

# Disease and injury statistics of Japanese Antarctic research expeditions during the wintering period: evaluation of 6837 cases in the 1st–56th parties – Antarctic health report in 1956–2016

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## ABSTRACT

This study aimed to evaluate disease and injury trends among wintering members of the Japanese Antarctic Research Expedition. Obtained information is indispensable to the advancement of medical system and research. Summation was performed based on medical records of reports prepared by each expedition over the period 1956–2016. The clinical department's classification methods of the names of injuries and diseases varied among expeditions, but the names were integrated following the same classification. Of 1734 members (29 women), 6837 disease or injury cases (4 cases/person) were recorded. The rates of cases were as follows: surgical-orthopaedic (45.3%), internal medical (21.7%), dental (11.6%), dermatological (8.4%), ophthalmological (5.8%), otorhinolaryngological (5.3%), psychiatric (1.6%), and urological (0.1%) cases. There was no major change in rates by type of medical case in each expedition. This analysis made it possible to prepare medical facilities, content of physical examinations to select members, training of physicians before departure, preventive hygiene at sites, and medical research themes.

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## KEYWORDS

Antarctica; medicine; morbidity; disease distribution; health survey; medical evacuation



## Introduction

Japanese Antarctic research activities initiated in 1956 have reached the 59th expedition (until December 2017), and the total number of Japanese Antarctic Research Expedition (JARE) members who participated has exceeded 1800. Japan has performed various scientific observations at Syowa Station and the surrounding areas. Syowa Station is the mother station of JARE at 69°00'S and 39°35'E in East Antarctica, where it is isolated from its surroundings even in Antarctica. Some expedition members had travelled to Dome Fuji Base (S77°190, E 39°420, altitude of 3810 m) which was built inland about 1000 km away from Syowa Station in 1995. The members of the wintering team stay in Antarctica for 14 months. In Syowa Station, there is no supply of food and living goods from the outside world from February to November because the ship cannot keep pace with the thick ice mass and air routes are closed due to stormy weather conditions and extreme darkness. The wintering members have no chance of leaving Antarctica in this period. Therefore, it is important for wintering doctors to understand the

disease tendency in Syowa Station for preventing health problems in the wintering team.

Several countries continuously survey injuries and diseases at the Antarctic [1–5]. In Japan, Ohno et al. analysed a total of 4233 medical cases from the 1st–39th expeditions [6]. Otani et al. assessed 4760 cases, including additional data for the 40th expedition [7], and analyses have been reported each year thereafter. In this study, diseases and injuries that occurred during the 40th–56th expeditions from February 1999 to January 2016 were summed up. By integrating the classification methods of injuries and diseases with those in previous reports, the injury and disease statistics were updated.

To carry out medical care research at the Antarctic, investigation of all medical types' trends during winter is essential, and the findings will help in the preparation of medical facilities, content of physical examinations to select members, training of physicians before departure, preventive hygiene at sites, and medical research themes. Therefore, this study aimed to evaluate disease and injury trends among wintering members of JARE to Antarctica. Obtained information is indispensable to the advancement of medical system and research.

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## Materials and methods

This retrospective review was performed based on medical records of reports prepared by each of the 40th–56th expeditions active between February 1999 and January 2016. Data on diseases and injuries encountered by the JARE team from the 1st to 56th expedition were collected from the annual report of National Institute of Polar Research (NIPR). For the 1st–39th expeditions (1956–1999), analytical data were provided by Ohno, the author of the report from 2000 [5]. The clinical department's classification methods of injuries and diseases varied among expeditions, but the names were integrated following Ohno's classification which was classified in Table 1. Excluding the 2nd and 6th expeditions without habitation and the 1st and 24th expeditions without descriptions of the numbers of injuries and diseases, data of 52 expeditions were integrated and analysed.

There were a total of 1156 members (2 women) in the 1st–39th expeditions and 578 members (27 women) in the 40–56th expeditions, and a total of 1,734 members (29 women) were included in the analysis. The range and mean age in each expedition are shown in Figure 1. All members were men until two women initially joined in the 39th expedition. The mean age for all periods was 34.1 years and that after the 38th expedition was between 35 and 39 years. This research was approved by NIPR through Project Research no. KZ-32.

