from radiographers in medical imaging centres. Therefore, knowledge about the long term effects of ionizing radiation among medical workers in Republic of Benin is not yet fully-explored.

The present study aimed to assess long term morbidity among radiology medical workers in Republic of Benin.

2. Methods

2.1. Population

The study population from private and public centres included 335 medical X-ray workers and a group of 193 medical workers from twelve (12) departments of Be-

nin, not exposed to X-ray equipment employed at the same centre, who worked in Republic of Benin between 1972 and 2019 (47 years) and were born between 1937 and 1997. The list of centers private and public was obtained from the Ministry of Health.

2.2. Design Process Description of Data Collection

The present retrospective cohort study, exposed and non-exposed, was based on self-reported questionnaires and required contact with members of the cohort. Republic of Benin's health system does not take into account universal health insurance for all citizens. Therefore, health information was not available in a searchable file health insurance. A list with contacts had been withdrawn from professional associations (radiologists, radiographers…) for exposed workers. But, for unexposed workers, questionnaires were administered to those who were present at the time of the survey. The survey was carried out in 2019 and collected 81.96% (250/305) and 87.34% (345/395) response rates out of 305 and 395 questionnaires administered (**Figure 1**) to unexposed and exposed workers, respectively. The questionnaire included some information as sociodemographic characteristics, number of children, such as described at Online Resource B. The questionnaire had been validated by an occupational physician and based on feedback from past studies [14]. The investigation standards have been elaborated to unify and facilitate the data collected.

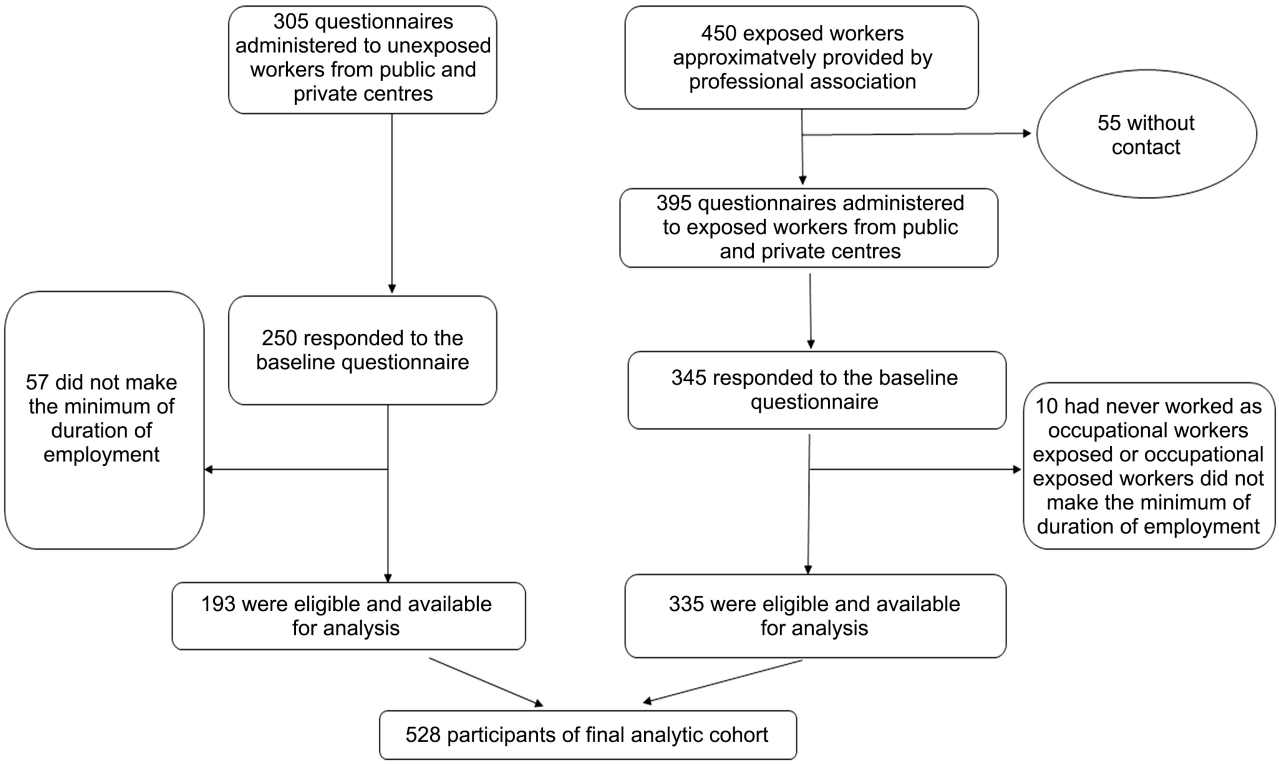

Figure 1. Flowchart selection process (Inclusions and exclusions in the analytic cohort) of study's subject for risk of disorders, in Benin, 1972-2019.

A retrospective cohort study involving healthcare workers was conducted in 12 departments of Republic of Benin. It is composed to radiologists, radiographers and physicians assistants at diagnostic radiology for exposed workers; and physicians, physician assistants at others services and administrative workers for unexposed workers. Telephone consultations were carried out with healthcare workers who had already left the national territory at the time of the survey. The minimum of duration of employment to be included in study was one year [15] [16]. In order to be an eligible disease case, the disease must be declared after the first employment as occupational exposed workers or occupational unexposed workers. The study cohort included all alive occupational exposed workers of the medical imaging departments of Republic of Benin. In all, 10 occupational exposed workers and 57 occupational unexposed workers were excluded because the occupational exposed workers did not make the minimum of duration of employment which was one year (**Figure 1**). The final subject cohort was comprised of 528 participants including 335 occupational exposed workers and 193 occupational unexposed workers. The retrospective cohort follow-up started with a date at first employment at the establishment and continued till the dates of survey.

2.3. Exposure Definition, Outcome

The subjects included in the study were divided into two groups—the group exposed to ionizing radiation in diagnostic radiology rooms and the group not exposed to ionizing radiation who work in workplace outside diagnostic radiology rooms. The dependant variables of interest (diseases of the eye and other disorders of skin and subcutaneous tissue) were extracted from the datasets by considering those which were the most representative (Online Resource A, **Table A1** and **Table A2**, Supplementary Information). All diseases of the eye and other disorders of subcutaneous tissue or skin mass were retrospectively coded according to the International Classification of Diseases tenth revision (ICD-10) [17].

2.4. Confounding Factors

Several factors were considered as potential confounders which were defined and included in questionnaires (in Online Resource B). Age at initial year of employment was categorized into less than 25 years old, 26 - 30 years and 31-year and over, considering the interquartile range. Smoking (yes/no) and alcohol drinking (none, 1 drink per week, moderate, 1 - 10 drinks per week, high, >10 drinks per week) status [15] were considered given previous evidence of associations with different diseases. The different questions related to confounding factors were developed in questionnaire (in Online Resource B).

2.5. Statistical Analysis

Data were entered by double-entry in Epiinfo version 3.5.4. The data collected were analyzed using SAS® version 9.4. Number and percentage were used to summarize the sociodemographic data for descriptive statistics of exposed or unex-

posed group. Chi-square tests were used to compare the differences between each group. Bilateral tests were carried out, and a p-value ≤ 0.05 was considered statistically significant. We also estimated the cumulative incidence of morbidities selected (diseases of the eye and skin mass) using follow-up as the timescale and presented Hazard ratio's (HR) and 95% Confidence Intervals (CI) calculated from crude and multivariable Cox model. Maximum likelihood test was used to obtain parameter estimates for cox regression. Left truncation was carried out by only including subjects who entered the study after occurrence of eye diseases and/or skin mass. Multivariable models with lower Akaike's information criterion (AIC) and higher concordance statistic were preferred. The multivariable model was carried out adjusted for age at initial year of employment, year of first employment, sex, smoking and alcohol consumption using Akaike's information criterion (AIC).

2.6. Ethical Consideration

The study was reviewed and approved by Research Ethics Committee of the Institute of Applied Biomedical Sciences (CER-ISBA) in Republic of Benin. The informed consent of occupational exposed workers or occupational unexposed workers was requested and obtained before administering the questionnaires.

Respondents were assured of their information and confidentiality, and they were informed of their right to withdraw from the study at any time.

