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ARAŞTIRMA MAKALESİ **RESEARCH PAPER**

Analysis of Environmental Contributions of Pharmaceutical Companies in Türkiye to Combat Climate Change [*]

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Abstract: The impact of global climate change on health negatively impacts human health and well-being. To mitigate the negative effects of climate change, the pharmaceutical industry must become a low-greenhouse gas emission sector. Reducing greenhouse gas emissions provides a clear benefit to human health. Therefore, low-greenhouse gas emission strategies are crucial in pharmaceutical production today. The websites of pharmaceutical companies was scanned in Türkiye, their activity reports and notifications were evaluated, and environmental policies aimed at reducing the negative impacts of climate change on human health were examined. In this context, the websites of pharmaceutical companies that were included in the ISO (Istanbul Chamber of Industry) Top 500 and ISO Second Top 500 evaluations between 2009 and 2024 were included in the study. Fifteen domestic pharmaceutical companies were included in the study. The results of the study indicated that pharmaceutical companies are implementing environmentally friendly activities such as renewable energy use, electric vehicle use, waste management, recycling, emission reduction, technological innovation, water management, and air pollution prevention. In terms of public health, Greenhouse Gas Protocol assessments of greenhouse gas reduction strategies reveal that the majority of pharmaceutical companies have completed independent audits of the Greenhouse Gas Protocol recommendations and conducted planned and systematic assessments of Scope 1, Scope 2, and Scope 3 studies. These assessments aim to develop environmental policies aimed at achieving net-zero emissions in the future. Furthermore, pharmaceutical companies are monitoring the negative impacts of climate change by establishing a professional staff for energy and climate management. Pharmaceutical companies also provide support through public awareness campaigns. The practices implemented by pharmaceutical companies are important in the development of environmental policies.

Keywords: Climate change, drugs, human health, pharmaceutical companies.

Türkiye' deki İlaç Firmalarının İklim Değişikliği ile Mücadeleye Yönelik Çevresel Katkı Çalışmalarının Analizi

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Öz: Küresel iklim değişikliğinin sağlık üzerindeki etkisi insan sağlığını ve refahını olumsuz etkilemektedir. İklim değişikliğinin olumsuz etkilerinin hafifletilmesi için ilaç endüstrisinin düşük sera gazı emisyonuna sahip sektörler arasına girmesi gerekiyor. Çünkü sera gazı emisyonlarını azaltmak insan sağlığına yönelik net fayda sağlamaktadır. Dolayısıyla ilaçların üretiminde düşük sera gazı emisyon stratejileri günümüzde önemli olmaktadır. Türkiye'deki ilaç firmalarının internet siteleri taranarak faaliyet raporları ve bildirimleri değerlendirilerek iklim değişikliğinin insan sağlığı üzerindeki olumsuz etkilerin azaltılmasına yönelik çevresel politikalar incelenmiştir. Bu bağlamda 2009-2024 yılları arasında İSO (İstanbul Sanayi Odası) 500 ve İSO ikinci 500 değerlendirmesine giren ilaç firmaları esas alınarak internet siteleri araştırmaya dâhil edilmiştir. Araştırmaya 15 yerli ilaç firması dâhil edilmiştir. Araştırmanın sonuçlarına göre ilaç firmaları yenilenebilir enerji kullanımı, elektrikli araç kullanımı, atık yönetimi, geri dönüşüm, emisyon azaltma, teknolojik yenilik, su yönetimi, hava kirliliğinin önlenmesi gibi çevre dostu faaliyetleri kullanmaktadır. Toplum sağlığı açısından sera gazı azaltma stratejilerinde, Greenhouse Gas Protocol değerlendirmelerine bakıldığında ilaç firmalarının büyük kısmının Greenhouse Gas Protocol önerilerine yönelik bağımsız kuruluş denetimlerini tamamlayarak kapsam 1, kapsam 2 ve kapsam 3 çalışmalarına yönelik planlı ve sistematik değerlendirmeler yaptıkları bu değerlendirmelerin amacının gelecekte net sıfır emisyona ulaşma hedefine yönelik çevre politikaları olduğu görülmektedir. Ayrıca ilaç firmaları iklim değişikliğinin yarattığı olumsuz etkileri, enerji ve iklim yönetimi konusunda profesyonel kadro oluşturarak takip etmektedir. İlaç firmaları toplumda farkındalık çalışmaları yaparak da destek vermektedirler. İlaç firmalarının yaptığı uygulamalar çevre politikalarının oluşması bağlamında önemlidir.