## Results

### *Injuries and diseases by expedition and by type of medical case*

Table 1 shows the details of diseases and injuries by expedition and by type of medical case. In the newly analysed 40th–56th expeditions, the number of injuries and diseases was 2604 and that per person was 4.5/expedition. After integration with previous reports, the total number of injuries and diseases in the 1st–56th expeditions was 6837 and there were 4 cases per person. The rates by type of medical case are shown in Figure 2. The rates of cases were as follows: surgical-orthopaedic (45.3%), internal medical (21.7%), dental (11.6%), dermatological (8.4%), ophthalmological (5.8%), otorhinolaryngological (5.3%), psychiatric (1.6%), and urological (0.1%) cases. In successive expeditions, no major change was noted in the rates based on the type of medical case (Figure 3).

### *Statistics for injuries and diseases by month and by type of medical case*

The details of the classification and number of injuries and diseases by month and by type of medical case are

shown in Table 2. Data were described by season, such as every 3 months, but were not described by months in the 1st–39th expeditions (two expeditions at Syowa Station, one expedition at Asuka Station, and one expedition at Dome Fuji). Excluding these, the summation period was set at 12 months from February to January of the following year. As the habitation period was changed in some expeditions, the total monthly number of injuries and diseases was 6502. The monthly number of episodes was almost constant.

### *Severe cases, surgical cases, and group infection*

There was one accidental death due to blizzard, but it was not due to an injury or disease. Two cases of surgery under lumbar anaesthesia were performed, and both were appendectomy. Surgery under general anaesthesia had never been performed. Three cases caused by an accident on snow vehicle in the 29th expedition (1987–1989) and one case of arrhythmia in the 46th (2004–2006) expedition were evacuated by aircraft in the summer period. No severe case requiring medical evacuation occurred in the wintering period, but in the 25th expedition (1983–1985), there was one case of pelvic fracture and urethral injury by a snow vehicle in November. The patient required hospitalisation for 3 months at Syowa Station until the research vessel "Shirase" arrived. In the 38th expedition (1996–1998), a vesicostomy was performed under local anaesthesia for acute renal failure associated with urinary retention. In this case, dialysis was considered. "Shirase" directly rushed to the Syowa Station without performing science on the outward route. Fortunately, this patient's general condition was not getting worse.

In the summer period, medical reports contained special notes on two groups of infections. In the 41st expedition (1999–2001), common colds accompanied by influenza-like symptoms and digestive symptoms were prevalent in May, which affected 18 of 29 members. In April, acute gastroenteritis with diarrhoea as the main symptom developed in many members of the 43rd expedition (2001–2003).

## Discussion

In this study, we found that the mean age of members in each expedition gradually increased and exceeded 37 years old after the 50th expedition, demonstrating ageing of members compared with those in previous expeditions. The participating medical cases slightly varied among the expeditions, but surgery and orthopaedics were the most frequent,

Table 1. Details of diseases and injuries by expedition and by type of medical case in 1956–2016.

