During a storm – the impact of the COVID-19 pandemic on the epidemiology of the most frequent cancers in Poland

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Abstract

Background

The late diagnosis, despite improving availability and accessibility of diagnostic procedures during the last decade in Poland and cooperation between specialist cancer centres, remains an unsolved problem. A new coronavirus SARS-CoV2 causing the COVID-19 disease occurred in the end of 2019. In a few months, it has become the most fundamental problem for public health worldwide. The accessibility to healthcare resources and diagnostic procedures has been drastically reduced because of the COVID-19 pandemic in 2019–2020. The study was aimed to assess the effect of the COVID-19 pandemic and slow cancer burden on the healthcare system of the most frequent cancers in Poland in the period 2015–2021.

Methods

Depersonalized, epidemiological data was obtained from the National Health Found of Poland. The epidemiological analysis was performed and divided into subregions, according to patients’ domicile. For each of the subregions, we have calculated the incidence rate per 100,000 standardized to the ESP 2013. The time points of providing the first healthcare service were considered as the time of cancer diagnosis.

Results

Colorectal cancer has become the leading oncological problem in Poland in recent years and the long-term trend shows a significant increase in the SIR in 2021 compared to 2020. The SIR of the lung cancer decreased in 2015–2019 across the country as well as the burden of kidney cancer has decreased in most of the subregions. The breast and prostate cancers were the most frequent cancer diagnosed in Poland among women and men respectively. Such a situation has remained stable till 2020 when the COVID-19 pandemic has occurred. In 2020, compared to 2019 a visible reduction of SIR of the breast cancer in most of the subregions was found, especially in the eastern areas. In 2020 when the COVID-19 pandemic occurred, a visible reduction of the SIR of C61 in most of the subregions was found.

Conclusions

Our results show a significant decrease in the SIR of the most frequent cancers diagnosed in Poland in 2020 compared to 2019. Subsequently, the excessive increase in 2021 was found, the most likely due to the gradual reduction of epidemic restrictions.

Contributions to the literature

- The assessment the effect of the COVID-19 pandemic, and the slow cancer burden on the healthcare system in Poland
- Many patients whose cancer diagnosis and beginning of treatment were delayed, because of pandemic restrictions and inaccessibility of healthcare services, could be diagnosed with a more advanced stage of cancer
- The increase burden of the most frequent cancers diagnosed in 2021, compared to 2020 indicates a gap in the cancer diagnosis, the reginal and nationwide screening programmes should be introduced to enable diagnosis at the earliest possible stage

Background

In 17 European countries, cancer ranked first ahead of cardiovascular diseases as the leading cause of death [1]. Still late diagnosis, despite improving availability and accessibility of diagnostic procedures during the last decade in Poland and cooperation between specialist cancer centers, remains an unsolved problem.

At the end of 2019, a new coronavirus SARS-CoV2 causing the COVID-19 disease, occurred in Wuhan, in the Hubei province of China [2]. A new ssRNA virus was similar to the SARS and MERS that had affected the epidemic in 2002 and 2012 respectively [3]. In a few months, it has become the most fundamental problem for public health worldwide. On March 11th, the World Health Organization announced the pandemic that has affected the daily life of ordinary people, the economy as well as the organization and availability of healthcare resources and services [2].

The accessibility to healthcare resources and diagnostic procedures has been drastically reduced because of the COVID-19 pandemic in 2019–2020. This stormy situation for the world order and public health politics resulted in the engagement of healthcare resources and staff in the fight against the COVID-19 pandemic. Therefore, the limitation of scheduled healthcare services and impediments in contact with medical doctors, including general practitioners was observed.

The study aimed to describe the impact of the COVID-19 pandemic on the epidemiology of the most frequent cancers diagnosed in Poland.

Material and methods
Country's characteristics

Poland is one of the countries that underwent a structural transformation at the turn of the years the 1980s and 1990s. The economic crisis associated with the fall of communism has affected adversely the healthcare system's condition. At the beginning of the 21st century, some reforms have been introduced, but the effects are unsatisfactory.

Poland remains among the European countries spending the least funds on healthcare. According to the Eurostat data, it was only 6.49% of the gross domestic product (GDP) in 2020. This score is significantly worse than the EU average (10.9%) and almost twice as bad as in Germany (12.82%). It causes limitations in the accessibility and availability of healthcare resources and services with their consequences.

