The Recent Trends and Metric Study on Autoimmune Disorder Across the Globe

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Abstract

The study intends to analyse the scholarly productions on Autoimmune disorders (one of the diseases affecting the immune system) from 2017 to 2021. The required data for the study has been retrieved from the Web of Science database. (The keyword "Autoimmune disorder" was applied as a topic phrase to extract the required data.) The retrieved data were analysed using the Microsoft-excel package, bibexcel and VOSviewer software. The study has been designed to assess the scientometrics parameters such as collaborative co-efficient index, collaborative index, degree of collaboration, relative growth rate, doubling time, authorship pattern, co-authorship index, and cluster analysis of authors' keyword publications at the international level. The maximum number of articles was published in 2021 with 1918(23.77%) records. The USA has published 1920(28.6%) articles compared to other countries. The degree of collaboration has observed an upward trend in the year 2021(0.96). The uppermost value of the collaborative co-efficient index and the collaborative index was observed in the year 2021 i.e. 0.73 and 4.69 respectively. (The most productive author is "Zhang Y" with 40(0.49) records.)

Keywords: Autoimmune disorder, Scientometrics, Degree of collaboration, Activity index, Cluster analysis, Collaborative co-efficient index

1. Introduction

An autoimmune disorder occurs when the body's immune system attacks and destroys healthy tissue. This study discusses a few autoimmune disorders, such as rheumatoid arthritis, multiple sclerosis, celiac disease, lupus, and type 1 diabetes. These diseases are the most common autoimmune diseases; hence, such diseases are considered for research work. Autoimmune diseases can affect many types of tissues and nearly any organ in the human body. It may cause a variety of symptoms, including pain, tiredness, rashes, nausea, headaches, dizziness, and more specific symptoms depending on the disease.

(Scientometrics is "the quantitative methods of research on the development of science as an informational process" (Nalimov & Mulcjenko, 1971).) This field focuses specifically on science, social sciences, and the humanities. Scientometrics is concerned with the quantitative features and characteristics of science and scientific research. Emphasis is placed on investigations in which the development and mechanism of science are studied by statistical and mathematical methods. (The term "bibliometric" has emerged from the words "biblio" (Latin) and "metrics" (Greek).) The most

comprehensive definition was given by Prince (1969). (According to Pritchard, bibliometrics is "the application of mathematical methods to books, journals, and other media of communication.")

2. Review of literature

Li et al. (2022) analyzed the emerging trends and hot spots in autoimmune thyroiditis research from 2020 to 2022. They analyzed the systematic assessment of autoimmune thyroiditis to reveal the dynamic scientific developments. The required data has been collected from the Web of Science Core Collection (WOSCC). Vosviewer, Citespace, and Pajeck software were employed to analyze the contributions of words, regions, institutes, journals, and so on. **He et al. (2023)** conducted a bibliographic study on recent advances in nanotechnology applications in autoimmune diseases. They attempted to reveal a comprehensive summary of the current state of development and research priorities in the field of bibliometric analysis. Moreover, annual publications, countries, institutions, and journals' contributions were analyzed. **Li et al. (2020)** have scrutinized and identified emerging trends in rheumatoid arthritis research: A scientometric analysis The authors have analyzed the emerging trends in rheumatoid arthritis research using the Citespace bibliographic mapping tool, and pertinent data was collected from the Web of Science database. Time distribution, cluster analysis, time zones, and timelines of keywords, as well as burst detection, are analyzed in the study. Likewise, **Boopathi, P., and Gomathi, P. (2020)** analyzed the scientometric-based research on Type 2 diabetes mellitus scholarly output during the period 2014–2018 indexed by the Scopus database with the help of SciVal. The authors analyzed the research manager, organizational role, collaboration with authors and institutions, research design, and final evaluation. The supercomputer technology to analyze these SciVals provides powerful analytics and on-demand visualization with large amounts of data. Furthermore, other types of autoimmune disorder diseases have been analyzed by several authors, such as lupus indris by **M., Peter, M., Pattukuthu, A., & Samuel, S. A. (2016)**; celiac disease by **Bansal, M., Gupta, R., & Bansal, J. (2017).**

Objectives of the study

- ❖ To examine the year-wise distribution of publications on autoimmune disorder
- ❖ To find out the relative growth rate and doubling time
- ❖ To measure the collaborative index and collaborative co-efficient
- ❖ To find out the authorship pattern and co-authorship index
- ❖ To calculate the degree of collaboration
- ❖ To analyze the activity index in India
- ❖ To analyze the occurrence of the keywords
- ❖ To analyze the cluster analysis of the co-occurrence of authors' keywords

3. Methodology

The required data for the study of autoimmune disorders has been collected from the Web of Science bibliographic database, which is published by Clarivate Analytics. (The data has been retrieved by using the term (TITLE-ABS-KEY = "autoimmune disorder"; timespan = 2017–2021).) The study covered five years of duration from 2017 to 2021, and a total of 8070 records were retrieved. The collected data was analyzed through Bibexcel and Histcite software, VOS viewer visualization software, and Microsoft Excel to find out the computational data results.