3. Results

3.1. Characteristics Demographic

The characteristics of the exposed workers and the unexposed worker group are described in Table 1. The mean age at initial year of employment of the exposed workers was 26 years (range, 21 - 46 years) (Table 1), and 59.7 % were female. In the unexposed workers, the mean age at initial year of employment was 28 years (range, 19 - 46 years) (Table 1), and 53.9 % were female. Age at initial year of employment ($p < 0.0001$) was significantly different between exposed and unexposed workers.

Table 1. Characteristics of the study population at the time of the baseline questionnaire, 1972-2019.

Variables	Exposed n (%)	Unexposed n (%)	p-values*
Status	335 (100.0)	193 (100.0)	-
Sex			
Male	135 (40.3)	89 (46.1)	*0.19*
Female	200 (59.7)	104 (53.9)	

Continued

Subgroup age at initial year of employment (years)			
≤25	233 (69.6)	75 (38.9)	
26 - 30	54 (16.1)	53 (27.5)	***<0.0001***
≥31	48 (14.3)	65 (33.7)	
Smoking			
No	330 (98.5)	192 (99.5)	*0.42*
Yes	5 (1.5)	1 (0.5)	
Alcohol drinking			
None	218 (65.1)	142 (73.6)	
Moderate	109 (32.5)	50 (25.9)	*0.06*
High	8 (2.4)	1 (0.5)	
No. of years of work as exposed or unexposed worker (years)			
≤1	119 (35.5)	72 (37.3)	
2 - 6	127 (37.9)	85 (44.0)	*0.10*
≥7	89 (26.6)	36 (18.7)	
Having Holidays during a career			
No	161 (48.1)	104 (53.9)	*0.21*
Yes	174 (51.9)	89 (46.1)	
Period of year of first employment (years)			
≤2007	99 (29.6)	47 (24.4)	
2008-2016	157 (46.9)	97 (50.2)	*0.44*
≥2017	79 (23.6)	49 (25.4)	
	Mean (min-max)	Mean (min-max)	p-value**s****
Mean age at initial year of employment (years)	26 (21 - 46)	28 (19 - 46)	***<0.0001***
Male	25 (21 - 41)	27 (19 - 46)	***<0.0001***
Female	26 (21 - 46)	29 (19 - 44)	***<0.0001***
Mean of years of work as exposed or unexposed worker (years)	5.2 (1 - 30)	4.2 (1 - 22)	*0.03*
Mean of year of first employment (years)	2009 (1972-2018)	2011 (1972-2019)	*0.22*

*From Chi-2 tests. **from Spearman test.

3.2. Outcome

Based on one questionnaire, 186 health events have been declared by 113 (21.4%) workers (in Online Resource A, Table A1, Supplementary Information). The predominant ailments were eye diseases (100/186) and skin mass or subcutaneous mass (26/186) (in Online Resource A, Table A2, Supplementary Information). The proportion of eye diseases (p = 0.02) and skin mass (p = 0.01) were significantly different between exposed and unexposed workers (Table 2). Four cases of cataracts have been reported among eye diseases (in Online Resource A, Table A2, Supplementary Information).

A total of 84 and 26 cases of diseases of the eye and skin mass (Table 3) were identified after a median follow-up of six years for the both, [interquartile range (IQR) 2 - 11] and [IQR, 3 - 12], respectively (Table 2). The median follow-up in cases only was eight (08) years [(IQR) 2 - 13] and eight and half (8.5) [(IQR) 4 - 12] for eye diseases and skin mass respectively (Table 3).

Table 2. Survival characteristic and summary of most representative diseases developed by exposed (n = 335) and unexposed (n = 193) group in the study population at the time of the baseline questionnaire, 1972-2019.

Outcomes (Diseases)	Exposed n (%)	Unexposed n (%)	p-values*	Follow up Median (IQR) Years
Diseases of the eye and adnexa (ICD-10 classification)				6 (2 - 11)
No	272 (81.2)	172 (89.1)	*0.02*	
Yes	63 (18.8)	21 (10.9)		
Skin mass				6 (3 - 12)
No	312 (93.1)	190 (98.5)	*0.01*	
Yes	23 (6.9)	3 (1.5)		

*From Chi-2 tests; skin mass = Other disorders of skin and subcutaneous tissue related to radiation according to ICD-10 classification.

Table 3. Diseases of the eye and adnexa and skin mass outcome of the study population at the time of the baseline questionnaire, 1972-2019.

Variables	Whole cohort	Retained health events	
		Diseases of the eye and adnexa	Skin mass
All	528	84	26
Age attained (years) (mean, min; max)	-	36.7 (22 - 66)	36.4 (25 - 57)
Median follow up for cases (years) (median, IQR)	-	8 (2 - 13)	8.5 (4 - 12)

Continued

	n (%)	n (%)	n (%)
Sex			
Male	224 (42.4)	33 (39.3)	5 (19.2)
Female	304 (57.6)	51 (60.7)	21 (80.8)
Subgroup age at initial year of employment (years)			
≤25	308 (58.3)	42 (50)	15 (57.7)
26 - 30	107 (20.3)	19 (22.6)	3 (11.5)
≥31	113 (21.4)	23 (27.4)	8 (30.8)
Smoking			
No	522 (98.9)	82 (97.6)	24 (92.3)
Yes	6 (1.1)	2 (2.4)	2 (7.7)
Alcohol drinking			
None	360 (68.2)	47 (55.9)	11 (42.3)
Moderate	159 (30.1)	33 (39.3)	11 (42.3)
High	9 (1.7)	4 (4.8)	4 (15.4)
No. of years of work as exposed or unexposed worker (years)			
≤1	191 (36.2)	27 (32.1)	3 (11.5)
2 - 6	212 (40.2)	26 (31)	10 (38.5)
≥7	125 (23.7)	31 (36.9)	13 (50)
Having Holidays during a career			
No	265 (50.2)	35 (41.7)	10 (38.5)
Yes	263 (49.8)	49 (58.3)	16 (61.5)
Period of year of first employment (years)			
≤2007	146 (27.7)	46 (54.7)	17 (65.4)
2008-2016	254 (48.1)	29 (34.5)	8 (30.8)
≥2017	128 (24.2)	9 (10.7)	1 (3.8)

% = n/all; skin mass = other disorders of skin and subcutaneous tissue related to radiation according to ICD-10 classification.

3.3. Cumulative Incidences and Risk Factors for Diseases of the Eye

Cumulative incidences of diseases of the eye in the whole cohort and by change in exposure status were shown (Figure 2(a) and Figure 2(b)). The overall cumula-

tive incidence at the 7 years of follow-up after the initial year of employment was 9.9 % (95% CI 7.3 to 13.3) (**Figure 2(a)**) and exposed workers were at a higher risk of developing diseases of the eye at the 7 years of follow-up after the initial year of employment the cumulative incidence was 12.2 % (95% CI 8.7 to 16.9) while for unexposed workers, this was 5.9 % (95% CI 3.0 to 11.4) (**Figure 2(b)**). Unadjusted and adjusted Hazards Ratio (HRs) and 95% Confidence Intervals (CIs) of eye diseases are shown in **Figure 3**. From univariable models, we found that, exposed workers had a significant risk of eye diseases (HR, 1.9 [95% CI, 1.2, 3.2]), compared to unexposed workers. Compared to workers who have started working before 2007, workers who have started working from 2017 (HR, 3.1 [95% CI, 1.2, 7.9]) had a high risk of eye diseases. The stratified analysis among exposed workers revealed a risk of eye diseases that was significantly increased for workers of Oueme-plateau departments (HR, 3.1 [95% CI, 1.3, 8.9]) and Atlantique-littoral (HR, 3.4 [95% CI, 1.5, 9.3]) (in Online Resource A, **Table A3**, Supplementary Information).

After adjustment for sex, age at initial year of employment, alcohol drinking, year of first employment, departments of Republic of Benin the risks of occurrence of eye diseases were statistically significant increased for exposed workers (HR, 2.3 [95% CI, 1.4, 3.9]) and for workers who have started working after 2017 (HR, 3.5 [95% CI, 1.3, 9.1]). While the reduced risk of eye diseases was borderline significant for sex (P = 0.058). Sensitivity of analysis carried out with as time scale age attained revealed association between eye diseases and ionizing radiation exposure (HR, 2.5 [95% CI, 1.5, 4.3]) after adjustment for sex, age at initial year of employment, alcohol drinking, year of first employment, departments of Republic of Benin (in Online Resource A, **Table A4** and **Table A5**, Supplementary Information).