Moreover, the situation is additionally complicated by national heterogeneity. The significant variation between regions concerns both: the density, wealth, and personal income structure as well as the healthcare resources. The differences in the selected socio-economic factors and healthcare resources between Polish regions are presented in Fig. 1 and Fig. 2:

The clear differentiation of healthcare resources in combination with the longitudinal healthcare system's underfunding has caused a system crash due to coronavirus SARS-CoV2, which has become the leading problem for public health worldwide.

The COVID-19 pandemic has imitated the accessibility of outpatients' healthcare services. Many general practitioners have limited healthcare services to telemedicine only. Those could cause difficulties in diagnosing non-COVID-19 chronic diseases, such as cancers. Figure 3 presents the percentage of teleconsultations granted by the GPs in 2020 in relation to all settled services.

Material

The analyses have focused on the most frequent cancers diagnosed in Poland in the 2015–2021 period, established based on the Polish National Cancer Registry 2021 rapport and our previous study concerning two Polish regions: the Silesian and Subcarpathian provinces [4]. It encloses malignant neoplasm of the colorectal – CRC (C18-C21 according to the ICD-10 classification), malignant neoplasm of bronchus and lung (C34), other malignant neoplasms of skin (C44), malignant neoplasm of kidney, except renal pelvis (C64) and malignant neoplasm of the breast (C50) among women or malignant neoplasm of the prostate (C61) in men.

Patients diagnosed with one of the above cancers who have obtained healthcare services in at least one of the ranges: 1. hospitalization in the clinical oncology units (including one-day hospitalizations), 2. hospitalizations in the oncological radiotherapy units (including one-day hospitalizations and all organizational forms of radiotherapy services), 3. hospitalizations in oncological and general surgery units and 4. outpatient oncological specialist healthcare were enrolled into the analysis.

The pre-processed, secondary epidemiological data were obtained from the National Health Found of Poland (NFZ), which is the only organization responsible for the contracting and accounting of healthcare services financed from public funds in Poland. So, the NFZ may be perceived as the most reliable and comprehensive data source.

Methodology

The epidemiological analysis was performed and divided into subregions (NUTS-3 units), according to patients’ domicile at the time of cancer diagnosis. The time points of providing the first healthcare service were considered as the time of cancer diagnosis.

Unlike the Polish National Cancer Registry which bases its annual rapports on the MZ/N-1a form filled in by the physician who has diagnosed cancer, we have based on the data from the medical treatment billing process by the NFZ.

We had chosen the years 2015, 2019, and 2020 as the three time-points for which the standardized incidence rates (SIR) were calculated to assess the basic level of cancer morbidity burden as well as the effect of the COVID-19 pandemic.

For each of the 73 Polish subregions, we have calculated the incidence rate per 100,000 population standardized to the European Standard Population 2013 (ESP 2013), with the use of the formula:

\[
SIR = \frac{\sum_{i=1}^{N} k_i \cdot w_i}{\sum_{i=1}^{N} w_i}
\]

where:

\(N\) – number of age groups,
To assess the annual change of SIR for each cancer that has been analyzed, the Annual Percent Change (APC) in the subregions with the 95% confidence interval (95% CI – confidence interval) was with the use of formulas:

$$APC = 100 \cdot \left( e^b - 1 \right)$$

where:

- $e$ – Euler’s number ($\approx 2.718$),
- $b$ – linear regression coefficient for the $\ln(rates)$ ~ calendar year model,

and

$$95\% CI = \left( e^{(b \pm (t_{value} \cdot SE))} - 1 \right) \cdot 100$$

where:

- $t_{value}$ – an inverse of the t distribution function evaluated at $1-p/2$ and with $n-2$ degrees of freedom,
- $SE$ – standard error.

The assessment of the statistical significance of APC was equivalent to the statistical evaluation of the linear regression model. Statistical significance was set at a $p$-value below 0.05. Two-tailed tests were used.

The statistical analyses as well as the mapping of SIR values were performed with the use of the Statistica v. 13.3 software (TIBCO Software Inc., Palo Alto, CA, USA).

Data on the state of population in each of the subregions as well as selected social and economic factors were obtained from the Statistics Poland database.