Anahtar Kelimeler: İklim değişikliği, ilaçlar, insan sağlığı, ilaç firması.

INTRODUCTION

Excessive emissions of greenhouse gases such as carbon dioxide are causing global climate change on Earth (Change, 2022). Global climate change increases extreme weather events, which directly threaten human health by causing increased morbidity, premature death, increased risk of the spread of infectious diseases, and threats of food supply chain famine (Change, 2001; Korkmaz, 2024). Because global climate change threatens human health, life, and well-being, adapting human systems to climate change (Berrang-Ford et al., 2011; Costello et al., 2009; Yıldız et al., 2021) and efforts to mitigate the climate risks created by climate change are crucial today (Myhrvold & Caldeira, 2012; Zheng et al., 2019; Diken, 2020; Eskander & Fankhauser, 2020).

The capacity to manage technological change is an essential prerequisite for climate change mitigation, adaptation and green growth (Malhotra et al 2022). Technological change in healthcare also contributes to the increase in pollutant emissions both directly and indirectly (Eckelman et al., 2018; Wang et al., 2021). As technological investment in healthcare increases, there is a significant increase in the health-damaging factors resulting from pollution and environmental change (Lenzen et al., 2020). Therefore, increasing investments in the healthcare sector leads to negative consequences, particularly 12% reduction in acid rain, 10% greenhouse gas emissions, 10% smog, 9% reduction in criteria air pollutants, 1% reduction in stratospheric ozone depletion (1%), and 1-2% reduction in carcinogenic and non-carcinogenic air toxins and 1-2% reduction in national air pollution emissions (Eckelman & Sherman, 2016). The carbon footprint from healthcare in developed countries is reported to be 3-10% of total greenhouse gas emissions (Wu, 2019), of which 39% comes from hospital operations and 14% from prescription drugs (Chung & Meltzer, 2009).

Pharmaceutical companies have a direct environmental impact in terms of waste production and disposal, greenhouse gas emissions, air pollution, water, plastics and energy consumption (Malik et al., 2018). Greenhouse Gas Protocol (GHG) produced during pharmaceutical production includes direct emissions due to energy use, indirect emissions due to energy consumption used in the company's activities and GHG emissions that are outside the company's ownership or control but related to the supply chain (i.e., material procurement, logistics, sales and disposal) (Nagai, 2023; Rodríguez-Jiménez et al., 2023).

A critical assessment of the key environmental factors in the pharmaceutical industry indicates that energy and chemical use are the largest contributors (Chen et al., 2024). This shows that the pharmaceutical industry is responsible for a significant portion of carbon emissions and is causing environmental damage globally. Therefore, there is a need for rapid intervention and finding ways to prevent the increasing levels of greenhouse gases in the atmosphere (Ray et al., 2021).

In order to reduce the impact of anthropogenic climate change, the pharmaceutical industry, which is an important aspect of health services, needs to be among the sectors with low greenhouse gas emissions in mitigating the climate impact (Keil, 2023). Actions to reduce greenhouse gas emissions provide clear benefits for health (Haines et al., 2009). Therefore, effective strategies and related initiatives leading to reductions in greenhouse gas emissions, which are an important element for pharmaceutical companies to successfully meet the climate change challenge, are important. (Meissen & Eagan, 2008). Among the greenhouse gas emission program strategy initiatives to be carried out by pharmaceutical companies; transition to renewable energy (Lima et al., 2020), industrial energy efficiency (Jordaan et al., 2017), sustainable agriculture, electrification of transportation, forest restoration, technological innovation (Andersson & Börjesson, 2021; Candra et al., 2023; Filonchyk et al., 2024a) can be expressed as follows.

