

Purpose

- To evaluate the characteristics of the hematological parameters of radiation workers using CBC
- To compare prevalence of abnormal CBC between radiation workers and the general population in South Korea

Background

- Health risks at the low doses (protracted occupational exposure) are uncertain
- Hematopoietic system is sensitive to radiation damage
- Complete blood count (CBC)**
 - CBC test is commonly used to monitor health status of radiation workers as a screening test with diagnostic and prognostic objectives for acute and/or chronic diseases
 - In South Korea, workers who are registered as radiation workers are legally required to check their CBC every year for radiation protection purpose
- Different results of previous studies**
 - Higher white blood cells among male medical workers who were exposed to higher cumulative dose radiation
 - Low white blood cells and platelet of medical workers compared to general population
 - Not significant differences

Methods

- Study population**
 - Korean Radiation Workers Study
 - 20,414 radiation workers available for CBC data
 - KNHANES (general population)
 - Korea National Health and Nutrition Examination Survey is national representative sample dataset in South Korea
 - Total 37,374 (avg. 6,229/year) who had CBC test results in 2014-2019

Normal range of WBC, PLT, and HB

CBC test	Normal range	Unit
White blood cell	3500~11000	cells/ μ L
Platelet	100~400	10^3 cells/ μ L
Hemoglobin (Male)	13~18	g/dL
Hemoglobin (Female)	12~16	g/dL

Analysis

- For comparison of abnormal CBC distribution, age-standardized prevalence ratios (SPR) of white blood cell (WBC), platelet (PLT), and hemoglobin(HB) between radiation workers and general population was used

Results

CBC test of radiation workers

Distribution of CBC among male radiation workers

Year	CBC test, n (mean \pm sd)		
	WBC(cells/ μ L) (n=79,462)	Platelet(10^3 cells/ μ L) (n=79,459)	Hemoglobin(g/dL) (n=79,446)
2014	11,277 (6699.59 \pm 1640.59)	11,283 (242.46 \pm 50.62)	11,279 (15.33 \pm 1.00)
2015	12,935 (6740.95 \pm 1641.74)	12,940 (244.34 \pm 50.25)	12,938 (15.36 \pm 0.99)
2016	15,293 (6732.67 \pm 1646.08)	15,291 (249.84 \pm 51.37)	15,285 (15.37 \pm 0.99)
2017	15,221 (6670.04 \pm 1632.12)	15,223 (249.81 \pm 51.63)	15,220 (15.37 \pm 0.98)
2018	13,081 (6581.96 \pm 1602.04)	13,073 (251.72 \pm 52.10)	13,074 (15.34 \pm 1.00)
2019	11,655 (6498.35 \pm 1608.64)	11,649 (252.92 \pm 52.50)	11,650 (15.30 \pm 1.01)