**Ethical approval**

According to the Bioethical Committee of the Medical University of Silesia (No PCN/CBN/0052/KB/108/22), this study did not require the permission of the Committee due to its retrospective character.

All methods were conducted following relevant guidelines and regulations and respecting the confidentiality of biomedical data.

**Results**

The nationwide pre-processed data concerning cancer patients’ shared by the NFZ have been analyzed. Colorectal cancer (C18-21) has become the leading oncological problem in Poland in recent years. In 2015 the greatest burden of C18-21 was observed in the Leszno, Słupsk, and Starogard subregions, and in the 2015–2019 period, unstigmatized by the pandemic, the SIR remained stable. Subsequently, in 2020 a significant decrease in the SIR was observed in most of the subregions beside the Leszno and Słupsk, with clear spatial division between northern-west and southern-east areas. The long-term trend shows a significant increase in the SIR in 2021 compared to 2020. The only subregions where the Annual Percent Change (APC) has increased despite the pandemic effect were: Elbląg, Gliwice, Cracow (rural), Łódź, Tamów, and Skierniewice, although APC changes were not significant.

The greatest SIR of lung cancer (C34) in 2015 was observed in the city of Szczecin as well as Słupsk and Starogard subregions. Then, in 2015–2019 the SIR decreased across the country (in most of the subregions statistically significant) remaining the greatest burden in the Leszno and Słupsk subregions. The greatest reduction of C34 burden was observed in the city of Szczecin with the APC $-13.99$ ($p < 0.05$).

The burden of skin cancer (C44) in 2015 was comparable across the country. Nevertheless, the greatest SIR was observed in the cities of Poznań and Szczecin, Ostrołęka, and Włocławek subregions and it did not change till 2019. The APC changes show that the C44 burden slightly decreased in 2015–2021 in most of the subregions. The Wrocław (rural) subregion has stood out as the one with a greater increase in the C44 burden.

In 2015–2021 the burden of kidney cancer (C64) has decreased in most of the Polish subregions and the most noticeable reduction was observed in the Przemyśl, Słupsk and Wrocław (both city and rural) subregions.
Similarly, to most developed societies in Western Europe, breast (C50) and prostate (C61) cancers were the most frequent cancer diagnosed in Poland among women and men respectively. In 2015 the greatest SIR for C50 was found in the subregions of Konin, Leszno, cities of Łódź and Poznań and Słupsk. Such a situation has remained stable till 2020 when the COVID-19 pandemic has occurred. In 2020, compared to 2019 a visible reduction of SIR in most of the subregions was found, especially in the eastern areas (ex. Tamobrzeg subregion). The least impact on the C50 SIR, the pandemic has had in the Konin Leszno, Słupsk subregions, and the city of Warsaw.

The burden of prostate cancer increased in the 2015–2019 period in most of the Polish subregions. Nevertheless, besides the increase of prostate cancer morbidity at the national level, in some subregions we have found a reduction of this burden; the greatest decrease of APC was found in the subregions of Olsztyn and Słupsk. Of note, the Słupsk subregion was also one of the subregions with the greatest burden of prostate cancer in 2019. The greatest SIR values were found in the subregions of Biłgoraj Podlaski, Chojnice Gdańsk, Jelenia Góra, Kielce, Koszalin, Leszno, Lublin Poznań (both city and rural), Szczytno (both city and rural), Starogard, Suwałki, and Tricity.

In 2020 when the COVID-19 pandemic occurred, a visible reduction of the SIR of C61 in most of the subregions was found.

The figures below show the SIR values in each of the subregions (additionally, the lines show the borders of counties) in 2015, 2019, and 2020. The annual percentage changes nationwide as well as in the each of subregions in the 2016–2021 period are presented below on the charts and maps, respectively.

The APC with 95% CI calculated for all the analyzed cancers in each of the subregions is presented in the supplementary table.

**Discussion**

Cancers are the leading health problem in aging societies. According to the WHO data, in 2015 cancers became the leading cause of total as well as premature deaths worldwide. Neoplastic diseases are responsible for much of a potential year of life lost and life years without disabilities [5]. European population remains only 9% of the world population but it accounts for about 25% of cancer incidents worldwide [6]. Because of the aging of European societies, an increase in the cancer burden in the next years should be expected. According to current estimations, by the end of 2040 the worldwide cancer burden will have achieved 28.4 million incidents, so fighting cancer becomes the prior task for the public health of the 21st century [7].