3.4. Cumulative Incidences and Risk Factors for Skin Mass

Cumulative incidences of skin mass in the whole cohort and by change in exposure status were shown (**Figure 4(a)** and **Figure 4(b)**). The overall cumulative incidence at the 4 years of follow-up after the initial year of employment was 1.8% (95% CI 0.9 to 3.7) (**Figure 4(a)**) and exposed workers were at a higher risk of developing skin mass at the 4 years of follow-up after the initial year of employment the cumulative incidence was 2.1 % (95% CI 0.9 to 5.0) while for unexposed workers, this was 1.2 % (95% CI 0.3 to 5.0) (**Figure 4(b)**). As for diseases of the eye, unadjusted and adjusted HRs, and 95% CIs of skin mass are shown in **Figure 5**. From univariable models, we found that, exposed workers had a significant risk of occurrence of skin mass (HR, 3.8 [95% CI, 1.4 - 14.2]) and heavy taking drinks of alcohol (HR, 8.6 [95% CI, 2.6 - 24.4]) increases also significantly the risk of occurrence of skin mass (**Figure 5(a)**). After adjustment for sex, age at initial year of employment, alcohol drinking, year of first employment, departments of Republic of Benin, the risks of occurrence of skin mass were statistically significant increased for exposed workers (HR, 3.3 [95% CI, 1.2, 12.7]) and for workers who took heavy alcohol (HR, 7.6 [95% CI, 2.2 - 22.5]) (**Figure 5(b)**).

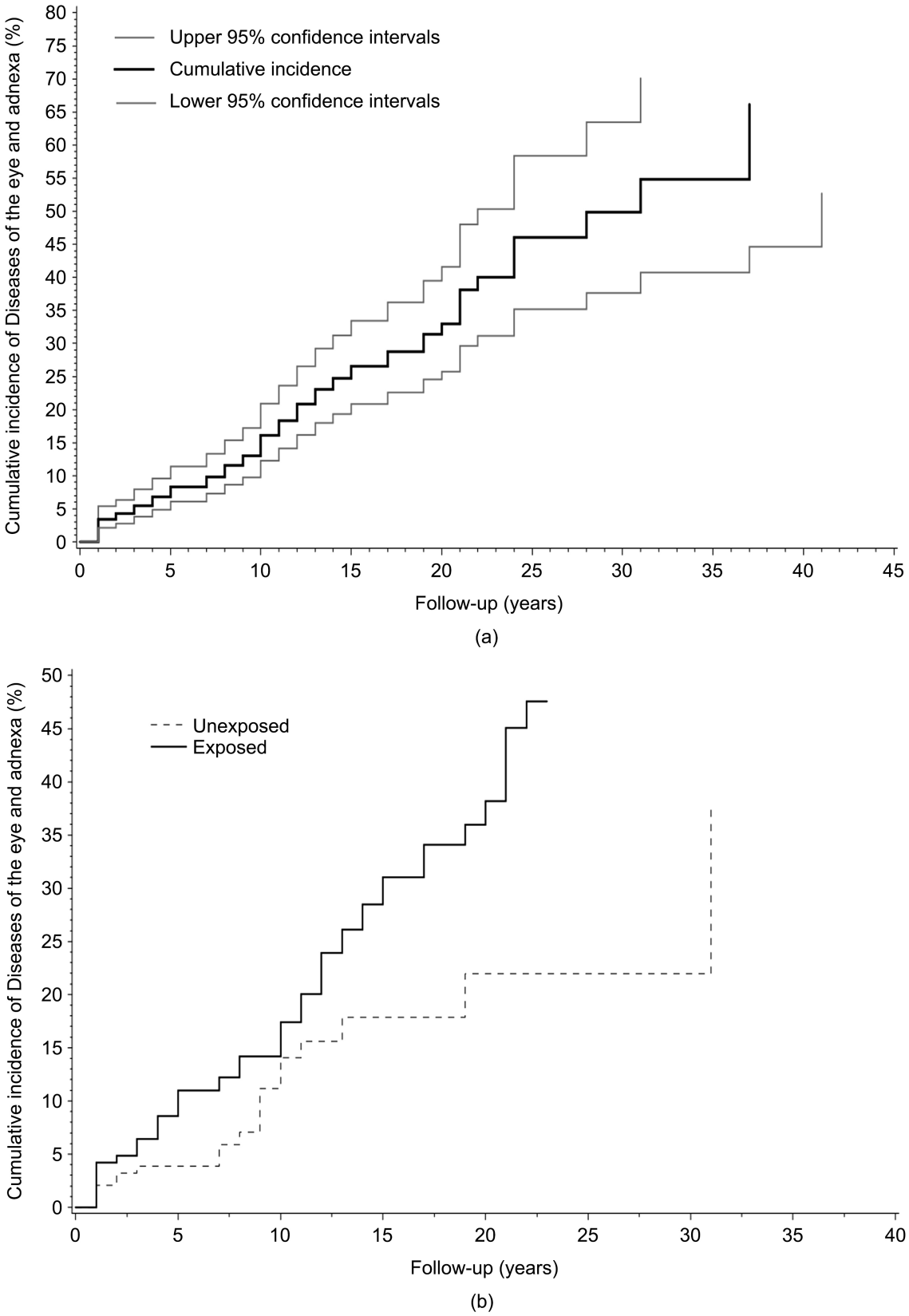

Figure 2. The cumulative incidence curves of diseases of the eye and adnexa (a) in cohort (exposed and unexposed) and stratified by exposure status (b) between 1972 and 2019.