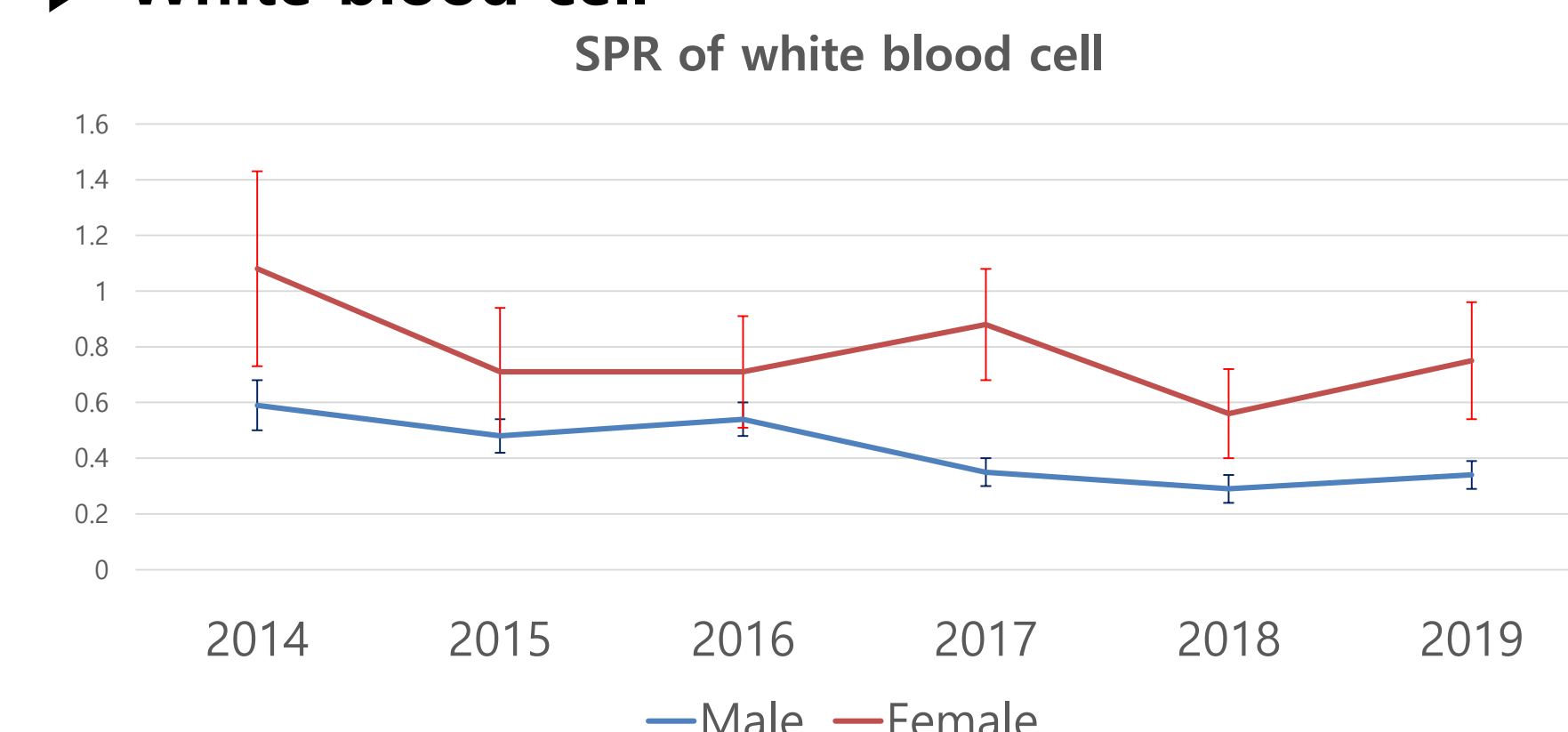
Distribution of CBC among female radiation workers

Year	CBC test, n (mean \pm sd)		
	WBC(cells/ μ L) n=10,757	Platelet(10^3 cells/ μ L) n=10,756	Hemoglobin(g/dL) n=10,756
2014	1,297 (6393.56 \pm 1637.79)	1,298 (260.03 \pm 54.92)	1,296 (12.99 \pm 1.06)
2015	1,686 (6404.24 \pm 1594.14)	1,688 (260.98 \pm 57.09)	1,687 (13.01 \pm 1.04)
2016	2,407 (6288.92 \pm 1571.49)	2,407 (264.48 \pm 55.95)	2,407 (13.02 \pm 1.01)
2017	2,286 (6204.87 \pm 1645.99)	2,286 (264.38 \pm 58.4)	2,287 (13.05 \pm 1.06)
2018	1,719 (6201.91 \pm 1653.64)	1,717 (268.84 \pm 60.20)	1,717 (13.07 \pm 1.04)
2019	1,362 (6029.83 \pm 1590.74)	1,360 (267.66 \pm 57.88)	1,362 (13.09 \pm 1.03)