In Poland, the National Cancer Registry (NCR) is collecting nationwide cancer data and publishing annual cancer bulletins since 1979 [8] and it is one of the best cancer registries among EU member states. The basis for editing the register is the cancer report form (MZ/N-1a) filled out by the physician who has diagnosed the cancer. Unfortunately, the NCR data are underestimated [9, 10]. So, another data source is needed to assess the complete cancer burden. In the Polish healthcare system, the National Health Fund of Poland is the only institution contracting and accounting the healthcare services financed by public funds. Citizens paying mandatory health insurance are entitled to healthcare access. Simultaneously, the private health insurance sector is poorly developed so the NFZ (Eng. NHF) nationwide data can be considered as the most complete and reliable. So, our study has covered the Polish population.

The cancers epidemiology

In the current study, we have analyzed selected the most common cancers diagnosed in Poland in 2015-2021, based on the National Cancer Registry database and our previous study concerning two regions of southern Poland: the Silesian and Subcarpathian voivodeships [4]. It was colorectal cancer, lung and bronchus cancer, skin cancers (without melanoma), kidney cancer except for renal pelvis, and two gender-related cancers: breast cancer among women and prostate cancer among men. Such structure of most prevalent cancers does not differ from Western societies with high Human Development Index (HDI). Our results correspond with available data [8].

One of the most common cancers diagnosed in Poland in 2015-2021 was colorectal cancer. This disease remains the third of the most frequent cancers diagnosed worldwide and the second cause of cancer-related deaths because of insufficient diagnostics and ineffective therapy [1, 11-13]. The high burden of colorectal cancer observed in Poland might be affected by the socio-economic transformation of the 1990s and progressive changes in lifestyle and Western diet change as well as the low utilization of screening programs (such as screening colonoscopy). The high prevalence of low physical activity, overweight and obesity, smoking, and excessive alcohol consumption remain serious problems for the nationwide health policy. The stabilization of the colorectal SIR in 2015-2019, observed in our study, corresponds with the Xi and Xu findings, according to which in the high-developed countries the burden of CRC stabilizes at a relatively high level, over four times greater compared to the countries of low HDI [1].

The lung cancer were the second of the most frequent cancers diagnosed nationwide in 2015-2021 without gender differences. The available data underline the relationship between smoking and air pollution and the risk of lung cancer [14-18]. Also, in Poland lung cancer incidents and air pollution are linked [19], especially that according to the World Bank Group, Polish cities remain 36 of 50 of the most polluted urban areas of the European Union [20].

Our results show that the burden of lung cancer has decreased in 2015-2021 all over the country. This could be affected by the social changes already observed over ten years ago resulting from the decrease in the smoking prevalence in 2015 compared to 1999 [21] and the changes in the smoker's structure [7].
The high prevalence of skin cancer (C44) observed in our study does not deviate from most of the countries with the domination of Caucasians. In the last thirty years, skin cancer morbidity has tripled in the United States and Europe [22].

The decrease in skin cancer’s APC in most of the northern and northern-west subregions may be associated with the limited number of medical doctors in those areas (Fig. 1a). Such findings correspond with Augustin et al. results indicating that the availability of medical doctors, especially general practitioners, and potential difficulties in accessing them are associated with the number of skin screening tests [22].

Breast and prostate cancers were the most frequent oncological diseases diagnosed in Poland in 2015-2021 among women and men, respectively. Those cancers are the most frequent oncological diseases diagnosed in highly developed countries.

In our study we found an increased morbidity for prostate cancer in 2015-2019, meanwhile, the burden of breast cancer remained stable. Those findings correspond with previous results. Pacelli et al. have shown that after the period of burden increase the morbidity and mortality of breast cancer in most developed countries have stabilized or even decreased slightly in the last 15-20 years [23]. It may be caused by the wide spreading of social campaigns and screening programs reducing inequalities and improving accessibility of mammography [24]. Moreover, when assessing the breast cancer burden, especially in survivors, we should not ignore the progress in the therapy, in particular HER2-positive and luminal subtypes. The increased burden of breast cancer, observed in our study, corresponds with Didkowska et al. results [7].