Department	Disease and injury	February	March	April	May	June	July	August	September	October	November	December	Jan.	Total	
Surgery and Orthopedics	Injury	55	81	43	45	42	47	47	31	39	48	51	38	567	
	Frostbite	7	14	38	85	29	38	63	49	32	19	2	11	387	
	Contused wound, distortion	47	66	46	41	34	36	45	51	61	41	60	39	567	
	Arthralgia, muscle pain, neuralgia, tendovaginitis	43	52	38	38	46	31	41	39	48	57	44	43	520	
	Lumbago, disk hernia	43	38	19	38	20	37	30	25	43	37	31	29	390	
	Haemorrhoid	7	11	8	6	15	15	18	13	9	7	7	8	124	
	Skin infection	13	13	8	8	6	9	10	9	10	10	10	8	11	115
	Burn	13	5	5	8	3	9	4	4	4	9	7	8	6	81
	Fracture	5	5	5	4	3	4	4	3	7	7	7	5	4	56
	Skin tumour	1	3	4	7	5	5	1	5	5	9	9	5	5	55
	Foreign	6	10	2	9	1	3	8	5	4	3	11	11	4	66
	Appendicitis	1	1	0	0	0	0	0	0	0	0	1	0	0	3
	Others	2	1	3	4	2	2	4	4	0	1	0	1	2	22
	Total	243	300	219	293	206	236	275	234	268	246	233	200	2953	
	Internal medicine	Digestive system	49	67	59	68	68	50	67	49	45	46	51	63	682
		Respiratory system	17	19	21	41	20	18	14	20	12	20	43	34	279
		Headache	9	10	7	11	17	15	17	10	24	12	8	10	150
Carbon monoxide poisoning		0	0	2	14	5	11	1	8	1	4	0	0	0	46
Circulatory system		4	10	10	5	9	8	12	7	6	9	5	2	87	
Mountain sickness		0	0	1	0	0	0	2	1	2	0	0	0	3	9
Tired, weakness		2	2	0	5	1	1	1	1	1	6	2	2	2	24
Gout		2	0	0	1	0	1	2	6	1	3	3	0	0	19
Alcoholism		0	0	3	1	5	1	1	1	1	0	0	0	3	16
Others		2	12	3	4	2	3	4	3	6	4	2	2	3	48
Total		85	120	106	150	127	108	121	106	99	104	114	120	1360	
Dentistry		Crown dislocation	26	33	22	25	12	28	21	32	29	25	32	28	313
		Dental caries	14	10	8	9	5	11	13	9	12	8	9	23	131
		Periodontitis	10	11	13	14	13	20	19	17	16	9	14	22	178
		Root canal disease	3	3	3	2	1	3	1	3	2	3	2	6	32
		Injury	1	2	2	3	4	1	5	3	7	4	2	1	35
		Others	2	12	3	4	6	7	6	8	6	3	5	7	69
	Total	56	71	51	57	41	70	65	72	72	52	64	87	758	
	Dermatology	Tinea	20	12	8	7	6	10	6	9	12	5	11	14	120
		Contact dermatitis	3	12	7	3	13	3	2	7	10	6	10	10	77
		Eczema, dermatitis	22	15	12	8	11	7	12	9	15	14	11	12	148
		Photo dermatitis	1	0	0	0	0	0	0	0	7	16	5	0	29
		Keratosis	1	5	3	2	5	1	1	0	1	2	0	2	23
		Urticaria	4	2	3	2	2	1	5	5	2	0	1	4	31
		Cheilitis, angular cheilosis	1	5	0	3	2	6	3	3	7	9	6	6	51
		Pompholyx	7	0	1	0	0	0	3	1	0	0	0	0	13
		Chilblain	1	0	3	0	1	2	3	0	0	0	0	0	11
		Wart	1	1	2	2	1	2	4	0	1	1	0	2	17
Impetigo		0	0	2	0	0	0	2	0	0	0	0	0	4	
Shingles		0	0	1	0	0	1	0	0	0	3	0	0	5	
Others		4	4	4	5	1	1	0	0	1	1	4	2	28	
Total		65	56	46	32	42	34	41	35	56	58	48	44	557	
Ophthalmology		Foreign bodies	26	20	6	5	5	6	6	3	5	7	13	7	109
		Keratoconjunctivitis, blepharitis	11	17	8	6	5	6	8	6	8	14	12	8	109
		Hordeolum, chalazion	2	6	7	5	3	7	5	3	5	8	3	4	64
	Asthenopia	2	3	6	3	4	4	2	3	8	6	5	1	47	
	Ophthalmia, ultraviolet ophthalmia	3	1	3	0	0	1	1	3	15	5	5	2	39	
	Injury	0	0	0	2	0	0	0	2	1	0	1	1	7	
	Others	1	1	4	2	1	0	1	0	0	1	1	0	11	
	Total	45	48	34	23	18	24	23	26	42	41	40	26	390	

(Continued)

Table 1. (Continued).