When take a look at the emission load originating from production in the pharmaceutical industry, it is stated that there are institutional emissions in pharmaceutical drugs (34.5%), active ingredient production (28.5%), drug manufacturing (25.5%), drug packaging (5.3%), drug logistics (3.6%), and excipients (2.7%) (Piffoux et al., 2024).

The carbon footprint of healthcare varies from country to country. In Australia, healthcare accounts for 7% of total carbon emissions, while the pharmaceutical industry accounts for approximately 19% of greenhouse gas emissions in the healthcare sector (Malik et al., 2018). In Japan, healthcare accounts for 4.6% of the carbon footprint. Preventing the waste of unused medicines reduces emissions by 1.24% per year (Nansai et al., 2020). The size of the healthcare carbon footprint in the UK (Hu et al., 2021; Rizan et al., 2021), the environmental impact of healthcare in the United States due to the carbon footprints resulting from the provision of medical care and medicines (Gaetani et al., 2024; Kaur et al., 2025), and the Chinese pharmaceutical industry, which has seen high energy consumption and significant increases in emissions as a result of growth (Xu & Tan, 2022). This situation poses serious problems even in the most developed countries of the world.

There are no detailed analyses regarding the greenhouse gas emissions of the pharmaceutical industry in Türkiye. In addition, according to the 2021 data of the Turkish Statistical Institute (TUIK), energy-related emissions account for the largest share of total greenhouse gas emissions with 71.3%, followed by industrial processes

and product use with 13.3%, agriculture with 12.8%, and the waste sector with 2.6%. (TUIK, 2025)

The number of drugs used in health services to treat diseases is constantly increasing. This increase is naturally reflected in environmental factors. The consumption of drugs produced for human and veterinary use pollutes the terrestrial and marine environment and affects the ecosystem. Increasing environmental awareness regarding drug-related activities and developing principles and measures to reduce negative environmental impacts are very important today (Bartolo et al., 2021). In fact, combating climate change is seen as the greatest global health opportunity of the 21st century (Watts et al., 2017).

Being aware of the carbon footprint of a health system provides a means to quantify its environmental impact, understand carbon-intensive areas to target with mitigation measures, and map trends in emissions over time. Attempts to calculate the carbon footprint of national health systems are few, mostly in developed countries, and limited by data availability and methodological shortcomings. All stakeholders within health systems need to join the global fight against climate change (Booth, 2022).

The expressions about carbon footprint in the world are very frequently on the agenda in our daily lives. The reason for this is the negative effects of carbon footprint on humanity by creating a negative effect on climate change. Although issues about climate change are at the top of the list in Türkiye, it is understood that there are not enough studies on the pharmaceutical industry, which has an important place in health services regarding global climate change. This study was conducted to provide information about greenhouse phase emissions of the pharmaceutical industry to decision makers, policy makers and stakeholders of the sector in Türkiye. In this context, it is the first original study to provide general information about the data of the pharmaceutical industry.

MATERIAL AND METHOD

The Association of Research-Based Pharmaceutical Companies (AİFD), one of the largest associations with membership in Türkiye's pharmaceutical companies, lists the Istanbul Chamber of Industry (ISO) as the reference institution for Türkiye's leading domestic pharmaceutical manufacturers in its 2024 Turkish Pharmaceutical Sector report (AİFD 2024). ISO data in Türkiye is crucial for the environmental, social, and economic assessment of industrial organizations (Yangil 2015). ISO is the largest industrial organization in terms of membership and production, and the oldest in terms of history, supporting Turkish industry (iso.org.tr, 2020). ISO lists the largest industrial organizations in Türkiye as ISO 500 and Second ISO 500 industrial companies by size (iso500.org.tr).