We found an increased SIR of prostate cancer in 2015-2019 as well. According to the previous study, the C61 APC was the highest among the most common cancers diagnosed in Poland [7]. The aetiology of prostate cancer is relatively weakly examined compared to other cancers. The early diagnosis is essential but over 75% of men aged over 45 have never performed the PSA measurement.

The COVID-19 impact

In 2020 a visible decrease in the SIR for each of the analyzed cancers was observed. It is most likely related to the limited accessibility and availability of healthcare services for non-COVID diseases because of healthcare staff and resources’ engagement in fighting the COVID-19 pandemic. The second important aspect was the procrastination of not requiring urgent medical consultations, physical examinations, and diagnostic procedures [25]. This was caused both by the care of the medical professionals’ maintenance and patients’ and physicians’ fear of COVID-19 infection, especially before the vaccine development.

The COVID-19 pandemic has exposed health inequalities and had a dramatic impact on cancer patients. Due to pandemic restrictions, most healthcare services have been realized with the use of remote methods, such as telemedicine. The traditional face-to-face medical consultations with physical examination had been limited [26, 27]. The percentage of physicians’ teleconsultations increased from 1.2% in March to over 60% in April 2020 [28]. Such patients’ management in the pandemic reality was difficult and probably in many cases delayed diagnosis, and treatment, and have affected the suboptimal therapy. Moreover, cancer patients had a higher risk of SARS-CoV2 infection and complications [25, 28].

Our results show a print of such unfavorable pandemic conditions by the visible reduction of SIR of each of the analyzed cancers in 2020.

In 2019, just before the pandemic occurred, the burden of colorectal and lung cancer had been characterized by a clear spatially dependent decreasing division along the northern-west-southern-east axis and these findings correspond with the previous results [7]. Subsequently, in 2020 the burden of colorectal cancer has decreased especially in the eastern subregions (those areas are characterized by relatively limited healthcare resources, e.g. hospital beds) while the lung cancer incidence rate has decreased equally across the country. The reduction of colorectal cancer was most likely affected by the abandonment of standard medical consultations and the replacement of them by remote methods. It caused a drastic limitation in the number of performed endoscopic [27].

The visible SIR decreasing in the northern-west-southern-east axis in 2020 was observed in the case of malignant neoplasms of skin and breast cancer among women as well. The subregions of southern-east areas of Poland are mainly rural with relatively poor healthcare resources. The pandemic-related limited access to healthcare supplies in rural areas may be the consequence of the insufficiency of the healthcare system and human resources [26].

The spatial differentiation of the cancer burden as well as the health inequalities were observed in many countries, including European states. The social determinants of health inequalities are well established but there is no exhaustive data on the spatial ones. In France at the beginning of the 21st century, the standardized mortality rate of cancers in the northern counties was almost twice as high as in the southern areas, which was caused by environmental, social, and spatial conditions. The spatial differentiation of the cancer burden was affected by the unequal access to healthcare resources occurring by the smaller use of medical services in the areas with a smaller number of medical entities. This contributes to less favorable prevention, early diagnostics, and appropriate patient management. So that remote patients have worse access to specialized health centers and lower survival chances [29].

The spatial differentiation of the cancer burden was found in Slovakia as well. Slovakia is close to Poland because of the similarities in the social and political transformation observed at the turn of the 80s and 90s. Since the middle of the 80s, the burden of communicable diseases had decreased, and cancers became the leading health problem in Slovakia. Moreover, the significant disproportion between the wealthy regions and the southern and western areas is noticeable both as the inequality of the socio-economic factors as well as the better quality of life and healthcare [5].
The Polish healthcare system has been underfinanced for many years and successive governments since 1990 it has been occurring as one of the leading problems that has to be solved.

In 2005 and 2019 Poland spent 1.05 and 2.3 billion euro on cancer treatment respectively [30]. The increase in the finances dedicated to oncology was associated with the development and implementation of the so-called "oncological package" which was supposed to increase the availability and efficiency of oncological healthcare. Simultaneously, according to the National Cancer Strategy 2020, one of the milestones was to increase the percentages of 5-year survivals in cancer diseases and improve the prevention and screenings [7]. According to the EUROCASE-5 study, the cancer 5-year survival rate noted in Poland was significantly lower than the EU average (43% vs. 54.6%). Those targets were essential, from the public health's point of view because according to WHO, over 40% of cancer incidents might be avoided or successfully treated in case of early detection [31].