CBC test comparison

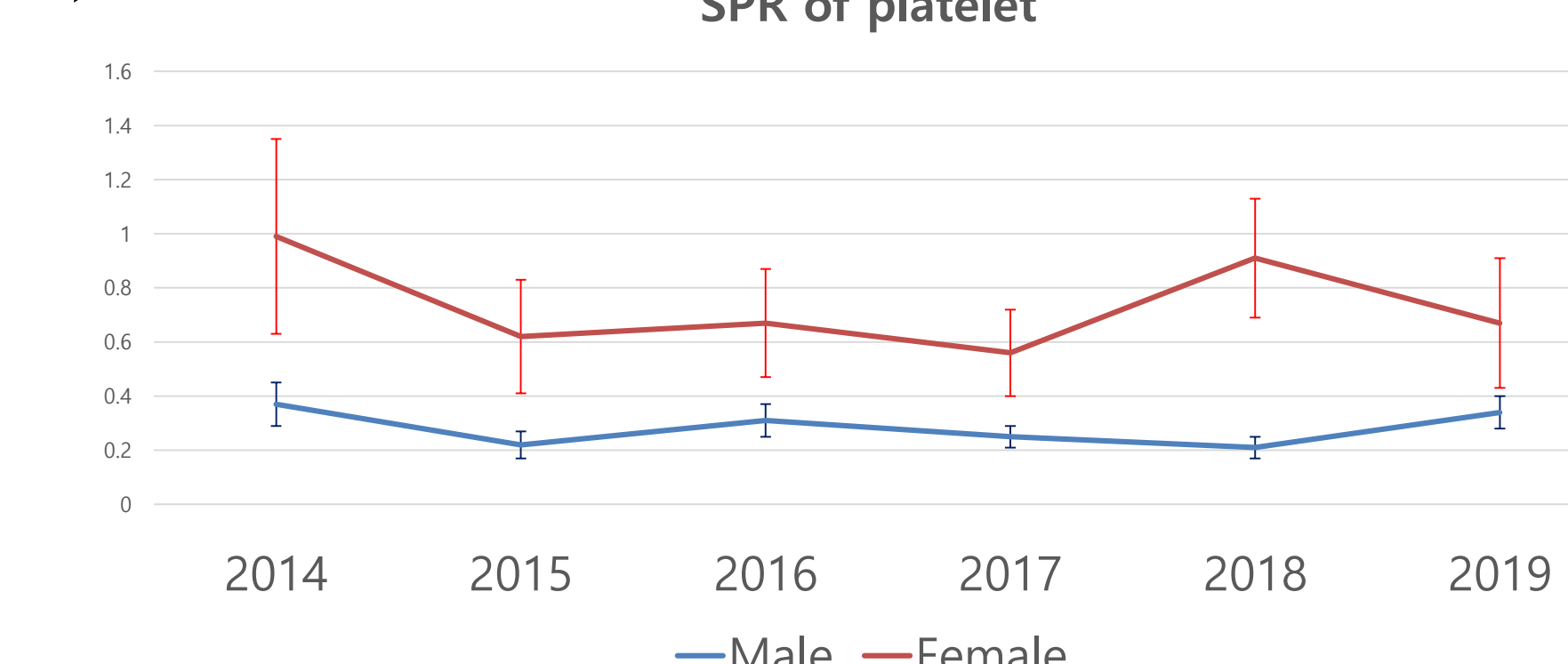
SPR for the comparison of abnormal CBC (radiation workers vs. general population)