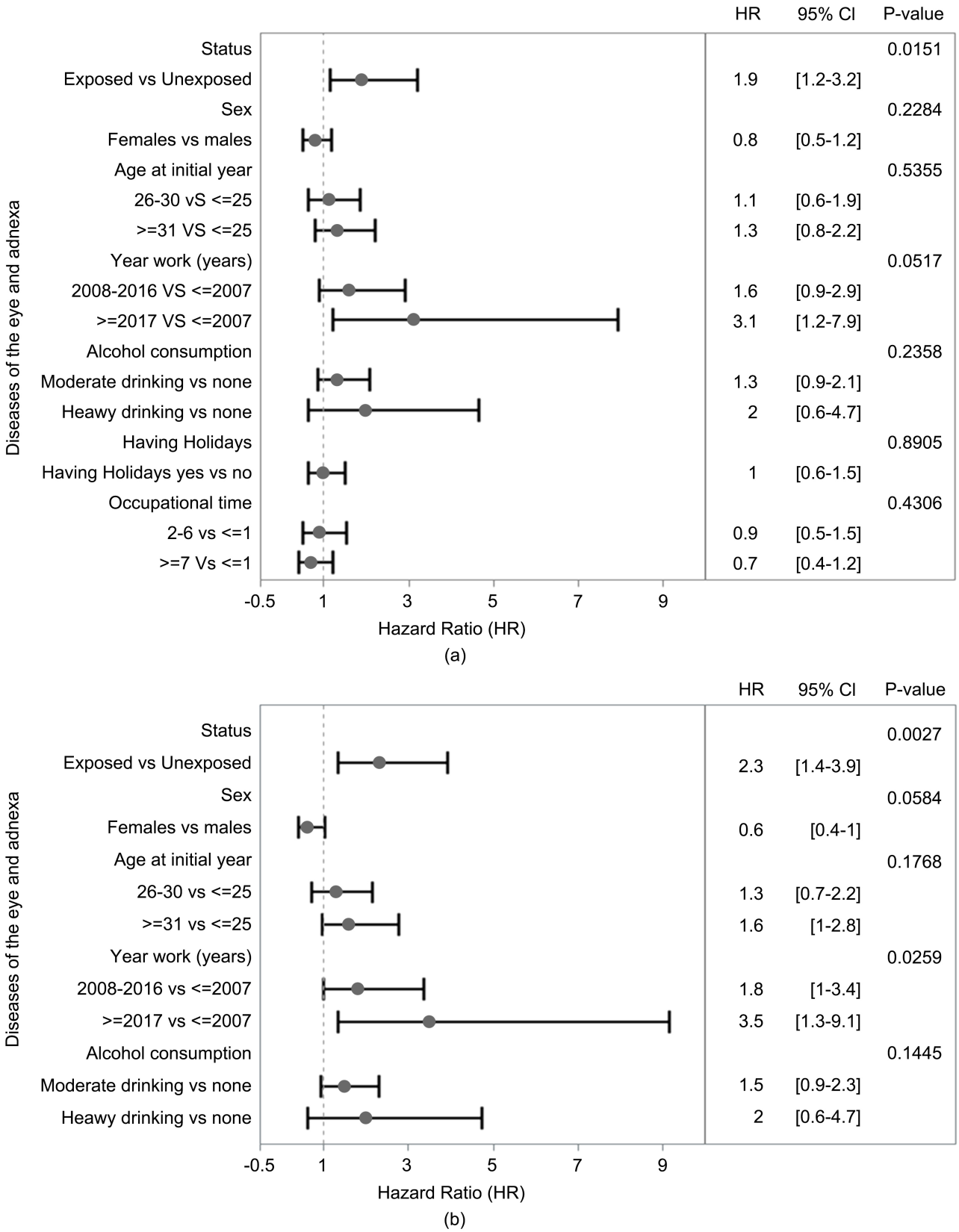

Figure 3. Hazard Ratios of diseases of the eye and adnexa in univariable (a) and multivariable (b) events analysis by confounders factors.

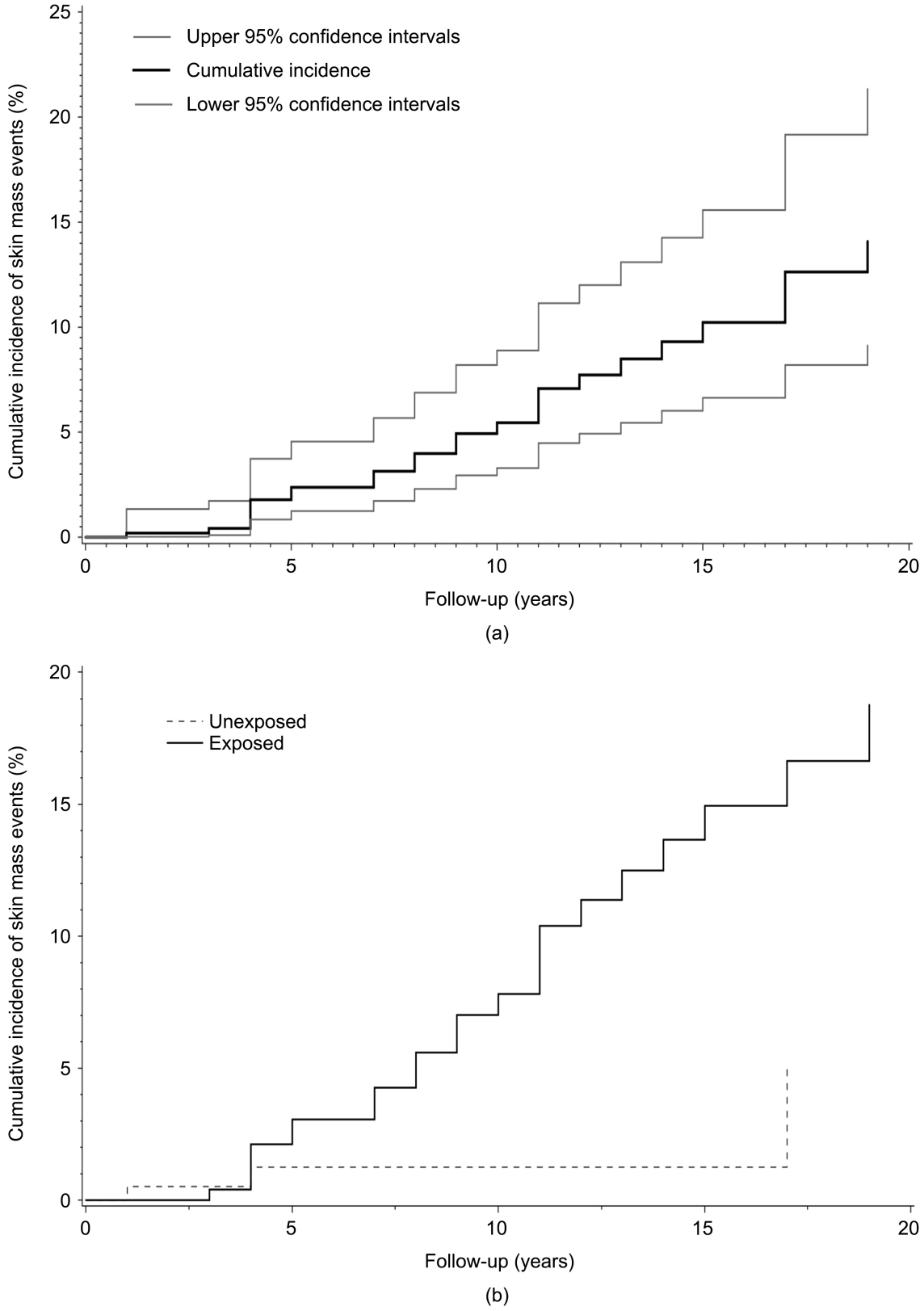

Figure 4. The cumulative incidence curves of skin mass (a) in cohort (exposed and unexposed) and stratified by exposure status (b) between 1972 and 2020. Skin mass = other disorders of skin and subcutaneous tissue related to radiation according to ICD-10 classification.

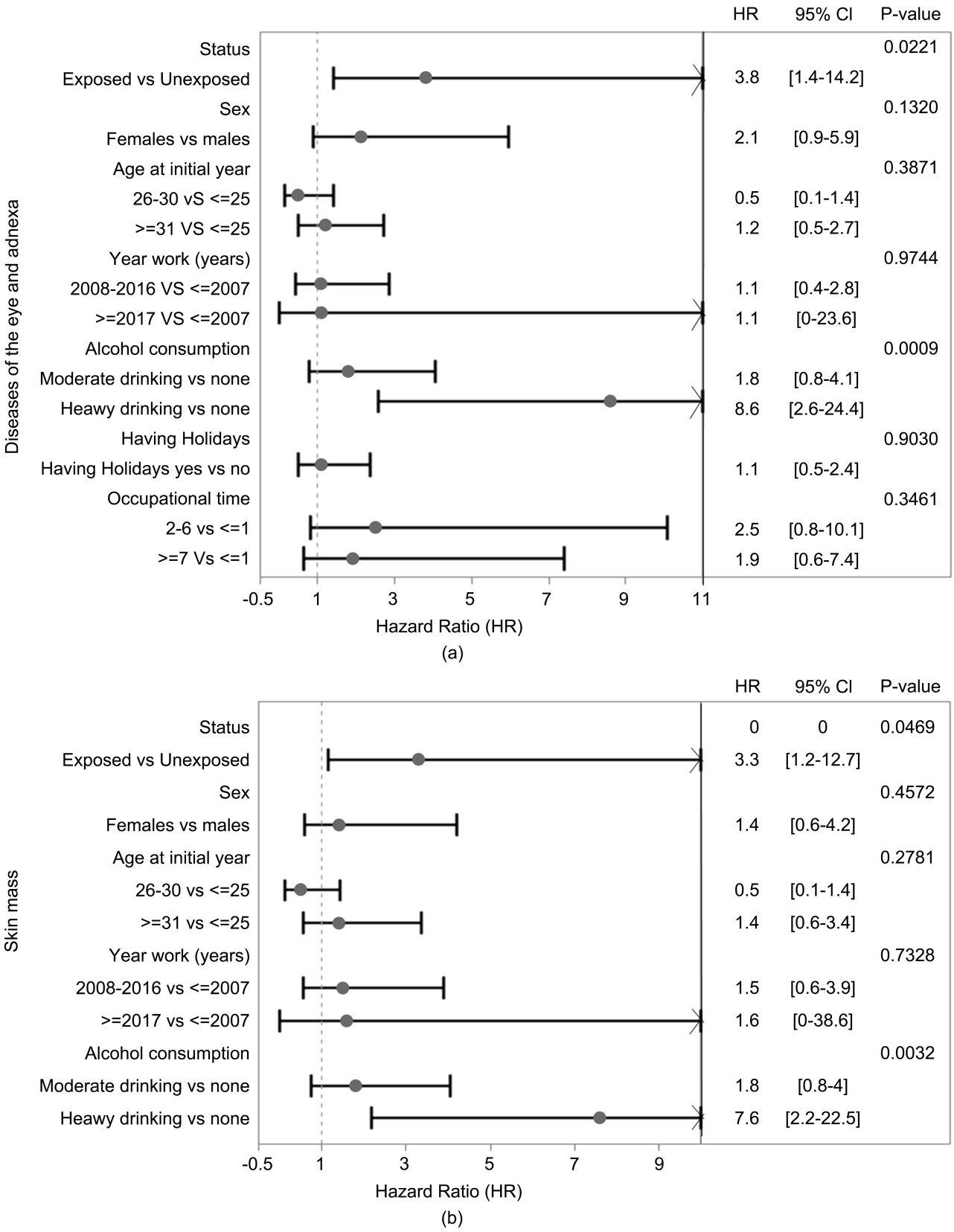

Figure 5. Hazard Ratios of skin mass in univariable (a) and multivariable (b) events analysis by confounders factors. Skin mass = other disorders of skin and subcutaneous tissue related to radiation according to ICD-10 classification.