The study targeted companies that manufacture pharmaceuticals and have an industrial presence in Türkiye.The study sample consisted of domestic pharmaceutical companies that are members of the pharmaceutical manufacturing industry in Türkiye and are included in the ISO list, which evaluates Türkiye's largest industrial enterprises. The reason why industrial enterprises were chosen as the sample group is that they create high added value to the national economy and the environmental impact of the waste used during production is high (Yangil 2015). In this context, domestic pharmaceutical companies that manufacture Essential Pharmaceutical Products and Pharmaceutical Materials, as listed in the NACE (Nomenclature of Economic Activities) classification system, which is used in the statistical industry standard classification of economic activities in the European Community, were included in the study. The inclusion criteria for the pharmaceutical companies included in the study were being domestic pharmaceutical companies, having an industrial presence, actively using their websites, and being ranked in the ISO NACE classification system between 2009 and 2024. According to data published by the Istanbul Chamber of Industry, a total of 15 pharmaceutical companies are among the top 1,000, with nine companies listed among Türkiye's Top 500 Industrial Enterprises and six among the Second Top 500 Industrial Enterprises.

The data source for the pharmaceutical companies included in the study was obtained using content analysis method between April and May 2025, using publicly available, self-reported company data published on the pharmaceutical companies' websites.

Content analysis is a systematic and objective research method used to describe, measure, and summarize large amounts of verbal, visual, and written information. Content analysis aims to analyze many different materials, such as documents, texts, and papers, within certain rules to obtain objective, measurable, and verifiable information. It is a scientific technique within the qualitative research method. (Alanka, 2024; Badzinski et al., 2021; Metin & Ünal 2022).

The data included general information about pharmaceutical companies, their climate change targets and standards, greenhouse gas emissions, emissions reporting standards, and practices or strategies implemented to reduce emissions. The practices in the literature review were considered as part of the companies' environmental contributions to combating global climate change.

In this context, detailed data was obtained by researching keywords such as corporate social responsibility, waste management, greenhouse gases, air pollution, water management, packaging, recycling, electrification of transportation, forestry, innovation, zero waste, logistics, cost and professional management in order

to determine Scope 1, Scope 2, Scope 3, independent institution audit, net zero emission targeting and environmental policy and environmental policy initiatives.

Information was also collected on the companies' general awareness-raising activities (Andersson & Börjesson 2021; Booth et al., 2023; Chomać-Pierzecka, 2023; Filonchyk 2024b; Sullivan, 2009). The research examined pharmaceutical companies' publicly reported targets for reducing greenhouse gas emissions, as well as their greenhouse gas emissions and the efforts they have undertaken to reduce these emissions.

The data were compared with international literature studies, and by comparing the climate studies of pharmaceutical companies operating in the global market with the studies of domestic pharmaceutical companies operating in the Turkish market, the findings were expanded and the discussion section of the study was strengthened.

Although they are in the ranking, Atabay Chemical Industry, Adeka Pharmaceutical Industry and Tüm Ekip Pharmaceutical Industry could not be included in the study due to their websites being under maintenance or not providing information.

The study data was obtained from public websites. Since the data is openly available to everyone, ethics committee approval was not obtained because the data was not collected in a way that would require ethics committee approval.

Limitations of the Study: Based on the results obtained from the literature, this study is the first to evaluate the climate change targets, emission reduction strategies, environmental policies, and awareness-raising activities of domestic pharmaceutical companies within the Turkish healthcare system using content analysis. Because the study does not cover all pharmaceutical companies in Türkiye, it is not possible to generalize the results, but some conclusions can be drawn. However, not all pharmaceutical companies selling in the Turkish pharmaceutical market have industrial operations. Furthermore, pharmaceutical companies cannot be held solely responsible for reducing the environmental impact of drugs. Since pharmaceutical consumption is the responsibility of all stakeholders in society, the relevant activities of all other sectors should also be examined.

The research is based on data obtained from the public self-reports of domestic pharmaceutical companies. With increasing pressure for environmentally friendly activities, to increase consumer sensitivity to environmentally friendly products, to increase their share prices, and to benefit from more environmental policy incentives, companies may engage in greenwashing by deliberately creating a misleading environmental public image. (Delmas & Burbano 2011; de Freitas Netto et al., 2020; Flammer, 2013; Zhou, 2024). Therefore, the fact that not all pharmaceutical companies included in the study were audited by independent third parties and the information was their own self-assessment may create limitations in terms of trust.