4. Data analysis and interpretation

Table 4. 1 Annum-wise distribution and growth rate

S.No	Annum	Publication	%	Cumulative	Cumulative %	LCS	TC	AGR
1	2017	1372	17	1372	17	1415	42540	0
2	2018	1444	17.89	2816	34.88	839	23201	5.24
3	2019	1595	19.77	4411	54.65	695	30990	10.45
4	2020	1741	21.57	6152	76.23	220	20428	9.15
5	2021	1918	23.77	8070	100	33	6025	10.16
	Total	8070	100			3202	123184	

(LCS - Local Citation Score, TC - Total Citation, AGR - Annual Growth Rate)

It denotes the contribution of year-wise published documents and the growth rate of autoimmune disorder research from 2017 to 2021. The maximum number of articles was published in 2021 with 1918 records (23.77%), and the next highest number of publications was observed in 2020 with 1741 records (21.57%). The lowest number of articles was published in 2017 with 1372 (17%). The relative growth rate has significantly increased from 5.24 to 10.16. This observation confirms that autoimmune disorders gradually increased from 2017 to 2021. The annual growth rate (AGR) has been suggested by Kumar and Kaliaperumal (2015). It is calculated using their formula, as mentioned below.

$$AGR = End\ value - First\ value/First\ value*100$$

Table 4. 2 Most eminent authors' contribution

Rank	Author	Records	%	H-index	Citation sum within h-core	All citations	ACPP
1	Zhang Y	40	0.49	15	561	718	17.95
2	LI J	35	0.43	9	368	492	14.07
3	Shoenfeld Y	35	0.43	16	781	977	27.91
4	Antonelli A	33	0.4	17	609	744	22.54
5	Wang Y	32	0.39	10	1099	1178	36.81
6	Fallahi P	31	0.38	16	540	676	21.80
7	Wang J	29	0.35	10	410	482	16.62
8	Azizi G	27	0.33	13	496	588	21.77
9	Zhang L	26	0.32	8	204	271	10.42
10	Amital H	26	0.32	13	482	578	22.23

(ACPP=Average Citation Per Publication)

Table 4. 2: Most Eminent Authors' Contributions 10 prolific authors were recognized in autoimmune disorder research. They published 26–40 papers between 2017 and 2021. Zhang Y has occupied the first rank with 40 publications, followed by Li J with 35 publications and Shoenfeld Y with 35 publications; the remaining authors have contributed less than 35 publications.

Table 4. 3 Authorship pattern

Years/ Author(s)	1A	2A	3A	4A	5A	>5A	Total
2017	66	159	174	154	145	674	1372
2018	70	174	189	182	167	662	1444
2019	75	166	195	198	190	771	1595
2020	72	173	191	217	192	896	1741
2021	65	170	265	242	218	958	1918
Total	**348**	**842**	**1014**	**993**	**912**	**3961**	**8070**

The year-wise authorship pattern during 2017–2021 was performed by three authors (first place) who contributed 1014 counts. The second and third places were gained by four and five authors with 993 and 912 counts, respectively. One author secured 348 counts. It was observed that within three authors' collaboration, collaboration highly contributed to the authorship pattern, and it reveals that a single author has contributed fewer records. Multi-authors have a wide number of contributions that are highly collaborative.