Note for Figure 3 and Figure 5:

Age at initial year [26 - 30] period of age at initial year of employment (year); *Age at initial year* [≥30] period of age at initial year of employment (year); *Year work* [2008-2016] period of year of first employment; *Year work* [≥2017] period of year of first employment; *Having Holidays* Having Holidays during a career (yes or no); *Occupational time* [2 - 6] No. of years of work as exposed or unexposed worker (years); *Occupational Time* [≥7] No. of years of work as exposed or unexposed worker (years).

Hazard ratios (HRs) were estimated from a single Cox proportional hazards multiple regression model.

(Figure 3(b)) Adjusted for sex, age at initial year of employment, alcohol drinking, year of first employment; departments of Benin; Survival time (Entry = date of first entry into the workplace, Out = date of events) for events and (Entry = date of first entry into the workplace, Out = date of survey) for no events;

Proportional hazards assumptions verified for age at initial year of employment (year), occupational time, having holidays, year work patterns.

4. Discussion

To our knowledge, this is the first evaluation of the risk non cancer diseases among medical imaging workers in Republic of Benin. Our analyses showed associations between medical X-ray workers and diseases of the eye and skin mass. At the same time, Heavy alcohol drinking had an increased risk of skin mass.

4.1. Diseases of the Eye

Diseases of the eye (HR, 2.3 [IC 95 %, 1.4 - 3.9]) were significantly associated to exposure ionizing radiation (Figure 3). It is evidence that exposure to ionizing radiation may be harmful to the lens of the eye and increases the long-term risk of cataract formation (Chodick *et al.* 2008) [18]. Certainly, several other studies showed the association between cataract (Hiller *et al.* 1986) [19]; Picano *et al.* 2012; Little 2013) [20], opacities of the lens (Ainsbury *et al.* 2021) [11], and protracted exposure to ionising radiation. Moreover, epidemiological studies, many years ago, established the association between exposure to sun (ultraviolet radiation) and development of cataracts Wright and Norval, 2021) [21]. Although there are several other eye ailments in this outcome not described by the literature recognized as radiation-induced, many of them could be related to opacification of the lens and which could involve cataract in its advanced stages. The workers who have started working after 2017 (HR, 3.5 [95% CI, 1.3, 9.2]), have a statistically significant higher risk of diseases of the eye from the multivariable model and were statistically significant. This could be explained by the fact that young workers performed more examinations than older workers, who are generally assigned to administrative work in the centres. The availability of dosimetry data could have supported this explanation and proved the dose-response trends of radiation on eye diseases. The median latency period of eight (08) years (Table 3) shown in this study was not entirely

similar to those reported in the literature. Because, according to study's Chodick [17], the latency period for cataract formation is probably longer for smaller doses and may reach 30 - 45 years (Wilde and Sjostrand, 1997) [22].

4.2. Skin Mass

Ionizing radiation exposure and alcohol consumption were the main risk factor significatively associated to skin mass, through this study. According to the descriptive mass made by participants, the skin mass was soft tumor, moveable and no pain, probably benign like a lipoma. The lipoma is commonly observed in ordinal clinics (Mashima *et al.* 2021) [23]. Association of having skin mass with radiation exposure has been scarcely reported by the literature. The risk of having skin mass for exposed workers was high even after adjusting (HR, 3.3 [95% CI, 1.2, 12.7]) and statistically significant (**Figure 5(b)**). The scarcity of cohort studies able to establish the links between radiation exposure and skin mass was a brake in the discussion. The availability of dosimetry data could have supported this explanation and to prove the dose-response trends of radiation on skin mass. Heavy alcohol consumption was significantly associated with a higher factor risk to having skin mass (**Figure 5(b)**). These results comfort us, because Sumi *et al.* [24] obtained in their study that higher weekly alcohol consumption was strongly and significantly associated with higher abdominal visceral adipose tissue areas and skin mass. In opposite, according to Kim *et al.* [25] alcohol consumption is associated with decreased skin mass and increased visceral adipose tissue accumulation.

4.3. Strength and Limitation

This study was one of the largest undertaken to date on morbidity among medical imaging workers risk with high size of the baseline retrospective cohort in Republic of Benin. A study strength includes nearly complete data collection, which reduces the possibility of selection bias. The lack of dosimetry data was limitative factor of the study. The dose-response link could not be proven. Nevertheless, some limitations of the study should be considered. Prevalence disorders cases were identified from the self-reported questionnaires without clinical confirmations. We carried out three groups for the participants based on the frequency of alcohol drinking (none, Moderate and High) and did not get the information about alcohol drinking volume. For the smoking, we also performed two groups based on the acceptance or no of smoking and did not get the information about cigarette rods or packs. This lack of precision may have led to bias. We were unable to match the two groups to limit misclassification bias, since the number of subjects was limited. The potential confounders such as diet, medications, and level of physical activity, exposure to solar ultraviolet (UV) radiation, family medical history, might have contributed to an under or overestimation of the different associations. The difference was statistically insignificant between the two groups (unexposed and exposed) for variables sex, smoking, alcohol drinking. Thus, we believe that the bias might be minimal.

5. Conclusions

This first study among x-rays medical workers in Republic of Benin, confirms the known results that ionizing radiation exposure is a risk factor for eye diseases and adds new information by providing risk estimates for the occurrence of skin mass, benign tumors probability which should not be neglected. It provides a basis for further studies on a link between low dose radiation measured and skin mass and eye diseases in this country.

The public health and dosimetry monitoring significance in the prevention of disorders developed likely in occupational environment due to ionizing radiation exposure is emphasized in this study.

Acknowledgements

We are also grateful to Françoise Terrier for her unfailing support and advice.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

Funding for this study was provided by the Division for Africa, Department of Technical Cooperation of International Atomic Energy Agency (IAEA).

Ethics Approval

The study was reviewed and approved by Research Ethics Committee of the Institut des Sciences Biomedicales Appliquees (CER-ISBA).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Wang, F., Fang, Q., Tang, W., Xu, X., Mahapatra, T., Mahapatra, S., *et al.* (2015) Nested Case-Control Study of Occupational Radiation Exposure and Breast and Esophagus Cancer Risk among Medical Diagnostic X Ray Workers in Jiangsu of China. *Asian Pacific Journal of Cancer Prevention*, **16**, 4699-4704. https://doi.org/10.7314/apjcp.2015.16.11.4699

[2] Berrington, A., Darby, S.C., Weiss, H.A. and Doll, R. (2001) 100 Years of Observation on British Radiologists: Mortality from Cancer and Other Causes 1897-1997. *The British Journal of Radiology*, **74**, 507-519. https://doi.org/10.1259/bjr.74.882.740507

[3] Lee, W.J., Bang, Y.J., Cha, E.S., Kim, Y.M. and Cho, S.B. (2020) Lifetime Cancer Risks from Occupational Radiation Exposure among Workers at Interventional Radiology Departments. *International Archives of Occupational and Environmental Health*, **94**, 139-145. https://doi.org/10.1007/s00420-020-01569-8