When assessing the current state of the Turkish pharmaceutical sector, information such as its ranking in the global pharmaceutical market, value scale, volume scale, original-generic drug market share and turnover ratios, pharmaceutical import and manufacturing market, box sales and turnover ratios, drug consumption by therapeutic group, box sales by therapeutic group, biotechnological drug market share, pricing, reimbursement, licensing, and research and development (R&D) is generally included (IEIS, AİFD). There is no list or study in the literature comparing or ranking pharmaceutical companies. Consequently, the inherent dynamics of each pharmaceutical company make assessments difficult. Pharmaceutical companies may be the largest in box production but lag behind in turnover, or the largest in employment but lag behind in box market share. A pharmaceutical company's size, ranking, or the importance of its strategic influence should be assessed based on multiple factors, such as box sales, turnover, employment, R&D, import-export share, patent value of its original drugs, its place in therapeutic groups, and net profit. Furthermore, the pharmaceutical companies included in these assessments must be willing to participate. There is no such evaluation in the literature.

RESULTS

Table 1 lists domestic capital pharmaceutical companies in Türkiye that are in the ISO 500 and ISO second 500 rankings. Among the pharmaceutical companies included in the study are companies that produce human, veterinary and agricultural drugs. Pharmaceutical companies are shown by number in the table. In addition, the head offices and websites of the companies are shared in detail.

Table 2 provides a table of detailed studies of companies on the Greenhouse Gas Protocol. The audit data of the studies conducted by an independent organization is also indicated in the table. Thus, the transparency details of the companies are also emphasized. The table also emphasizes that the aim of the companies' studies is to reach net zero emissions. It can be said that all of the companies in the table have developed an environmental policy for climate change and the ecosystem.

Table 3 provides information on the details of the companies' work on climate change and the ecosystem. Pharmaceutical companies are numbered according to the match in Table 1. When take a look an evaluate the table data of pharmaceutical companies in Türkiye, it is seen that they have almost completely implemented practices regarding climate change.

Table 1. List of pharmaceutical companies included in the study.

Number	Pharmaceutical Company Name	Headquarters	e-mail
1	Abdi İbrahim Pharmaceutical Industry and Trade Inc.	İstanbul	www.abdiibrahim.com.tr
2	Nobel Pharmaceutical Industry and Trade Inc.	İstanbul	www.nobel.com.tr
3	Koçak Farma Pharmaceutical Industry and Trade Inc.	İstanbul	www.kocakfarma.com
4	Polifarma Pharmaceutical Industry and Trade Inc.	İstanbul	www.polifarma.com.tr
5	World Medicine Pharmaceutical Industry and Trade Inc.	İstanbul	www.worldmedicine.com.tr
6	Santa Farma Pharmaceutical Industry and Trade Inc.	İstanbul	www.santafarma.com.tr
7	İlko Pharmaceutical Industry and Trade Inc.	İstanbul	www.ilko.com.tr
8	Biofarma Pharmaceutical Industry and Trade Inc.	İstanbul	www.biofarma.com.tr
9	Turk Pharmaceuticals and Serum Industry Inc.	Ankara	www.turkilac.com.tr
10	Onko Pharmaceutical Industry and Trade Inc.	Kocaeli	www.onkokocsel.com
11	Agrobest Group Agricultural Medicines Seed Manufacturing Import Export Industry and Trade Inc.	İzmir	www.agrobestgrup.com
12	Bilim Pharmaceutical Industry and Trade Inc.	İstanbul	www.bilimilac.com.tr
13	Ali Raif Pharmaceutical Industry and Trade Inc.	İstanbul	www.aliraif.com.tr
14	Deva Holding Inc.	İstanbul	www.deva.com.tr
15	Humanis Health Inc.	İstanbul	www.humanis.com.tr

Table 2. Greenhouse Gas Protocol information.