Table 4. 4 Co-authorship index

Annum	1A	CAI	2A	CAI	3A	CAI	4A	CAI	5A	CAI	>5A	CAI	Total
2017	66	200.59	159	171.24	174	138.86	154	86.06	145	78.27	674	89.06	1372
2018	70	202.14	174	178.05	189	143.31	182	96.64	167	85.65	662	83.11	1444
2019	75	196.07	166	153.78	195	133.86	198	95.18	190	88.22	771	87.63	1595
2020	72	172.44	173	146.83	191	120.12	217	95.56	192	81.67	896	93.30	1741
2021	65	141.31	170	130.97	265	151.28	242	96.74	218	84.18	958	90.55	1918
Total	**348**		**842**		**1014**		**993**		**912**		**3961**		**8070**

1A - One Author, CAI - Co-Authorship Index

The co-authorship index table indicates three authors collaborated and highly contributed in the study period 2017–2021 with 1014 articles; continuously, four authors contributed with 993 and 912 records collaborated with five authors. The table confirms that the three authors' collaboration played a major role in the co-authorship index. The formula for the co-authorship index (CAI) was suggested by Garg, K. C., and Padhi, P. (2021).

CAI=

N_{ij}: Number of papers having j authors

N_{io}: Total output of block I

N_{oj}: Number of papers by authors for all blocks

N_{oo}: Total number of papers for all authors and blocks

Table 4. 5 Activity Index in India

Annum	Global output	India output	Activity Index In India
2017	1372	47	109.96
2018	1444	59	92.19

2019	1595	52	115.54
2020	1741	63	104.10
2021	1918	83	87.05
Total	**8070**	**304**	**508.84**

The activity index is the ratio of the country's share in the world's publication output to compare with global publication output. Mathematically, the activity index has been identified by the following formula suggested by Schneider, A., and Braun, T. (1986).

Activity Index $= [\, (C_i / C_o) / (W_i / W_o) \,] * \mathbf{100}$

Where CI is the number of publications of the specific country in the "i" block, Co is the total number of publications of the specific country during the period of study, Wi is the number of publications of all countries in the "i" block, and Wo is the number of publications of all the countries during the period of study. If the activity index is 100, it indicates that a country's research effort in the given field corresponds precisely to the world average. If the activity index is > 100, it reflects higher than average activity. If the activity index is below 100, it indicates lower than average activity. For Example, (1372/8070) / (47/304) * 100 = 0.1700/0.1546*100 = 109.96

In India, the most number of publications was published in the year 2019 with 52 records, and the highest activity index value was 115.54. In the year 2021, the lowest activity index contributed 83 records (87.05) in India.

Table 4. 6 Keyword occurrences

S.No	Keyword	Occurrence	%
1	DISEASE	618	7.65
2	EXPRESSION	583	7.22
3	MULTIPLE-SCLEROSIS	536	6.64
4	RHEUMATOID-ARTHRITIS	478	5.92
5	DISORDERS	460	5.70
6	SYSTEMIC-LUPUS-ERYTHEMATOSUS	452	5.60
7	DIAGNOSIS	448	5.55
8	PREVALENCE	418	5.17
9	RISK	413	5.11
10	ACTIVATION	384	4.75
11	ASSOCIATION	372	4.60
12	T-CELLS	362	4.48
13	ANTIBODIES	336	4.16
14	CHILDREN	329	4.07
15	EXPERIMENTAL AUTOIMMUNE ENCEPHALOMYELITIS	324	4.01

The keyword-wise contributions of the top fifteen keywords were identified, respectively. The highest time the disease keyword is used is 618 (7.65%). The second-most-used keyword is used 583 times (7.22%). It confirms that disease is a frequently used keyword in the research; the word excremental autoimmune encephalomyelitis has been used a smaller number of times, i.e., 324 (4.01%).
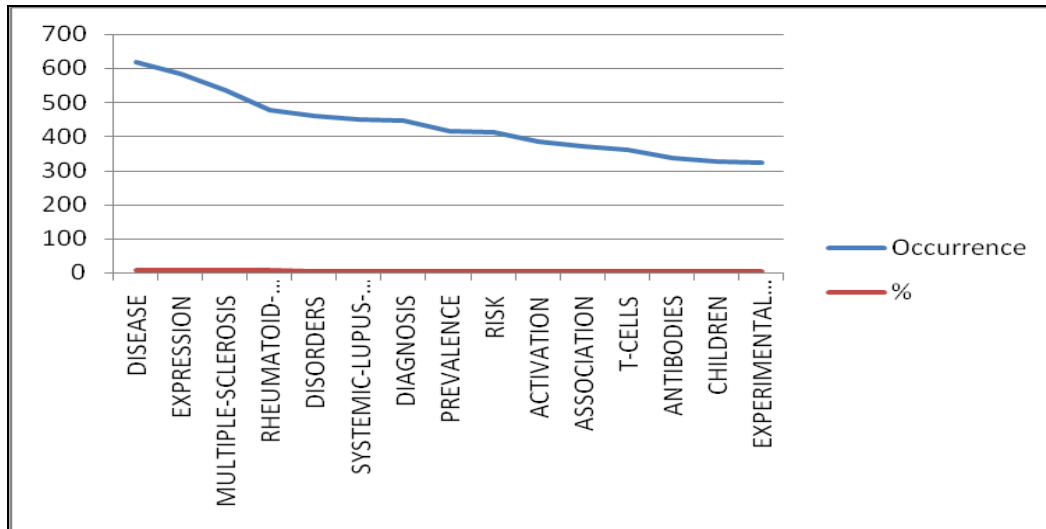
Figure 4.6.1 Zip's law-word occurrences