[4] Allodji, R.S., Hawkins, M.M., Bright, C.J., Fidler-Benaoudia, M.M., Winter, D.L., Alessi, D., *et al.* (2019) Risk of Subsequent Primary Leukaemias among 69,460 Five-

Year Survivors of Childhood Cancer Diagnosed from 1940 to 2008 in Europe: A Cohort Study within Pancaresurfup. *European Journal of Cancer*, **117**, 71-83. https://doi.org/10.1016/j.ejca.2019.05.013

[5] Azizova, T.V., Bannikova, M.V., Grigoryeva, E.S. and Rybkina, V.L. (2018) Risk of Malignant Skin Neoplasms in a Cohort of Workers Occupationally Exposed to Ionizing Radiation at Low Dose Rates. *PLOS ONE*, **13**, e0205060. https://doi.org/10.1371/journal.pone.0205060

[6] Fournier, L., Laurent, O., Samson, E., Caër-Lorho, S., Laroche, P., Le Guen, B., *et al.* (2016) External Radiation Dose and Cancer Mortality among French Nuclear Workers: Considering Potential Confounding by Internal Radiation Exposure. *International Archives of Occupational and Environmental Health*, **89**, 1183-1191. https://doi.org/10.1007/s00420-016-1152-4

[7] Akyurt, N. (2021) Health-Related Quality of Life among Radiology Technicians in Turkish Hospitals: A Cross Sectional Study. *International Archives of Occupational and Environmental Health*, **94**, 1415-1425. https://doi.org/10.1007/s00420-021-01723-w

[8] UNSCEAR 2006: United Nations Scientific Committee on the Effects of Atomic Radiation, General Assembly (2008) Effects of Ionizing Radiation: UNSCEAR 2006 Report to the General Assembly, with Scientific Annexes. United Nations.

[9] Charles, M. (2001) UNSCEAR Report 2000: Sources and Effects of Ionizing Radiation. *Journal of Radiological Protection*, **21**, 83-85. https://doi.org/10.1088/0952-4746/21/1/609

[10] Picano, E., Vano, E., Domenici, L., Bottai, M. and Thierry-Chef, I. (2012) Cancer and Non-Cancer Brain and Eye Effects of Chronic Low-Dose Ionizing Radiation Exposure. *BMC Cancer*, **12**, Article No. 157. https://doi.org/10.1186/1471-2407-12-157

[11] Ainsbury, E.A., Dalke, C., Hamada, N., Benadjaoud, M.A., Chumak, V., Ginjaume, M., *et al.* (2021) Radiation-Induced Lens Opacities: Epidemiological, Clinical and Experimental Evidence, Methodological Issues, Research Gaps and Strategy. *Environment International*, **146**, Article ID: 106213. https://doi.org/10.1016/j.envint.2020.106213

[12] Maalej, M., Hentati, D., Slimène, M., *et al.* (2007) [Skin Cancer in Tunisia: A Retrospective Study: 1379 Cases and Risk Factors]. *La Tunisie Médicale*, **85**, 728-733.

[13] Dossou, J., Abinda, S.G.G.M., Adjagba, M., *et al.* (2014) Study Cytogenetics Aberrations Chromosome in Workers under X-Rays. *Journal de la Recherche Scientifique de l' Université de Lomé*, **16**, 35-45. https://www.ajol.info/index.php/jrsul/article/view/117713

[14] Laurier, D., Richardson, D.B., Cardis, E., Daniels, R.D., Gillies, M., O'Hagan, J., *et al.* (2016) The International Nuclear Workers Study (Inworks): A Collaborative Epidemiological Study to Improve Knowledge about Health Effects of Protracted Low-Dose Exposure. *Radiation Protection Dosimetry*, **173**, 21-25. https://doi.org/10.1093/rpd/ncw314

[15] Sun, Q., Mao, W., Jiang, H., Zhang, X., Xiao, J. and Lian, Y. (2018) The Effect of Protracted Exposure to Radiation on Liver Injury: A Cohort Study of Industrial Radiographers in Xinjiang, China. *International Journal of Environmental Research and Public Health*, **15**, Article 71. https://doi.org/10.3390/ijerph15010071

[16] Schnall, P.L., Schwartz, J.E., Landsbergis, P.A., Warren, K. and Pickering, T.G. (1998) A Longitudinal Study of Job Strain and Ambulatory Blood Pressure: Results from a Three-Year Follow-Up. *Psychosomatic Medicine*, **60**, 697-706. https://doi.org/10.1097/00006842-199811000-00007

[17] World Health Organization (2004) International Statistical Classification of Diseases and Related Health Problems, 10th Revision. 2nd Edition, World Health Organization.

[18] Chodick, G., Bekiroglu, N., Hauptmann, M., Alexander, B.H., Freedman, D.M., Doody, M.M., *et al.* (2008) Risk of Cataract after Exposure to Low Doses of Ionizing Radiation: A 20-Year Prospective Cohort Study among US Radiologic Technologists. *American Journal of Epidemiology*, **168**, 620-631. https://doi.org/10.1093/aje/kwn171

[19] Hiller, R., Sperduto, R.D. and Ederer, F. (1986) Epidemiologic Associations with Nuclear, Cortical, and Posterior Subcapsular Cataracts. *American Journal of Epidemiology*, **124**, 916-925. https://doi.org/10.1093/oxfordjournals.aje.a114481

[20] Little, M.P. (2013) A Review of Non-Cancer Effects, Especially Circulatory and Ocular Diseases. *Radiation and Environmental Biophysics*, **52**, 435-449. https://doi.org/10.1007/s00411-013-0484-7

[21] Wright, C.Y. and Norval, M. (2021) Health Risks Associated with Excessive Exposure to Solar Ultraviolet Radiation among Outdoor Workers in South Africa: An Overview. *Frontiers in Public Health*, **9**, Article 678680. https://doi.org/10.3389/fpubh.2021.678680

[22] Wilde, G. and Sjostrand, J. (1997) A Clinical Study of Radiation Cataract Formation in Adult Life Following Gamma Irradiation of the Lens in Early Childhood. *British Journal of Ophthalmology*, **81**, 261-266. https://doi.org/10.1136/bjo.81.4.261

[23] Mashima, E., Sawada, Y. and Nakamura, M. (2021) Recent Advancement in Atypical Lipomatous Tumor Research. *International Journal of Molecular Sciences*, **22**, Article 994. https://doi.org/10.3390/ijms22030994

[24] Sumi, M., Hisamatsu, T., Fujiyoshi, A., Kadota, A., Miyagawa, N., Kondo, K., *et al.* (2019) Association of Alcohol Consumption with Fat Deposition in a Community-Based Sample of Japanese Men: The Shiga Epidemiological Study of Subclinical Atherosclerosis (Sessa). *Journal of Epidemiology*, **29**, 205-212. https://doi.org/10.2188/jea.je20170191

[25] Kim, K.H., Oh, S., Kwon, H., Park, J., Choi, H. and Cho, B. (2012) Alcohol Consumption and Its Relation to Visceral and Subcutaneous Adipose Tissues in Healthy Male Koreans. *Annals of Nutrition and Metabolism*, **60**, 52-61. https://doi.org/10.1159/000334710

Abbreviations

CI:	Confidence interval
ICD-10:	International Classification of Diseases 10th Revision
HR:	Hazard Ratio
IQR:	Interquartile Range
AIC:	Akaike's information criterion
UNSCEAR:	United Nations Scientific Committee on the Effects of Atomic Radiation
CER-ISBA:	Research Ethics Committee of the Institute of Applied Biomedical Sciences

Appendix 1: Supplementary Information (Online Resource A)

Table A1. Different ailments collected from the study population at the time of the baseline questionnaire, 1972-2019.

	Participants who declared a health event	113/528
Health events		n (%)
	Eye diseases	100 (53.8)
	Skin mass	26 (13.9)
	Infertility	24 (12.9)
	Intra-pelvis mass (Myoma)	20 (10.8)
	Chronic digestive disorders	12 (6.5)
	Thyroid mass	4 (2.1)
	All	186 (100.0)
	Participants who have not declared a health event	415/528

% = n/all; skin mass = Other disorders of skin and subcutaneous tissue related to radiation according to ICD-10 classification.

Table A2. According to International Classification of Diseases 10th Revision (ICD-10), classification of different eye diseases developed by exposed and unexposed group in the study population at the time of the baseline questionnaire, 1972-2019.