Unfortunately, the cancer prevention expenditures in 2012-2015 decreased by 10% [33] as a low percentage of Poles utilized screening tests, such as colonoscopy or mammography, despite the access to these programs.

Conclusions

Our results show a significant decrease in the SIR of the most frequent cancers diagnosed in Poland in 2020 compared to 2019. Subsequently, the excessive increase in 2021 was found, the most likely due to the gradual reduction of epidemic restrictions. It should be assumed that many patients whose cancer diagnosis and beginning of treatment were delayed, because of pandemic restrictions and inaccessibility of healthcare services, could be diagnosed with a more advanced stage of cancer. Those implicate a worse prognosis and diminished chance for cure.

Declarations

Ethics approval

All experimental protocols were approved by Bioethical Commission of the Medical University of Silesia (permission Nº PCN/CBN/0052/KB/108/22).

Consent for publication

The research material was depersonalized data so the informed consent in not required.

Authors' contributions

PCh: research concept and design, collection and/or assembly of data, data analysis and interpretation, writing the article, final approval of the article

AO: research concept and design, critical revision of the article, final approval of the article

WK: data interpretation, final approval of the article

JCh: critical revision of the article, final approval of the article

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Availability of data and materials

Secondary epidemiological, depersonalized data was obtained from the National Health Fund of Poland (NFZ) after the healthcare services settlement process. Disclosure of data requires the consent of the National Health Fund of Poland, as data administrator.

The datasets analysed during the current study are not publicly available but there is possible to obtain them through access to public information. For this purpose, a written request addressed to the Director of the National Health Fund of Poland should be made.

Competing interests

The authors declare that they have no competing interests.

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References


Figures

Figure 1

The average density per 1 km² in each of the Polish regions in 2019. Bars present the ratio of the average monthly salary to the national average (presented as horizontal lines).
Figure 2

The spatial differentiation selected healthcare resources in Polish regions in 2019 where: A – The number of medical doctors per 100,000 citizens; B – The number of oncologists per 100,000 citizens; C – The number of hospital beds per 100,000; D – The number of hospital beds in the oncological departments per 100,000 citizens; E – The number of hospital beds in the infectious diseases departments per 100,000 citizens.
Figure 3

The percentage of teleconsultations of all granted services realized by the general practitioners in Polish voivodeships in 2020.
Figure 4

The epidemic situation of colorectal cancer (C18-C21) in Poland where: A – SIR values in 2015, 2019, and 2019 in each of the subregions; B – the nationwide APC of SIR in subsequent years; C – the APC in 2015-2021 period in each of the subregions.

Figure 5

The epidemic situation of bronchus and lung cancer (C34) in Poland where: A – SIR values in 2015, 2019, and 2019 in each of the subregions; B – the nationwide APC of SIR in subsequent years; C – the APC in 2015-2021 period in each of the subregions.
Figure 6

The epidemic situation of skin cancer (C44) in Poland where: A – SIR values in 2015, 2019, and 2021 in each of the subregions; B – the nationwide APC of SIR in subsequent years; C – the APC in 2015-2021 period in each of the subregions.
Figure 7

The epidemic situation of kidney cancer, except the renal pelvis \(\textbf{(C64)}\) in Poland where: \(\textbf{A}\) – SIR values in 2015, 2019, and 2020 in each of the subregions; \(\textbf{B}\) – the nationwide APC of SIR in subsequent years; \(\textbf{C}\) – the APC in 2015-2021 period in each of the subregions.
Figure 8

The epidemic situation of breast cancer (C50) among women in Poland where: A – SIR values in 2015, 2019, and 2021 in each of the subregions; B – the nationwide APC of SIR in subsequent years; C – the APC in 2015-2021 period in each of the subregions.
Figure 9
The epidemic situation of prostate cancer (C61) in Poland where: A – SIR values in 2015, 2019, and 2020 in each of the subregions; B – the nationwide APC of SIR in subsequent years; C – the APC in 2015-2021 period in each of the subregions.

Supplementary Files
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