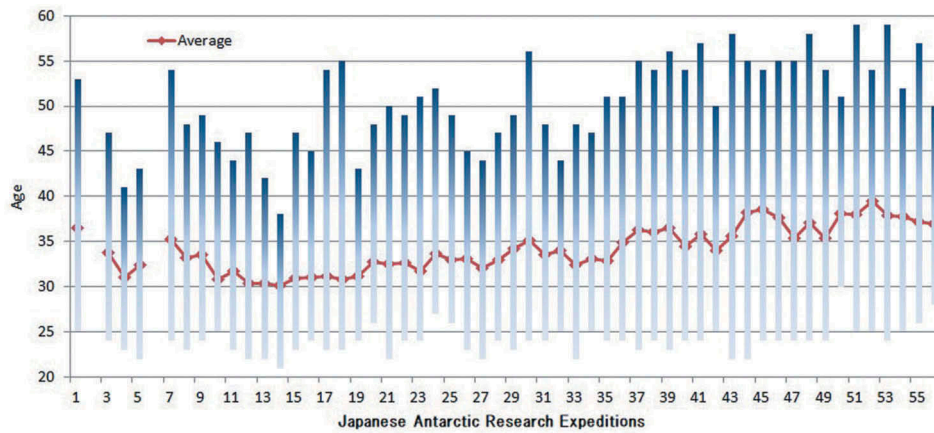
Department	Disease and injury	February	March	April	May	June	July	August	September	October	November	December	Jan.	Total
Otorhinolaryngology	Aphtha	9	7	6	8	4	11	9	5	4	6	15	11	95
	Pharyngitis	3	13	6	10	5	14	9	9	12	8	16	17	122
	Rhinitis	1	9	6	5	5	6	5	2	2	11	4	7	64
	Otitis	4	1	2	2	2	3	1	4	9	3	0	0	31
	Pharyngeal foreign bodies	0	1	3	0	3	0	0	1	1	0	0	1	10
	Gloss disorder	1	0	0	0	1	1	1	0	0	1	0	0	5
	Others	1	0	3	4	3	4	2	1	3	3	3	2	29
Psychiatry	Total	19	31	26	29	23	39	27	22	41	23	38	38	356
	Insomnia	2	2	4	13	9	21	11	6	1	7	5	8	89
	Depression	0	2	0	1	1	1	0	0	0	0	1	2	8
	Total	2	4	4	14	10	22	11	6	1	7	6	10	97
Urology	Urolithiasis	2	1	1	1	1	2	1	1	0	3	0	0	13
	Cystitis	1	0	0	1	2	2	2	0	1	0	0	2	11
	Others	1	2	1	0	0	0	0	0	0	0	0	1	5
	Total	4	3	2	2	3	4	3	1	1	3	0	3	29
Gynaecology	Dysmenorrhoea	0	1	0	0	0	0	0	0	0	1	0	0	2
	Total	519	634	488	600	470	537	566	502	580	535	543	528	6502
Department	Disease and injury	February	March	April	May	June	July	August	September	October	November	December	Jan.	Total

followed by internal medicine. These were similar to past reports [1–5]. The number of medical episodes required for treatments per member varied among expeditions, but this may have been because the number of facilities varied and drugs were provided in mild cases as self-management during some expeditions.

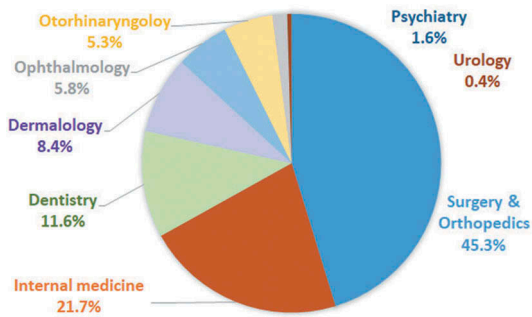
According to the monthly statistics of injuries and diseases by department, regarding changes in disease onset during the 12-month period from initiation of habitation in February to January of the following year, some diseases had seasonal changes, but other disease were almost constantly observed. Afflictions of motor organs and the digestive system, bruises, sprains, cuts and contusions, and lower back pain occurred almost every month. In contrast, periods with frequent disease development were noted: the frequency of frostbite was high in May (accounting for 22.0% of all cases in the 12-month period) and August–September (39%), insomnia in May–August (59%), headache in July–August (22%) and October (16%), ocular foreign body in February–April (47%), otitis in August–October (45%), and alcohol-related cases in May–July (44%). In addition, 88% of carbon monoxide poisoning cases developed in May–October, which may have occurred in snow vehicles during outdoor activities. This had not occurred after the 21st expedition (1979–1981) since the vehicles had changed.

