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The number of calibrations of electrometers with different types of ionization chambers performed by the calibration laboratory in Poland in the context of the COVID-19 pandemic

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Laboratory accredited by the Polish Centre for Accreditation, accreditation No. AP 155*

* an actual scope of accreditation No. AP 155 is available on the PCA website: www.pca.gov.pl

Introduction

Due to the **COVID-19 pandemic**, an epidemic state was in force in Poland from 20 March 2020 to 15 May 2022 in accordance with Polish legislation.

From 16 May 2022 until further notice, a **state of epidemic emergency is in force in Poland**.

Calibration service of electrometers with different types of ionization chambers is provided in Poland by the Secondary Standards Dosimetry Laboratory (SSDL) run by Medical Physics Department of the Maria Sklodowska-Curie National Research Institute of Oncology, member of Secondary Standards Dosimetry Laboratories Network established by the International Atomic Energy Agency and the World Health Organization.

The Polish SSDL has been accredited for the conformity with the norm ISO/IEC 17025 by the Polish Centre for Accreditation since 28 May 2014 and has the accreditation certificate No AP 155.

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Introduction

The aim of this study was to check **whether the COVID-19 pandemic caused a decrease in the number of calibrations of electrometers with different types of ionization chambers performed by a calibration laboratory in Poland** on behalf of its clients, mainly radiation therapy centers in Poland.

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Material

The material of this study was data on calibrations carried out by SSDL in Poland in 2020, i.e. the year the COVID-19 pandemic began, and those carried out in five years before and in two years after 2020 (**i.e. in the period of 2015-2022**).

In the analyzed period, the SSDL in Poland <u>operated as usual</u>, carrying out orders of clients, mainly radiation therapy centers in Poland.

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Methods

Statistical techniques were applied to review the results, namely to analyze the association between **the total number of calibrations carried out in a given year** counting **from 2015**, i.e. the first full calendar year of the SSDL's accreditation **till 2022** and **number of years since 2020 when the COVID-19 pandemic was declared**.

Moreover, an **analysis of the number of calibrations of various types of electrometers with different types of ionization chambers**, including well chambers, cylindrical chambers and plane-parallel chambers in each year was performed.

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Methods

The **Pearson correlation coefficient (r)** is the most common way of measuring a linear correlation. It is a number between –1.0 and 1.0 that measures the strength and direction of the relationship between two variables.

The following table was used to assess the strength and direction of the relationship.

Note:
Although interpretations of the relationship strength (also known as effect size) vary between disciplines, the table below gives general rule of thumb.

Pearson correlation coefficient (r) value	Strength	Direction
Greater than 0.5	Strong (large)	Positive
Between 0.3 and 0.5	Moderate	Positive
Between 0 and 0.3	Weak (small)	Positive
0	None	None
Between 0 and - 0.3	Weak (small)	Negative
Between - 0.3 and - 0.5	Moderate	Negative
Less than - 0.5	Strong (large)	Negative

Positive correlation — When one variable changes, the other variable changes in the **same direction**.

**No correlation** — There is **no relationship** between the variables.

Negative correlation — When one variable changes, the other variable changes in the **opposite direction**.

Results

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Total number of calibrations carried out in years 2015 - 2022

Line Fit Plot

Y / Total number of calibrations carried out in a given year

X / Number of years since 2020
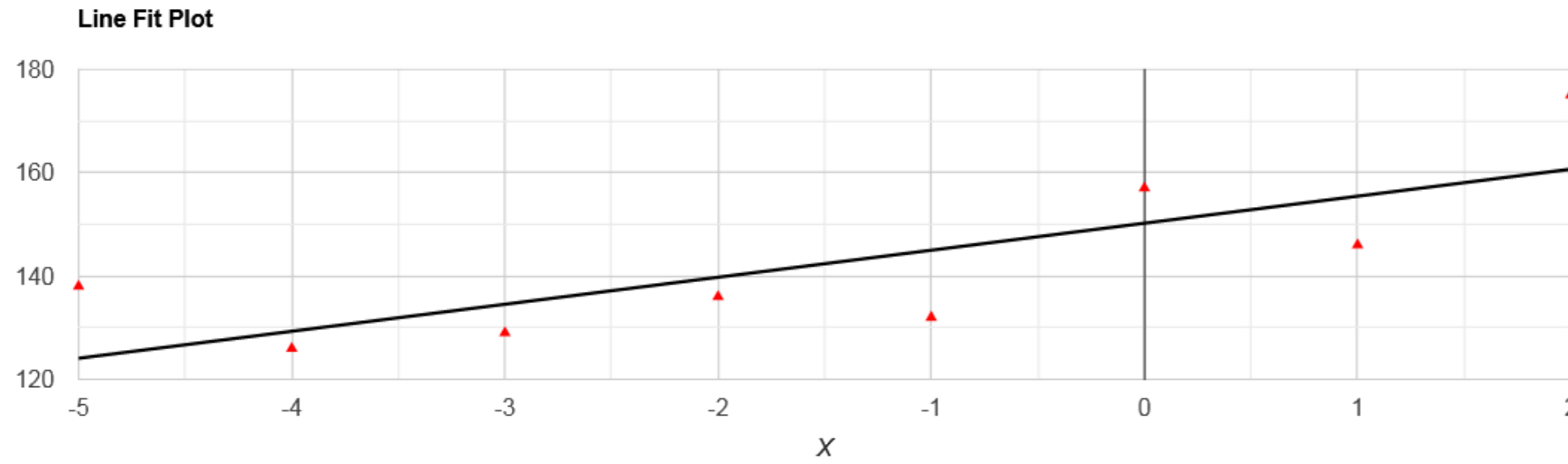
Parameter	Value
Pearson correlation coefficient (r)	0.7758
P-value	0.02364
Covariance	31.3571
Sample size (n)	8
Statistic	3.0119