Table 4. 7 Degree of collaboration

Annum	NS	NM	NS+NM	DC= NM/NS+NM
2017	66	1306	1372	0.95
2018	70	1374	1444	0.95
2019	75	1520	1595	0.95
2020	72	1669	1741	0.95
2021	65	1853	1918	0.96
Total	**348**	**7722**	**8070**	**0.95**

The above-shown table reveals the degree of collaboration, which indicates the trends in single and multiple authors from 2017 to 2021. The degree of collaboration ranges from 0.95 to 0.96, and the average degree of collaboration is 0.95. The DC is calculated by using the formula. DC = Nm/Nm+Ns; Nm = number of multiauthors; Ns = number of single authors. This formula is suggested by K. Subramanium.

DC = 7722/8070 = 0.95

As a result, the degree of collaboration in the study of autoimmune disorders is 0.95, which shows the collaboration of multiple authors.

Table 4. 8 Relative growth rate and doubling time

Annum	Records	Cumulative	LogW1	LogW2	RGR(W2-W1)	RGR Mean	DT (0.693/RGR)	DT Mean
2017	1372	1372	7.22	-	-		-	
2018	1444	2816	7.27	7.94	0.67		1.03	
2019	1595	4411	7.37	8.39	1.02	1.09	0.67	0.68
2020	1741	6152	7.46	8.72	1.26		0.55	
2021	1918	8070	7.55	8.99	1.44		0.48	
Total/	**8070**							
Average					**0.98**		**0.54**	

The relative growth rate and doubling time have been brought to the highest relative growth rate of 1.44 in 2021. And the lowest relative growth rate was 0.67 in 2018. The highest doubling time is 0.67 in the year 2019, and the lowest doubling time is 0.48 in the year 2021. It can be identified that the relative growth rate has an increasing trend and a doubling-time-decreasing trend.

Table 4. 9 Collaborative index and collaborative co-efficient index

Annum	1A	2A	3A	4A	5A	>5A	Total	CI	CCI
2017	66	159	174	154	145	674	1372	4.58	0.72
2018	70	174	189	182	167	662	1444	4.51	0.71
2019	75	166	195	198	190	771	1595	4.61	0.72
2020	72	173	191	217	192	896	1741	4.7	0.73
2021	65	170	265	242	218	958	1918	4.69	0.73
Tota	**348**	**842**	**1014**	**993**	**912**	**3961**	**8070**	**4.618**	**0.72**

CI – Collaborative Index, CCI – Collaborative Co-efficient Index

The collaborative index is calculated as the total number of authors divided by the total number of publications. The highest rate of CI was found in the year 2021 (4.69) and the lowest value in the year 2017 (4.58). Similarly, the most significant values of the collaborative coefficient were also found to be in the year 2021 (0.73), and the shortest amount of the collaborative coefficient is in the year 2017 (0.72).

Table 4. 10 Top prominent journal-wise publications

S.No	Journal	Records	%	LCS	TC	IF	CS
1	Frontiers in immunology	417	5	0	8864	8.786	9.8
2	InternationalJournal of molecularsciences	135	1.7	0	2090	6.208	6.9
3	Frontiers in neurology	82	1	107	1938	4.086	4.6
4	Autoimmunity review	70	1	0	1022	17.39	20.7
5	Multiple sclerosis and related disorders	47	0.6	25	974	4.808	5
6	Scientific reports	63	0.7	0	955	4.996	6.9
7	Plos one	93	1.1	0	924	3.24	5.6
8	Journal of immunology	52	0.7	34	783	5.426	9.0
9	Journal of autoimmunity	80	1	49	670	14.513	19.9
10	Medicine	44	0.6	0	650	1.817	0.1
11	Frontiers in endocrinology	37	0.4	21	640	6.055	6.3
12	Journal of clinical medicine	37	0.4	0	413	4.964	4.40
13	Journal of neuroinflammation	41	0.5	28	373	8.322	10.1
14	Brain behaviour and Immunity	41	0.5	0	239	19.227	17.6
15	Frontiers in pharmacology	46	0.6	0	194	5.988	6.6

IF – Impact factor, CS - Citescore

The journal-wise contribution of the top fifteen most prominent journals was identified. The most productive journal is Frontiers in Immunology, with 417 records. The second-most-produced journal, International Journal of Molecular Sciences, has 135 records. The lowest-produced journal in the top

fifteen journals is Frontiers in Pharmacology, with 46 records. The journal Frontiers in Immunology was identified as the most prominent journal in the study.