Pharmaceutical Company Name	Scope 1	Scope 2	Scope 3	Independent institution audit	Targeting net zero emissions	Environmental Policy
Abdi İbrahim Pharmaceutical Industry and Trade Inc.	X	X	X	X	X	X
Nobel Pharmaceutical Industry and Trade Inc.						X
Koçak Farma Pharmaceutical Industry and Trade Inc.	X	X	X	X	X	X
Polifarma Pharmaceutical Industry and Trade Inc.						X
World Medicine Pharmaceutical Industry and Trade Inc.						X
Santa Farma Pharmaceutical Industry and Trade Inc.						X
İlko Pharmaceutical Industry and Trade Inc.	X	X	X	X	X	X
Biofarma Pharmaceutical Industry and Trade Inc.	X	X	X	X	X	X
Turk Pharmaceuticals and Serum Industry Inc.						X
Onko Pharmaceutical Industry and Trade Inc.						X
Agrobest Group Agricultural Medicines Seed Manufacturing Import Export Industry and Trade Inc.	X	X	X	X	X	X
Bilim Pharmaceutical Industry and Trade Inc.						
Ali Raif Pharmaceutical Industry and Trade Inc.	X	X	X	X	X	X
Deva Holding Inc.	X	X	X	X	X	X
Humanis Health Inc.						X

Table 3. Studies on environmental policies

Criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Corporate social responsibility	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Waste management	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Greenhouse gas emissions	X	X		X				X	X		X	X		X	X
Air pollution studies	X	X		X		X	X	X	X	X	X	X	X	X	X
Water management	X	X		X		X	X	X	X	X	X	X	X	X	X
Packaging management	X	X		X		X	X	X	X			X		X	X
Energy saving	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Renewable energy use	X	X	X	X		X		X	X	X	X	X		X	X
Industrial energy efficiency	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Recycling	X	X		X		X	X	X	X	X	X	X		X	X
Electrification of transportation	X			X							X			X	X
Forest restoration	X	X		X	X	X	X	X	X	X		X	X	X	X
Technological innovation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Zero waste	X	X		X	X	X		X	X	X		X	X	X	X
Logistics efficiency	X			X		X		X			X	X		X	X
Cost reduction	X			X				X	X	X	X	X		X	X
Energy and climate management professional staff	X	X		X				X	X			X		X	X

When take a look at the awareness studies of pharmaceutical companies in Table 4, it is also see awareness studies on environmental protection. Studies that bring people together in particular can also cause people to take individual measures to protect the environment.

Table 4. Awareness studies.

Awareness studies
Educational support
Athlete sponsor support
Foundation activities
Health awareness studies
Bicycle sponsorships
Support for people with disabilities
Climate change awareness studies
Public health studies
Afforestation studies
Environmental health

As part of the study, the corporate social responsibility activities of companies listed in the Borsa Istanbul (BIST) Sustainability Index were scanned through their sustainability reports and company websites, and subjected to content analysis using qualitative research methods. In this context, the social responsibility activities of the companies listed in Table 1 were analyzed. These activities not only contribute to a company's sustainability but also ensure its adoption and support by its stakeholders.

Companies conduct awareness-raising activities with their employees as a social activity. This way, they contribute to solving social problems by collaborating with employees, building emotional bonds, educating them, and raising awareness. In this way, companies transparently share their sense of responsibility to society, thereby increasing trust and confidence in the brand.

Comparison with International Pharmaceutical Companies: In a study investigating international pharmaceutical companies' efforts to reduce the negative effects of climate change (Table 5), the world's leading pharmaceutical companies are working on environmental protection (Booth et al., 2023).

According to the Greenhouse Gas Protocol information (Table 5) from international pharmaceutical companies, the world's largest and most advanced

pharmaceutical companies are working towards zero-emission targets to reduce the negative impacts of the global climate. Pharmaceutical companies from the United States (US), in particular, are among the most supportive of environmental initiatives worldwide. International pharmaceutical companies share these studies with the public through independent institutional oversight. These companies appear to strongly support environmental policies. Data from domestic pharmaceutical companies in Türkiye (Table 3). The Turkish pharmaceutical industry appears to have limited responsiveness to climate change issues, particularly with regard to the Greenhouse Gas Protocol. While Türkiye's domestic pharmaceutical companies have limited access to Greenhouse Gas Protocol information, they are still open to improvement. While approximately 54% of domestic pharmaceutical companies in the study stated that they aim to implement the Greenhouse Gas Protocol, this rate is 100% in the study that included international companies. Furthermore, the number of companies in Türkiye conducting independent institutional audits appears to be lower than that of international pharmaceutical companies.