Fortunately, there were no serious cases requiring medical evacuation in the winter period. Even if it was necessary, it was impossible because the Syowa Station was isolated and separated from other countries' bases. Hasegawa et al. reported an international comparative study of winter medical services from a total of 18 stations from 13 countries in 2007 [8]. Each station has 4–37 wintering members, and the average age was 36.4 years in 2004–2006. The Syowa Station had two medical doctors, and other stations had one each. About 60% of the stations had medical facilities for operations under general anaesthesia. In the past, 32 operations including 14 appendectomies have been performed at 9 stations. There have been 18 deaths at 9 stations. Most were accidental deaths, and 2 were caused by acute myocardial infarction. At 11 stations, there were 21 medical evacuations in summer, and 2 in winter, including 11 cases of orthopaedic disease and 3 cases of acute appendicitis. Medical evacuation has made remarkable progress with an airlift in summer, but JARE had no experience and no evacuation program in the winter.

This review has some limitations. The classification was integrated because the records and classification



**Figure 1.** Range and average age of members in each expedition. The bar graph represents the age range, and the red line graph represents the average age. The mean age of members in each expedition gradually increased and exceeded 37 years old after the 50th expedition. The 2nd and 6th expeditions were not overwintering.

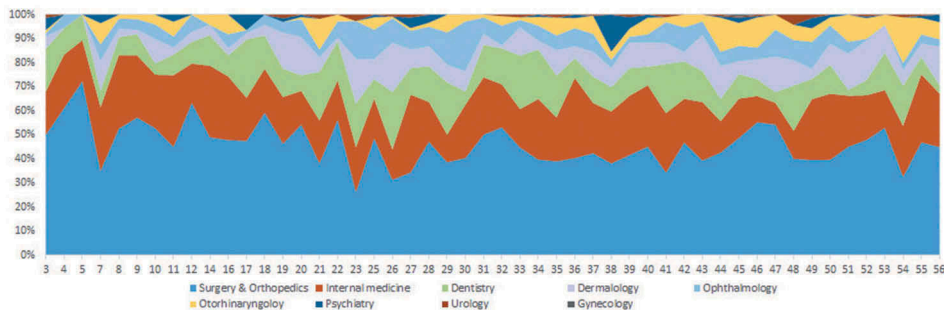


**Figure 2.** Rate of diseases by medical departments. The cases and their rates were as follows: surgical-orthopaedic, 45.3%; internal medical, 21.7%; dental, 11.6%; dermatological, 8.4%; ophthalmological, 5.8%; otorhinaryngological, 5.3%; psychiatric, 1.6%; and urological, 0.1% cases.

of clinical departments and names and sites of injuries were different among expeditions, but it may differ from the original record. Variation in diagnosed diseases due to differences in the specialties of medical care members was also considered. Moreover, judgement of the classification and severity based on International Classification of Diseases 10 was

difficult. It was not possible to investigate the incidences of injuries and diseases by age because age information of the patients could not be obtained. However, in addition to treatment, methods to prevent injuries and diseases may be a task to be solved as members aged. A remote medical system between Syowa Station and Japan through satellite was introduced in the 47th expedition (2005–2007), which enabled consultation with a physician specialising in the corresponding field. Further utilisation of this system may be useful to secure quality medical care and promote preventive medicine regardless of the speciality of medical members.

Even in Antarctica, medical treatments that can be provided have made progress. However, there are few reports on clinical data collected since the 2000s. For all countries, this latest analysis made it possible to prepare medical facilities, update content of physical examinations to select members, training of physicians before departure, preventive hygiene at sites, and medical research themes. We believe that these data will be useful to promote medicine in the Antarctic region in the future.



**Figure 3.** Change in rate based on departments. No major change was noted in the rates based on departments.

**Table 2.** Details of the classification and number of diseases and injuries by month and by type of medical case in 1956–2016 excluding the 2nd and 6th expeditions without habitation and the 1st and 24th expeditions without descriptions of the numbers of injuries and diseases.