Table 4. 11 Country-wise distribution

S.No	Country	Records	%	LCS	TC
1	USA	1920	28.6	1232	47966
2	Peoples R China	825	12.3	289	14520
3	Italy	813	12.1	432	15499
4	Germany	628	9.4	489	15977
5	UK	466	6.9	458	16131
6	France	337	5	239	9265
7	Japan	273	4.1	145	4700
8	Spain	257	3.8	210	8245
9	India	252	3.8	59	3700
10	Canada	248	3.7	160	5886

The country-wise contribution of publication output on autoimmune disorders was 8070 records observed in the study during the period 2017–2021. There is a fact that 1920 records on Autoimmune disorders by the USA are considered the most productive country. The second rank is gained by People's Republic of China with 822 records. The third rank is given to Italy since it produced 813 publications.

Figure 4.11.1 Country-wise distribution
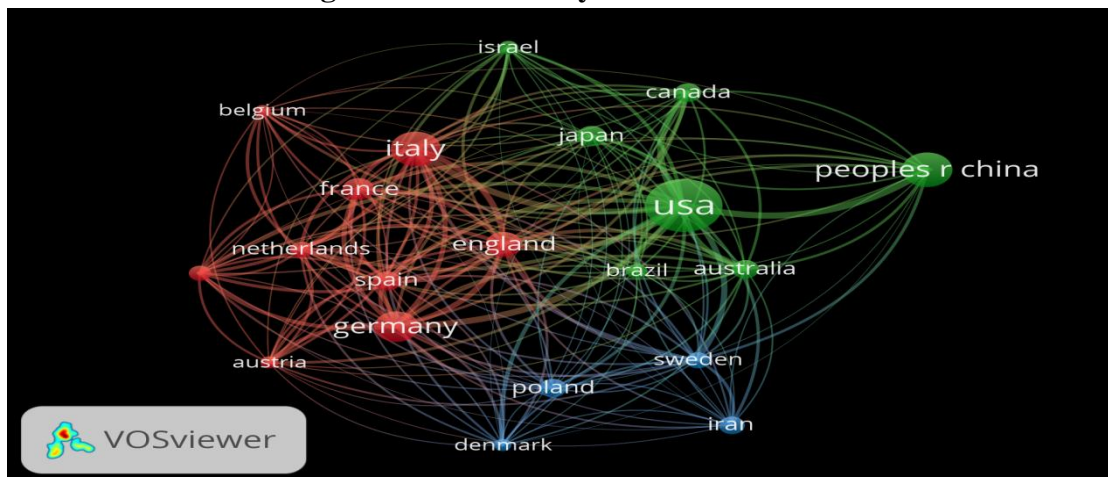
Table 4. 12 Document type's wise distribution

S.No	Document Type	Records	%	H-Index	Citation sum within h-core	All citations
1	Article	4651	57.63	80	13289	59963
2	Review	2953	36.59	105	22953	75661
3	Meeting Abstract	152	1.88	3	13	24
4	Editorial Material	100	1.24	13	365	643
5	Letter	68	0.84	10	287	407
6	Review; Book Chapter	51	0.63	19	1103	1353

7	Article; Proceedings Paper	45	0.56	15	612	789
8	Article; Book Chapter	23	0.29	8	110	151
9	Article; Early Access	13	0.18	2	6	15
10	Review; Early Access	10	0.12	4	40	45
11	Correction	4	0.04	0	0	9
	Total	**8070**	**100**	**259**	**38778**	**13960**

The above table indicates the document type-wise distribution of autoimmune disorder research. There are nine publications identified in the study. Articles were observed in 4651 (57.63.99%) records out of 8070 records, followed by the form of review, which got the second position among the 9 items. The other preferred forms followed by the study are meeting abstracts, editorial materials, proceeding papers, letters, news items, book chapters, and early access in the period of study.