Table 5. Greenhouse Gas Protocol information of international pharmaceutical companies.

Name	Scope 1	Scope 2	Scope 3	Targeting net zero	Independent institution audit	Environmental Policy	Country
Roche	X	X	X	X	X	X	Switzerland
Novartis	X	X	X	X	X	X	Switzerland
AbbVie	X	X	X	X	X	X	USA
Johnson & Johnson	X	X	X	X	X	X	USA
Merck &Co.	X	X	X	X	X	X	USA
Sanofi	X	X	X	X	X	X	France
Pfizer	X	X	X	X	X	X	USA
GlaxoSmithKline	X	X	X	X	X	X	England
Takeda	X	X	X	X	X	X	Japan
AstraZeneca	X	X	X	X	X	X	England
Amgen	X	X	X	X	X	X	USA
Gilead Sciences	X	X	X	X	X	X	USA
Novo Nordisk	X	X	X	X	X	X	Denmark
Bayer	X	X	X	X	X	X	Germany
Astellas Pharma Inc	X	X	X	X	X	X	Japan
Teva Pharmaceutical	X	X	X	X	X	X	Israel
Viatris	X	X	X	X	X	X	USA
Boehringer Ingelheim	X	X	X	X	X	X	Germany
Eli Lilly	X	X	X	X	X	X	USA
Bristol-Myers Squibb	X	X	X	X	X	X	USA

Furthermore, it can be said that domestic pharmaceutical companies in Türkiye and international pharmaceutical companies have similar rates of developing environmental policies. This indicates that pharmaceutical companies worldwide are implementing positive practices in developing positive environmental policies.

DISCUSSION AND CONCLUSION

Efforts to improve carbon footprints have been established to reduce the negative impacts of climate change on human health for environmental and health benefits worldwide and to ensure the highest health standards for people. (Watts et al., 2015; Chen-Xu et al., 2024). The carbon footprint of the pharmaceutical sector is said to be approximately 55% higher than the emission intensity of the automotive sector (Belkhir & Elmeligi, 2019; Richie, 2022). Ironically, emissions from the healthcare sector affect the healthcare sector itself (Sapuan et al., 2022). Studies have shown that among the emissions emitting carbon dioxide, the preventive actions to be taken by pharmaceutical companies against climate change and the protection of the ecosystem are very important. In this context, the improvement efforts to be made in the infrastructure of the pharmaceutical industry, cleaner production, rational R&D investments, and efficient use of energy will make the efforts to protect the ecosystem more efficient (Gao et al., 2019). Therefore, in order to accurately and rationally evaluate the production results and environmental impact of drugs, reliable, comparable and important information is needed about the environmental impacts of the drug throughout its life cycle (Pålsson et al., 2019). The 15 pharmaceutical companies included in the research are companies that have a deep-rooted history in Türkiye's pharmaceutical industry, producing drugs for human, veterinary and agricultural use and conducting R&D studies. Therefore, it is important to develop and improve environmental policies to reduce the health risks caused by greenhouse gas emissions released into the atmosphere for public health (Gavurova et al., 2021).

Greenhouse Gas (GHG) Protocol standards require pharmaceutical companies to measure and report greenhouse gas emissions resulting from operations and value chain activities and to achieve emission targets. These emissions include direct, indirect and logistic activities. (Protocol, 2011). It is observed that 8 out of 15 pharmaceutical companies in Türkiye have policies that implement environmental studies regarding protocols aimed at protecting the ecosystem against climate change. This situation also reveals the ability of pharmaceutical companies to reach zero emissions in a short time by setting forth future targets. It can be said that these policies are aware of the harmful effects of climate change in the pharmaceutical sector in Türkiye and support the protection of the ecosystem accordingly.