	Diseases	**Exposed n = 75 (100%)**	**Unexposed n = 25 (100%)**
Diseases of the eye and adnexa* (ICD-10 classification)	**Glaucoma**	1 (1.3)	0 (0.0)
	Cataract	4 (5.3)	0 (0.0)
	Eye irritation and disturbances	21 (28)	7 (28.0)
	Eye redness and disturbances	37 (49.3)	14 (56.0)
Total		63 (84.0)	21 (84.0)
Others diseases declared by participants for eyes**	**lacrymal**	2 (2.6)	3 (12.0)
	Abscess	10 (13.3)	1 (4.0)
Total		12 (16.0)	4 (16.0)

*These diseases were taken into account in diseases of the eye and adnexa subgroup accprding to ICD-10 classification; **This diseases subgroup was not taken into account by ICD-10 classification.

Table A3. Hazard Ratio (HR, 95% CI) of diseases of the eye and skin mass in univariable analysis (Cox regression model) in the study population at the time of the baseline questionnaire, 1972-2019.

Diseases	Variables	Cases/n	Univariable analysis (HR 95% CI)
	Departments of Benin (old territorial division)		
Diseases of the eye	Atacora-Donga	5/47	Reference (HR = 1)
	Borgou-Alibori	4/45	0.9 (0.3; 3.1)
	Zou-Collines	3/22	2.7 (0.8; 9.2)
	Mono-Couffo	3/16	1.9 (0.5; 6.7)
	Ouémé-Plateau	15/62	3.1 (1.3; 8.9)
	Atlantique-Littotal	33/143	3.4 (1.5; 9.3)
	p-value		*0.01*
	Departments of Benin (old territorial division)		
Skin mass	Atacora-Donga	3/47	Reference (HR = 1)
	Borgou-Alibori	3/45	1.2 (0.3; 5.3)
	Zou-Collines	0/22	0.3 (0.0; 3.4)
	Mono-Couffo	1/16	0.8 (0.1; 4.8)
	Ouémé-Plateau	4/62	1.1 (0.3; 4.9)
	Atlantique-Littoral	12/143	1.4 (0.5; 5.4)
	p-value		*0.92*

Table A4. Hazard Ratio (HR, 95% CI) of diseases of the eye and skin mass in univariable analysis (Cox regression model) for age attained in the study population at the time of the baseline questionnaire, 1972-2019.

Diseases	Variables	Cases/n	Univariable analysis (HR 95% CI)
	Age attained		
Diseases of the eye	≤28	20/139	Reference (HR = 1)
	29-40	38/267	0.3 (0.1; 0.5)
	≥41	26/122	0.1 (0.0; 0.1)
	p-value		*<.0001*

Continued

	Ageattained		
	≤28	6/137	Reference (HR = 1)
Skin mass	29 - 40	12/259	0.1 (0.0; 0.4)
	≥41	8/132	0.0 (0.0; 0.1)
	p-value		*<0.0001*

Table A5. Cox regression model Multivariable analyses (HR and 95% CI) of diseases of the eye in the study population at the time of the baseline questionnaire with time scale age attained, 1972-2019.

Covariate	**Cases/n**	**Multivariable analysis (HR 95% CI)**
Status		
Unexposed	21/193	Reference (HR = 1)
Exposed	63/335	2.5 (1.5; 4.3)
p-value		*0.0007*
Sex		
Male	33/224	Reference (HR = 1)
Female	51/304	0.6 (0.4; 0.9)
p-value		*0.04*
Age at initial year of employment		
≤25	42/308	Reference (HR = 1)
26 - 30	19/107	0.7 (0.4; 1.1)
≥31	23/113	0.5 (0.3; 0.9)
p-value		*0.04*
Year of first employment (years)		
≤2007	46/146	Reference (HR = 1)
2008-2016	29/254	1.9 (1.1; 3.4)
≥2017	9/128	3.2 (1.3; 7.5)
p-value		*0.02*
Alcohol drinking		
None	47/360	Reference (HR = 1)
Moderate	33/159	1.4 (0.9; 2.2)
Heavy	4/9	1.9 (0.6; 4.6)
p-value		*0.20*

Adjusted for sex, age at initial year of employment, alcohol drinking, year of first employment, departments of Benin; Survival time (Entry = age at first employment, Out = age at events) for events and (Entry = age at first employment, Out = age at survey) for no events; Proportional hazards assumptions verified for sex, age at initial year of employment (year), smoking, alcohol consumption, occupational time, having holidays patterns.

Appendix 2: Questionnaire (Online Resource B)

Part 1

IDENTIFIANT DU TRAVAILLEUR: |__|__|-|__|__|___|

à ne pas renseigner par l'enquêteur)

Nom et prénom:

Numéro de téléphone:

Etude épidémiologique chez les travailleurs exposés aux rayonnements X des centres d'imagerie médicale du Bénin.

Cible: TRAVAILLEURS EXPOSES—Atravailleurs affectés aux travaux sous rayonnements ionisants (ingénieurs, techniciens et aides soignants qui accèdent en zone contrôlée et/ou surveillée)

RENSEIGNEMENTS GENERAUX

Identification du travailleur (ingénieurs, techniciens et aides-soignants qui accèdent en zone contrôlée et/ou surveillée)

01. Numéro: |__|__|-|__|__|__|__| (à ne pas renseigner par l'enquêteAur)

02. Date: |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

03. Sexe: Masculin ❒0 Féminin ❒1

04. Date de naissance: |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

05. Catégorie socio-professionnelle (Tech/Ing en radiologie ou imagerie médicale/Radiologue/Autres):__________ (Variable autres à créer)

06. Nombre d'enfants: |__|__|

07. Date de première prise de service:

|__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

08. Carrière:

Structure 01	Durée au poste 02	Congés (adm et tech) 03	Temps de travail/jr sous Rx/par poste 04				
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire

09. Avez-vous fait valoir vos droits à la retraite?

Non ❒0 Oui ❒1

10. Si oui fournissez la date de mise à la retraite:
|__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

11. Travaillez-vous dans d'autres unités de radiologie après votre admission à la retraite?

Non ❒0 Oui ❒1

12. Si oui renseigner le tableau ci-dessous

Structure 01	Durée au poste 02	Congés (adm et tech) 03	Temps de travail/jr sous Rx/par poste 04				
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H Scopie	|__|__| H Radio	|__|__| H Scan	|__|__| H Mamo	|__|__| H Dentaire

RENSEIGNEMENTS SPECIFIQUES

Risque radiologique

13. Avez-vous reçu des cours de radioprotection après votre formation académique?

Non ❒0 Oui ❒1

14. Séjournez-vous en zone contrôlée pendant la réalisation des examens?

Non ❒0 Oui ❒1

15. Séjournez-vous en zone surveillée pendant la réalisation des examens?

Non ❒0 Oui ❒1

16. Portez-vous des Equipements de Protection Individuelle - EPI (tablier plombé, cache-thyroïde, cache-gonade), lorsque vous devez séjourner dans une zone contrôlée pendant la réalisation des examens?

Non ❒0 Oui ❒1

17. Faites-vous de la maintenance préventive pour les EPI?

Non ❒0 Oui ❒1

18. Si oui à quelle périodicité?

1 - 2 ans ❒0 2 - 4 ans ❒1 2 - 6 ans ❒2 >6 ans ❒3

Risque chimique

19. Faites-vous du développement manuel/automatique des clichés?

Non ❒0 Oui ❒1

20. Si oui, pendant combien de temps par jour?

Structure 01	Nombre de jours au poste de développement	Temps développement/jr 02
	|_|_|_|_|_| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| H

21. Utilisez-vous des gants en latex pour le développement?

Non ❒0 Oui ❒1

22. Utilisez-vous des cintres pour le développement?

Non ❒0 Oui ❒1

23. Utilisez-vous des masques protège nez spécifiques pour le développement?

Non ❒0 Oui ❒1

Surveillance dosimétrique et médicale

24. Êtes-vous sous surveillance dosimétrique?