Table 4. 13 Co-occurrence of author's keyword (Cluster analysis)

Table 13 depicts the co-occurrence of the author's keywords. There are a total of 25 items that have 4 clusters and 236 links connected with 11550 link strength.

Clusters	1 (Red)	2 (Green)	3 (Blue)	4 (Yellow)
1	Autoimmune	Autoantibodies	Cytokines	Experimental autoimmune encephalomyelitis
2	Autoimmune disease	Autoimmune diseases	Depression	Multiple sclerosis
3	Covid-19	Autoimmune disorders	Immune system	Neurodegeneration
4	Epidemiology	Autoimmune encephalitis	Inflammation	Neuroinflammation
5	Hypothyroidism	Autoimmunity	Schizophrenia	
6	Inflammatory bowel disease	Cancer		
7	Psoriasis	Immunotherapy		
8	Rheumatoid arthritis			
9	Systemic lupus erythematosus			
Items	9	7	5	4

Figure 4.13.1 Co-occurrence of author's keyword (Cluster analysis)
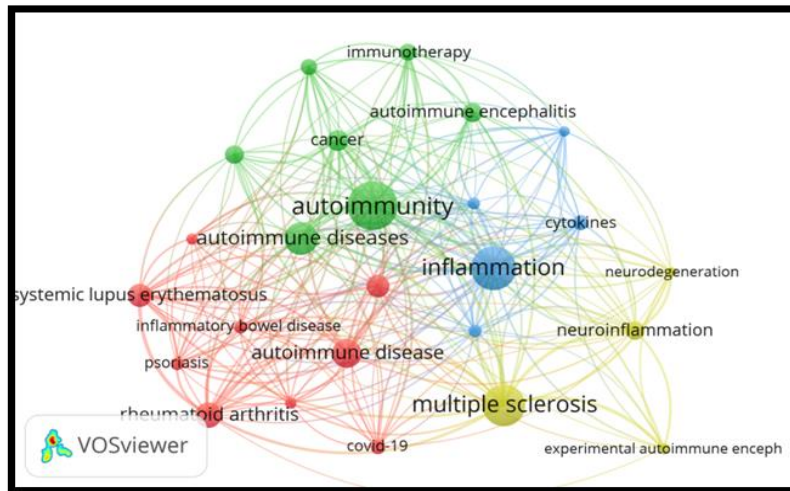
Findings

Out of 8070 articles, the annum-wise contributions of autoimmune disorders reached their maximum in 2021 (1918) with 17%. The relative growth rate of publications has shown an increasing trend from the starting value of 0.67 to 1.44; the doubling time of publications has decreased from 1.93 to 0.48. (Among the most prolific authors, "Zhang Y" has contributed the highest number of articles (0.49%), and he is identified as the most productive author of the autoimmune disorder research output during 2017–2021.) A single author has contributed fewer numbers, and multiple authors have contributed high numbers of collaborations. The degree of collaboration ranges from 0.95 to 0.96, and the average degree of collaboration is 0.95. The USA published 1920 articles in the first place. The prime keyword observed in the study is "disease," with 618 publications.

Discussion and conclusion

This study has examined autoimmune disorder diseases with a wide range of people affected across the world. Especially in the US, it has affected a large number of people. Accordingly, Autoimmune Association reports revealed that real facts and risk factors across the globe, predominantly women, have been affected. It may not be possible to prevent autoimmune diseases. But it is recommended that such things as staying away from cigarettes, avoiding toxins, eating a healthy diet, and limiting processed foods from the diet are a few suggestions provided by physicians and experts.

This study's results concluded that autoimmune disorder diseases are consistently growing across the world from 2017 to 2021. Those who are affected by autoimmune disorders suffer throughout their lives due to the lack of standard treatment for the diseases. The Autoimmune Association is the world's leading non-profit organization dedicated to autoimmune awareness, advocacy, education, and research. The US government and the National Institute of Health also conducted innovative and pivotal basic, clinical, and translational research while fostering research training and mentoring opportunities to create new knowledge to improve health. The United Nations and the World Health Organization should consider and take stringent steps to provide adequate awareness and preventive treatment. Research related to autoimmune disorders is a predominant thing to do by researchers in the growing era to prevent autoimmune disorder diseases and generate awareness regarding autoimmune disorder diseases. The research findings confirm that autoimmune disorders and diseases have been affecting people

consistently. Further research will help identify autoimmune disorder-related diseases and explore the hotspots of autoimmune diseases.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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