When take a look an evaluate the studies carried out by pharmaceutical companies on environmental

policies, it is seen that they are at the highest level in corporate social responsibility activities, industrial energy efficiency and technological innovation. It is seen that pharmaceutical companies are turning to renewable energies to reduce carbon emissions in energy use. This situation shows that pharmaceutical companies have the ability to reduce the carbon footprint formed in production. It can be said that the features that have the least impact are the electrification of transportation and the ability to reduce costs. When compared with the study evaluating pharmaceutical companies operating in Poland, it is seen that the studies on environmental policies that pharmaceutical companies most frequently refer to are turning to efficient energy policies and using renewable energy sources, developing innovation and quality studies for the efficient use of limited resources, zero emissions, and using waste management in the evaluation of environmental toxic waste (Chomać-Pierzecka, 2023). The use of electric vehicles is encouraged among developed countries due to environmental problems such as air pollution and global warming (Li et al., 2019). Encouraging pharmaceutical companies to switch to electric vehicles and creating supportive policies in this context can have a facilitating effect on the transition. This situation can also accelerate the decrease in costs. It can also be thought that the ability to reduce costs may be due to the time it takes for renewable energies to break away.

In the future, the decrease in costs may produce more positive results. It is seen that pharmaceutical companies care about waste management, water management, packaging management, recycling and zero waste.

When take a look at the awareness activities of pharmaceutical companies, it is also see awareness activities aimed at protecting the environment. In particular, studies carried out by bringing people together and supported educational activities can increase the importance of environmental education and environmental awareness among students. This situation can also cause people to take individual measures to protect the environment.

There are positive environmental notifications and practices of domestic pharmaceutical companies in Türkiye to reduce the negative health effects of climate change.

Although studies on carbon emissions of health institutions and pharmaceutical companies in the world have increased recently, the carbon emission reduction studies of pharmaceutical companies in Türkiye regarding climate change have not been examined sufficiently. The consumption of drugs produced to protect people's health also brings environmental problems. The research provides information about the positive practices of pharmaceutical companies operating in health services regarding the negative effects of climate change on people. In this context, more environmentally friendly and sustainable practices are important both in the production of drugs and in their consumption to protect human health.

The problem of climate change is seen as one of the most important problems in the world. Therefore, strict state regulations and high standards must be the basis for the solution and management of these problems. Such a problem should not be left to the initiatives of individuals or businesses. In addition, states must definitely support the preference of environmentally friendly technologies. Applications to be made against the negative effects of climate change on health will ensure healthier future generations.

This study supports the understanding of the importance of measures taken to reduce the negative effects of climate change on human health. In this context, the research results can give an idea about the importance of greenhouse gas reduction practices to all stakeholders in the subject. In addition, sustainable industries should be increased in the evaluation of the environmental effects of drugs, state regulations should be rearranged in an up-to-date and supportive manner in this direction, information on practices should be disclosed to the public regularly and transparently, and all stakeholders should be included in the decision-making process on the environment and cooperation of everyone in the process should be ensured.

Pharmaceutical companies appear to be deficient in areas such as electric vehicle use, cost-cutting policies, Greenhouse Gas Protocol and transparency. This may be due to the fact that pharmaceutical companies' climate change efforts are still relatively new and have a long way to go. A prospective examination of Turkish pharmaceutical companies' climate change policies and comparison with international literature will be crucial for assessing the success and progress of these efforts. Therefore, considering the pharmaceutical industry's benefits to human health and its economic importance, future research is crucial.

Health authorities could encourage healthcare providers to prioritize prescribing for pharmaceutical companies that prioritize climate change action and environmental stewardship, leading to greater adoption of environmental initiatives by pharmaceutical companies. In this context, health authorities could prioritize pharmaceutical companies with lower carbon footprints over those with higher carbon footprints. Furthermore, health authorities could use color-coded labels to reflect the environmental impact levels of each drug, enabling consumers to assess drug preferences in real time (Okereke 2021). While it is impossible to distinguish between environmentally preferable drugs, this lack of data could

enable prescribers to take important and effective steps to address drug pollution (Parker & Miller 2024).

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