Outliers

Outliers' detection method: Tukey Fence, k = 1.5.
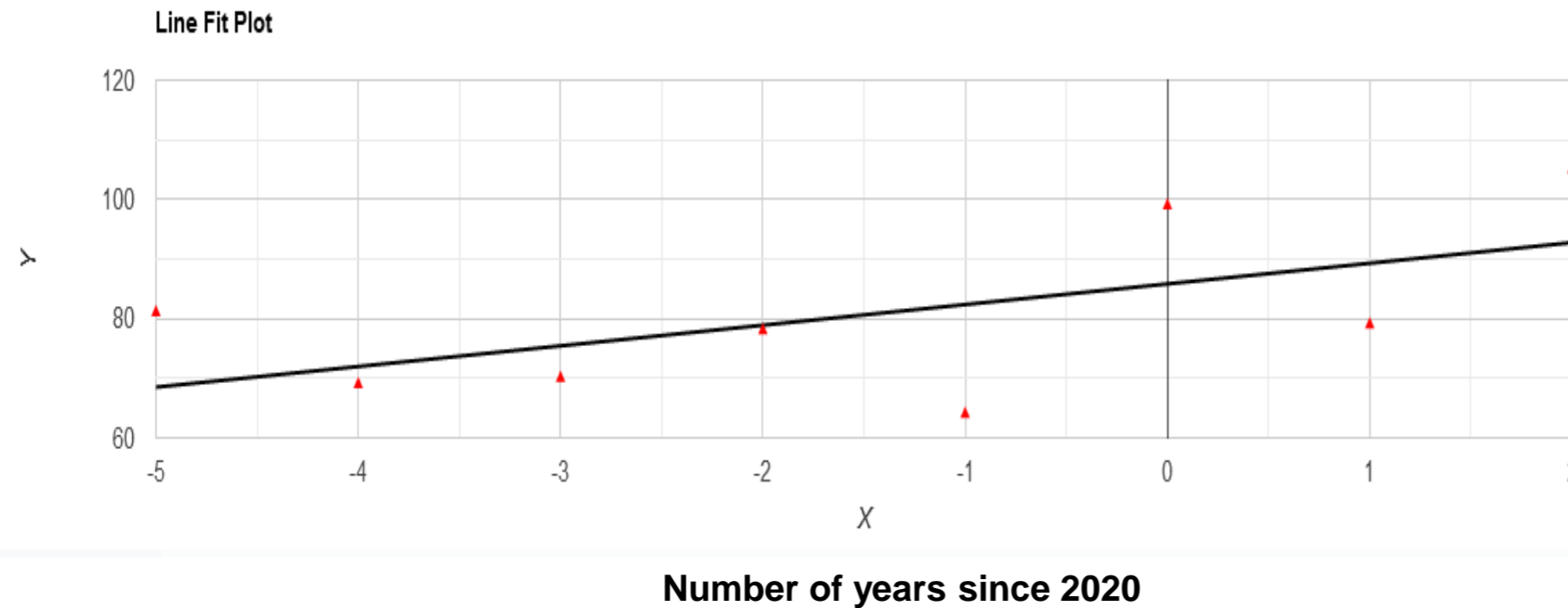The data doesn't contain outliers.

Normality

The assumption was checked based on the Shapiro-Wilk Test (α = 0.05).
The Shapiro-Wilk tests for X values did not showed a significance departure from the normality, $W(8)$ = 0.974, p = 0.982.
The Shapiro-Wilk tests for Y values did not showed a significance departure from the normality, $W(8)$ = 0.885, p = 0.225.