JARE	Year	Members	Surgery and Orthopedics	Internal medicine	Dentistry	Dermatology	Ophthalmology	Otorhinolaryngology	Psychiatry	Urology	Gynecology	Total	Cases/member/year
1	1956–1958	11											
2	1957–1958												
3	1958–1960	14	39	14	14	4	1	3	4	1	0	80	5.7
4	1959–1961	15	11	4	2	0	1	0	0	0	0	18	1.2
5	1960–1962	16	34	8	5	0	0	0	0	0	0	47	2.9
6	1961–1962												
7	1965–1967	18	17	16	4	9	2	5	2	0	0	55	3.1
8	1966–1968	24	62	36	9	4	5	2	0	0	0	118	4.9
9	1967–1969	29	64	29	10	2	5	2	0	0	0	112	3.9
10	1968–1969	28	79	33	7	15	9	6	0	0	0	149	5.3
11	1969–1971	30	126	83	24	8	13	17	8	0	0	279	9.3
12	1970–1972	29	60	16	9	4	7	0	3	0	0	99	3.4
13	1971–1973	30	26	23	9	0	2	0	0	1	0	61	2.0
14	1972–1974	30	23	14	6	2	0	2	0	0	0	47	1.6
15	1973–1975	30	39	11	16	0	0	0	0	0	0	66	2.2
16	1974–1976	30	63	37	12	0	8	11	0	0	0	131	4.4
17	1975–1977	29	40	14	19	2	1	0	5	0	0	81	2.8
18	1976–1978	30	55	17	15	0	4	0	0	0	0	91	3.0
19	1977–1979	30	58	26	16	20	6	0	0	0	0	130	4.3
20	1978–1980	30	58	15	7	17	8	0	2	2	0	107	3.6
21	1979–1981	33	45	22	24	7	4	1	1	0	0	119	3.6
22	1980–1982	34	41	12	12	1	5	15	0	2	0	73	2.1
23	1981–1983	34	10	7	7	7	6	2	0	0	0	38	1.1
24	1982–1984	35						0	0	1	0		
25	1983–1985	35	47	16	8	8	12	5	1	0	0	97	2.8
26	1984–1986	35	43	17	32	28	14	1	0	1	0	136	3.9
27	1985–1987	35	31	29	11	7	7	1	4	1	0	91	2.6
28	1986–1988	37	57	20	18	10	10	2	4	0	0	121	3.3

(Continued)

Table 2. (Continued).

JARE	Year	Members	Surgery and Orthopedics	Internal medicine	Dentistry	Dermatology	Ophthalmology	Otorhinolaryngology	Psychiatry	Urology	Gynecology	Total	Cases/member/year
29	1987-1989	37	39	11	21	7	13	7	0	0	0	98	2.6
30	1988-1990	37	41	27	5	9	18	3	3	0	0	106	2.9
31	1989-1991	38	48	21	12	4	6	1	0	0	0	92	2.4
32	1990-1992	39	96	32	27	6	15	7	0	1	0	184	4.7
33	1991-1993	36	42	15	21	7	3	1	0	1	0	90	2.5
34	1992-1994	39	52	28	23	4	7	4	1	0	0	119	3.1
35	1993-1995	40	145	87	45	34	18	21	0	3	0	353	8.8
36	1994-1996	40	71	80	16	14	11	8	8	0	0	208	5.2
37	1995-1997	40	108	53	28	26	19	19	0	1	0	254	6.4
38	1996-1998	40	63	38	18	17	6	6	27	0	0	175	4.4
39	1997-1999	39	86	52	24	22	5	7	10	2	0	208	5.3
40	1998-2000	40	150	85	26	33	12	23	4	0	0	333	8.3
41	1999-2001	40	67	48	40	17	17	4	0	2	0	195	4.9
42	2000-2002	40	36	14	12	3	8	4	0	0	0	77	1.9
43	2001-2003	40	42	26	14	16	6	4	0	0	0	107	2.7
44	2002-2004	44	72	22	16	23	10	3	0	0	0	169	3.8
45	2003-2005	42	128	43	27	14	17	24	1	1	0	263	6.3
46	2004-2006	37	101	20	13	15	9	25	6	1	2	183	4.9
47	2005-2007	35	96	16	8	26	20	23	1	1	0	177	5.1
48	2006-2008	34	38	11	18	10	8	11	0	0	0	95	2.8
49	2007-2009	29	28	18	6	3	8	6	0	4	0	71	2.4
50	2008-2010	28	36	25	11	8	7	4	3	1	0	91	3.3
51	2009-2011	28	36	17	2	12	4	3	1	0	0	80	2.9
52	2010-2012	30	67	26	9	23	1	9	0	0	0	140	4.7
53	2011-2013	31	37	11	11	8	0	12	1	1	0	70	2.3
54	2012-2014	30	31	20	16	6	3	3	0	0	0	95	3.2
55	2013-2015	24	109	66	17	13	9	18	0	1	0	233	9.7
56	2014-2016	26	101	50	8	36	7	16	2	1	0	225	8.7
Total		1734	3094	1481	790	571	397	363	109	30	2	6837	4

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