Non ❒0 Oui ❒1

25. Si oui ; quelle est la périodicité?

1 mois ❒0 3 mois ❒1 6 mois ❒2 1 ans ❒3

26. Portez-vous un dosimètre passif/opérationnel lorsque vous séjournez en zone surveillée ou zone contrôlée?

Non ❒0 Oui ❒1 Oui mais données non disponibles ❒2

27. Si oui quelles sont les valeurs des cumuls de doses annuelles reçues dans la période pendant laquelle vous avez travaillé au poste actuel? (Créer un autre masque avec le même identifiant)

Structure 01	Année 02	Doses/an (mSv) 03
	|__|__||__|__| Année	|__|__|__|, |__|__|
	|__|__||__|__| Année	|__|__|__|, |__|__|
	|__|__||__|__| Année	|__|__|__|, |__|__|
	|__|__||__|__| Année	|__|__|__|, |__|__|
	|__|__||__|__| Année	|__|__|__|, |__|__|

28. Êtes-vous sous surveillance médicale?

Non ❒0 Oui ❒1

29. Si oui ; quelle est la périodicité?

<6 mois❒0 1 an ❒1 2 ans ❒2 3 ans ❒3 >4 ans ❒4

30. Êtes-vous fumeur?

Non ❒0 Oui ❒1

31. Prenez-vous des boissons alcoolisées?

Rare ❒0 souvent ❒1 toujours ❒2

Morbidité (depuis 1970)

32. Avez-vous contracté des maladies malignes de la peau?

Non ❒0 Oui ❒1

33. Si oui lesquelles?_____

34. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

35. Avez-vous contracté des maladies des yeux (cataracte, irritation ou rougeur fréquente des yeux, trouble de la vision)? ou en ressentez-vous les signes?

Non ❒0 Oui ❒1

36. Si oui lesquelles?_____

37. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

38. Avez-vous des masses sous-cutanées?

Non ❒0 Oui ❒1

39. Si oui lesquelles? _____

40. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

41. Aviez-vous été mis au courant d'une masse suspecte au niveau de la thyroïde au cours d'un examen d'exploration diagnostique?

Non ❒0 Oui ❒1

42. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

43. Aviez-vous été mis au courant après une consultation que vous avez contracté une maladie liée à l'un des organes?

44. Cœur

Non ❒0 Oui ❒1

45. Si oui lesquelles?_____

46. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

47. Les poumons (Cancer, broncho-pulmonaire primitif…)

Non ❒0 Oui ❒1

48. Si oui lesquelles?_____

49. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

50. Aviez-vous des troubles digestifs chroniques de causes inconnues?

Non ❒0 Oui ❒1

51. Si oui, Quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

52. Aviez-vous été mis au courant que vous avez contracté une maladie maligne du sang (Lymphome non hodgkiniens, leucémie, myélome multiples…) au cours d'un examen d'exploration diagnostique?

Non ❒0 Oui ❒1

53. Si oui lesquelles?_____

54. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

55. Aviez-vous été mis au courant d'une masse suspecte dans votre organisme au cours d'un examen d'exploration diagnostique?

Non ❒0 Oui ❒1

56. Si oui lesquelles?_____

57. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

58. Avez-vous eu une infertilité primaire ou secondaire?

Non ❒0 Oui ❒1

59. Si oui quelle a été la durée de cette infertilité: |__|__|ans

60. En quelle année est survenue l'infertilité: |__|__|__|__|ans

Part 2

IDENTIFIANT DU TRAVAILLEUR: |__|__|-|__|__|__| (à ne pas renseigner par l'enquêteur)

Nom et prénom:

Numéro de téléphone:

Etude épidémiologique chez les travailleurs exposés aux rayonnements X des centres d'imagerie médicale du Bénin.

Cible: TRAVAILLEURS NON EXPOSES (personnel administratif et d'entretien ; soignants et aides-soignants)

RENSEIGNEMENTS GENERAUX

Identification du travailleur (personnel administratif et d'entretien ; aides-soignants, brancardiers).

01. Numéro: |__|__|-|__|__|__| (à ne pas renseigner par l'enquêteur)

02. Date: |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

03. Sexe: Masculin ❒0 Féminin ❒1

04. Date de naissance: |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

05. Catégorie socio-professionnelle (aide-soignant, technicien de surface, secrétaire, brancardier): (Variable autres à créer)

06. Nombre d'enfants: |__|__|

07. Date de première prise de service:

|__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

08. Carrière:

Structure 01	Durée au poste 02	Congés 03	Temps de travail/jr 04
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H

09. Avez-vous fait valoir vos droits à une retraite?:

Non ❒0 Oui ❒1

10. Si oui fournissez la date de mise à la retraite:

|__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

11. Travaillez-vous dans d'autres unités de radiologie après votre admission à la retraite?

Non ❒0 Oui ❒1

12. Si oui renseigner le tableau ci-dessous

Structure 01	Durée au poste 02	Congés 03	Temps de travail/jr 04
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| Jours	|__|__| H

Renseignements spécifiques

Risque radiologique

13. Avez-vous reçu des cours de radioprotection après votre embauche?

Non ❒0 Oui ❒1

14. Avez-vous accès de manière régulière à la zone contrôlée/surveillée (salle d'examens) pendant la réalisation des examens?

Non ❒0 Oui ❒1

NB: pour une réponse oui prière soumettre l'intéressé (e) à aux questions de la première partie du présent questionnaire.

15. Êtes-vous sous surveillance médicale?

Non ❒0 Oui ❒1

16. Si oui; quelle est la périodicité?

1 an ❒0 2 ans ❒1 3 ans ❒2 > 4 ans ❒3

17. Êtes-vous fumeur?

Non ❒0 Oui ❒1

18. Prenez-vous des boissons alcoolisées?

Rare ❒0 Souvent ❒1 Toujours ❒2

Risque chimique

19. Faites-vous du développement manuel/automatique des clichés?

Non ❒0 Oui ❒1

20. Si oui, pendant combien de temps par jour?

Structure 01	Nombre de jours de développement	Temps développement/jr 02
	|_|_|_|_|_| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| H
	|_|_|_|_|_| Jours	|__|__| H

21. Utilisez-vous des gants en latex pour le développement?

Non ❒ Oui ❒1

22. Utilisez-vous des cintres pour le développement?

Non ❒ Oui ❒1

23. Utilisez-vous des masques protège nez spécifique pour le développement?

Non ❒ Oui ❒1

Morbidité (depuis 1970)

24. Avez-vous contracté des maladies malignes de la peau?

Non ❒0 Oui ❒1

25. Si oui lesquelles?_____

26. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

27. Avez-vous contracté des maladies des yeux (cataracte, irritation ou rougeur fréquente des yeux, trouble de la vision)? ou en ressentez-vous les signes?

Non ❒0 Oui ❒1

28. Si oui lesquelles?_____

29. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

30. Avez-vous des masses sous-cutanées?

Non ❒0 Oui ❒1

31. Si oui lesquelles? _____

32. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

33. Aviez-vous été mis au courant d'une masse suspecte au niveau de la thyroïde au cours d'un examen d'exploration diagnostique?

Non ❒0 Oui ❒1

34. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

35. Aviez-vous été mis au courant après une consultation que vous avez contracté une maladie liée à l'un des organes?

36. Cœur

Non ❒0 Oui ❒1

37. Si oui lesquelles?_____

38. Quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

39. Les poumons (Cancer, broncho-pulmonaire primitif…)

Non ❒0 Oui ❒1

40. Si oui lesquelles?_____

41. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

42. Aviez-vous des troubles digestifs chroniques de causes inconnues?

Non ❒0 Oui ❒1

43. Si oui, quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

44. Aviez-vous été mis au courant que vous avez contracté une maladie maligne du sang (Lymphome non hodgkiniens, leucémie, myélome multiples…) au cours d'un examen d'exploration diagnostique?

Non ❒0 Oui ❒1

45. Si oui lesquelles?_____

46. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)

47. Aviez-vous été mis au courant d'une masse suspecte dans votre organisme au cours d'un examen d'exploration diagnostique?

Non ❒0 Oui ❒1

48. Si oui lesquelles?_____

49. Si oui quand? |__|__|/|__|__|/|__|__|__|__| (jj/mm/aaaa)
50. Avez-vous eu une infertilité primaire ou secondaire?
Non ❒0 Oui ❒1
51. Si oui quelle a été la durée de cette infertilité: |__|__|ans
52. En quelle année est survenue l'infertilité: |__|__||__|__|ans