**Results of the Pearson correlation indicated that there is a significant large positive relationship
between X variable (number of years since 2020) and Y variable (number of calibrations carried out by the SSDL in Poland in a given year),
($r(6)$ = 0.776, p = 0.024, significance level: α = 0.05).**

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Results

The number of cylindrical chambers calibrations carried out in years 2015 - 2022

Line Fit Plot

Number of cylindrical chambers calibrations carried out in a given year

Number of years since 2020

Parameter	Value
Pearson correlation coefficient (r)	**0.5864**
P-value	0.1266
Covariance	20.7857
Sample size (n)	8
Statistic	1.7732

Outliers

Outliers' detection method: Tukey Fence, $k = 1.5$.
The data doesn't contain outliers.

Normality

The assumption was checked based on the Shapiro-Wilk Test ($\alpha = 0.05$).
The Shapiro-Wilk tests for X values did not showed a significance departure from the normality, $W(8) = 0.974$, $p = 0.982$.
The Shapiro-Wilk tests for Y values did not showed a significance departure from the normality, $W(8) = 0.898$, $p = 0.299$.
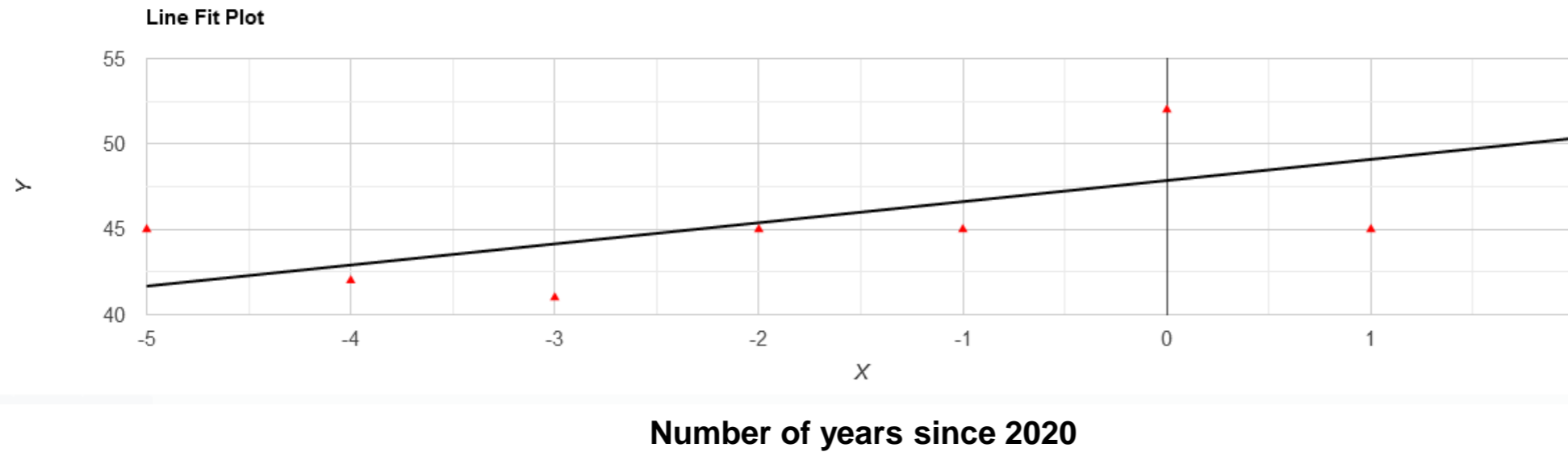
Results of the Pearson correlation indicated that there was a non significant large positive relationship
between X variable (number of years since 2020) and Y variable (number of cylindrical chambers calibrations carried out by the SSDL in Poland in a given year),
($r(6) = 0.586$, $p = 0.127$, significance level: $\alpha = 0.05$).

Results

The number of plane-parallel chambers calibrations carried out in years 2015 - 2022

Parameter	Value
Pearson correlation coefficient (r)	**0.7037**
P-value	0.05142
Covariance	7.4286
Sample size (n)	8
Statistic	2.4263