White blood cell



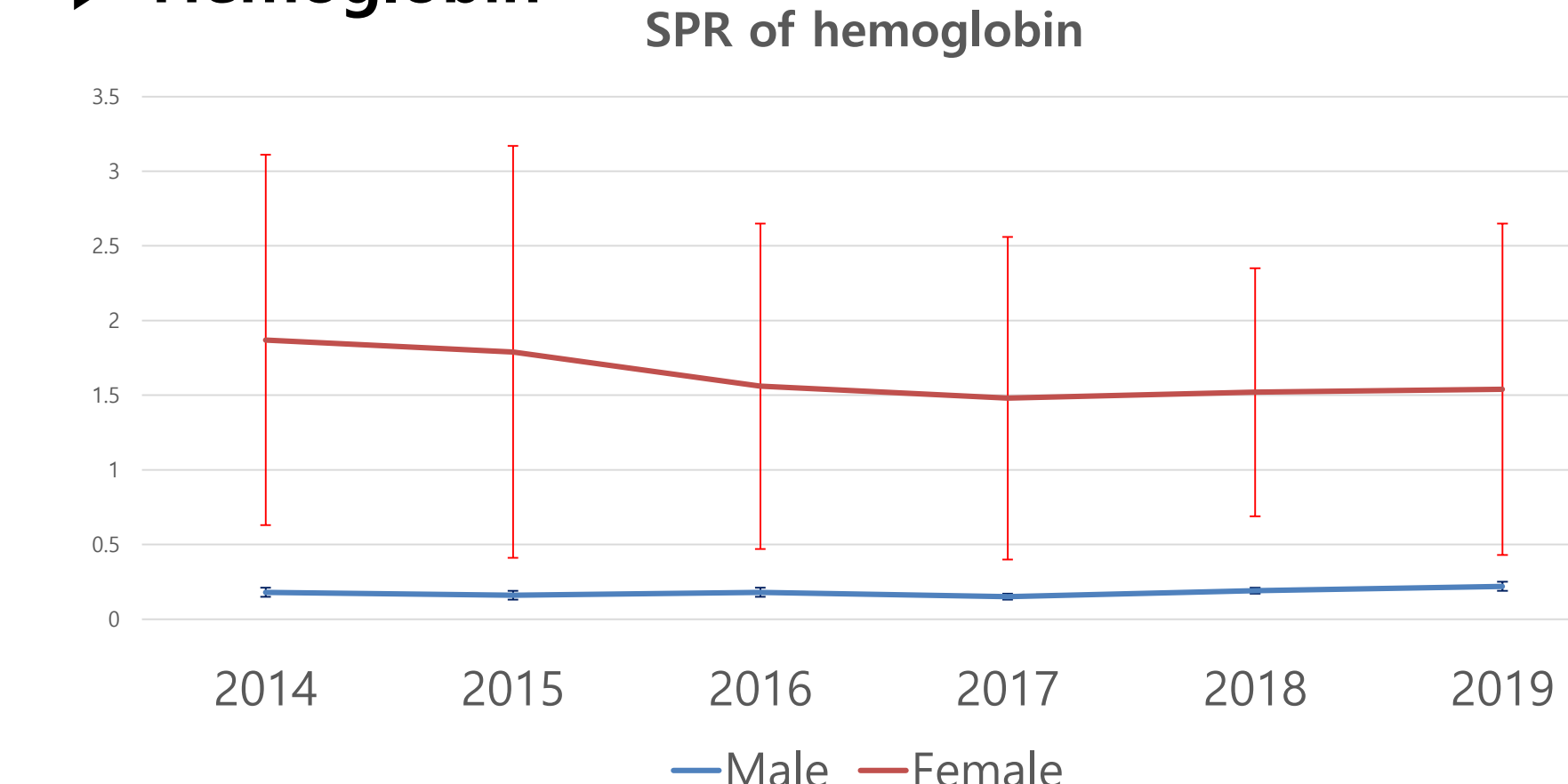
Total SPR	Male SPR (95% CI)	Female SPR (95% CI)
2014-2019	0.41 (0.39, 0.43)	0.75 (0.66, 0.85)

Platelet



Total SPR	Male SPR (95% CI)	Female SPR (95% CI)
2014-2019	0.27 (0.25, 0.29)	0.72 (0.62, 0.82)

Hemoglobin



Total SPR	Male SPR (95% CI)	Female SPR (95% CI)
2014-2019	0.18 (0.17, 0.19)	1.62 (1.54, 1.71)

Results

- General Characteristics of CBC test among Korean radiation workers**
 - WBC, PLT, and HB results of most radiation workers were normal range
 - Abnormal prevalence of CBC test (year average)
 - Male: WBC 1.4%, PLT 0.7%, HB 1.5%
 - Female: WBC 2.3%, PLT 1.9%, HB 12.2%
- Comparison of CBC test to general population**
 - Standardized prevalence ratios of abnormal CBC results were 0.56-0.80 for men and 1.60-13.1 for women among radiation workers in 2014-2019 compared to the general population
 - Male radiation workers had significantly lower abnormal prevalences of the CBC items than those of the general population
 - SPR of WBC = 0.41 (95% CI: 0.39, 0.43)
 - SPR of platelet = 0.27 (95% CI: 0.25, 0.29)
 - SPR of hemoglobin = 0.18 (95% CI: 0.17, 0.19)
 - Female radiation workers had significantly low SPRs of white blood cell and platelet, but a higher SPR of hemoglobin
 - SPR of WBC = 0.75 (95% CI: 0.66, 0.85)
 - SPR of platelet = 0.72 (95% CI: 0.62, 0.82)
 - SPR of hemoglobin = 1.62 (95% CI: 1.54, 1.71)

Discussion & Conclusion

- Distribution of radiation dose among radiation workers**
 - Average cumulative dose among radiation workers was 0.57 mSv/year (\pm 1.98) in the range of 0 to 195.28 mSv
 - 0.010% workers (N=2) had exceeded 100 mSv in a single year in this study
- Lower abnormal prevalences of the CBC among radiation workers**
 - Workers with relatively short-term (<10 years) employment included in this study
 - Healthy worker effect
- Higher SPR of hemoglobin among female radiation workers**
 - Might be related to screening effects due to periodic workers' medical examinations
- Further studies**
 - Needs to monitor health status of workers with abnormal CBC values and investigate its association with exposure to work-related hazards.

Acknowledgement

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