Outliers

Outliers' detection method: Tukey Fence, k = 1.5.
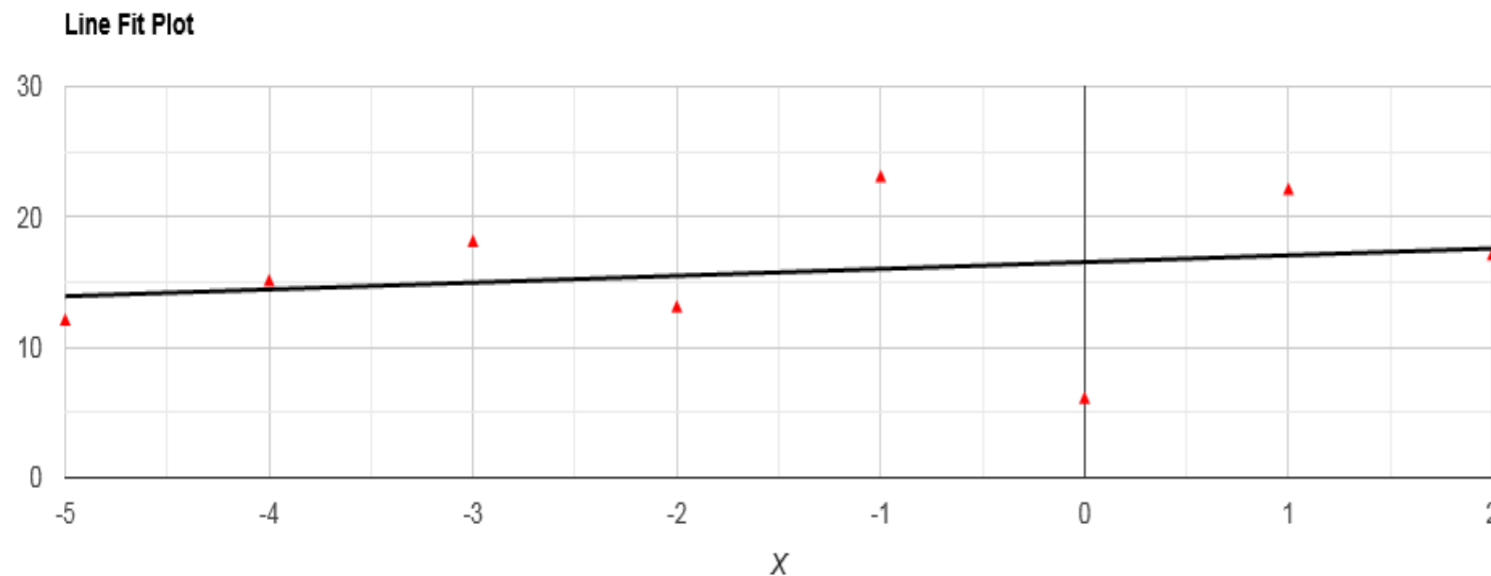
The data doesn't contain outliers.

Normality

The assumption was checked based on the Shapiro-Wilk Test (α = 0.05).

The Shapiro-Wilk tests for X values did not showed a significance departure from the normality, $W(8)$ = 0.974, p = 0.982.

The Shapiro-Wilk tests for Y values did not showed a significance departure from the normality, $W(8)$ = 0.836, p = 0.078.

**Results of the Pearson correlation indicated that there is a non significant large positive relationship
between X variable (number of years since 2020) and Y variable (number of plane-parallel chambers calibrations carried out by the SSDL in Poland in a given year),
(r(6) = 0.704, p = 0.051, significance level: α = 0.05).**

Results

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The number of well chambers calibrations carried out in years 2015 - 2022

Number of well chambers calibrations carried out in a given year

Line Fit Plot

Y

X

Number of years since 2020

Parameter	Value
Pearson correlation coefficient (r)	**0.2312**
P-value	0.5816
Covariance	3.1429
Sample size (n)	8
Statistic	0.5822

Outliers

Outliers' detection method: Tukey Fence, k = 1.5.
The data doesn't contain outliers.

Normality

The assumption was checked based on the Shapiro-Wilk Test (α = 0.05).
The Shapiro-Wilk tests for X values did not showed a significance departure from the normality, $W(8) = 0.974$, $p = 0.982$.
The Shapiro-Wilk tests for Y values did not showed a significance departure from the normality, $W(8) = 0.967$, $p = 0.947$.

**Results of the Pearson correlation indicated that there is a non significant small positive relationship
between X variable (number of years since 2020) and Y variable (number of well chambers calibrations carried out by the SSDL in Poland in a given year),
(r(6) = 0.231, p = 0.582, significance level: α = 0.05).**

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Conclusions

There **is an increasing trend in the total number of calibrations carried out in the period of 2015-2022.**
Obtained results <u>**are in line with our expectations**</u> **because the time elapsed since 2015 till 2022 should have not significantly decreased the total number of calibrations carried out by SSDL in Poland in the analyzed period, i.e. the COVID-19 pandemic should have not caused a decrease in the number of calibrations.**

These results may indicate **the high awareness of medical physicists responsible for dosimetry in radiotherapy centers in Poland** about the need for use of calibrated equipment for the aforementioned activity, despite the COVID-19 pandemic and related restrictions announced for the first time in the history of the SSDL and radiation therapy centers in Poland.

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Thank you for your attention.