IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 6 Ser.1 (June. 2023), PP 52-59
www.iosrjournals.org

Secular Trends In Cellulitis In Andaman And Nicobar Islands: A Hospital-Based Retrospective Observational Study

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Abstract
Background: *To describe the incidence of hospitalizations for cellulitis and to characterize the associated trends. Secondly, to explore the seasonal trends in occurrence of cellulitis and lastly, to assess its severity in terms of need of any surgical intervention.*
Materials and Methods: *All hospital admissions due to cellulitis over a period of three years. The total study participants were 180 in the year 2020-21 (125 males; 55 females), 182 in the year 2021-22 (130 males; 52 females) and 190 in the year 2022-23 (137 males; 53 females) .To estimate the monthly incidence of cellulitis, aggregation by year and month, the details of hospitalizations for cellulitis and studied the trends in seasonal variations, gender distribution, age distributions, duration of stay in hospital and those patients who required surgical intervention. The distribution of micro-organisms isolated from the cases is also studied.*
Results: *We found patterns of bimodal distribution in seasonal trends and clustering of cellulitis cases in particular months of a year. Most common organisms isolated from the tissue samples was Staphylococcus aureus. The most common risk factor for cellulitis was diabetes mellitus followed by hypertension. Behavioural risk factors like alcohol consumption and smoking were also studied.*
Conclusion: *The incidence of cellulitis in the population increases in the rainy season in Andaman and Nicobar islands resulting in increased hospital admissions of cellulitis cases. Diabetic patients are at more risk of developing cellulitis even with trivial trauma. Staphylococcus aureus is the most common organism associated with cellulitis. We have shown a striking seasonality in hospitalizations for cellulitis and highlight the need for future work to estimate the financial burden of the disease on our population.*
Keywords : *Secular trends in cellulitis, seasonal trends in cellulitis, severity of cellulitis*

Date of Submission: 21-05-2023 Date of Acceptance: 01-06-2023

I. Introduction

Cellulitis is non-suppurative, invasive infection of tissues, which is usually related to the point of injury. There is poor localisation in addition to the cardinal signs of spreading inflammation. Clinical signs and symptoms include swelling, warmth, erythema, and discomfort of the affected area [1]. Cellulitis is often preceded by damage to skin integrity, mostly through trauma, inflammation, venous insufficiency or from lymphedema [2,3]. However, many patients with cellulitis do not recall any specific history of trauma because small disruptions to the skin may be sufficient as a predisposing risk factor. In fact, small breaks between the toes are common sites of skin disruptions leading to cellulitis, and, hence , lower extremities are the most frequently involved [4,5]. Cellulitis presenting in surgical practice are typically caused by organisms such as beta hemolytic streptococci, staphylococci and clostridium perfringens. Tissue destruction, gangrene, and ulceration may follow, which are caused by release of proteases[1].

Systemic signs (toxemia) like chills, fever and rigors are common. These events follow the release of toxins into the circulation, which stimulate a cytokine-mediated systemic inflammatory response even though blood cultures may be negative[1]. Mild cases of cellulitis can be treated on an out-patient basis with oral antibiotics, but more severe infections require intravenous antibiotics and hospitalizations. Ocassionally, very severe cases may need surgical intervention in the form of fasciotomy, debridement or amputations[2,3].

Patient-related risk factors for cellulitis include diabetes, tinea pedis, chronic venous insufficiency, lymphedema, prior surgery, or radiation therapy. But, very less is known about any environmental risk factors for cellulitis except exposure to salt water or fresh water[3].

The purpose of this study is, firstly, to describe the incidence of hospitalizations for cellulitis and to characterize the associated trends. Secondly, to explore the seasonal trends in occurrence of cellulitis and lastly, to assess its severity in terms of need of any surgical intervention.

II. Materials and Methods

Data was collected from Medical Records Library of Gobind Ballabh Pant Hospital, Port blair of Andaman and Nicobar Islands, the database of all hospital discharges in the islands. This database is maintained by the Andaman Nicobar Institute of Medical Sciences. Our study is a retrospective observational study. It's a cross-sectional study design.We have used ICD code 10 L02413-02416, L02611-2612, L03113-3116, L03119 for cellulitis of limbs. Our study included all hospital admissions due to cellulitis over a period of three years 2020-21, 2021-22 and 2022-23. The total study participants were 180 in the year 2020-21 (125 males; 55 females), 182 in the year 2021-22 (130 males; 52 females) and 190 in the year 2022-23 (137 males; 53 females) .To estimate the monthly incidence of cellulitis, we aggregated by year and month, the details of hospitalizations for cellulitis and studied the trends in seasonal variations, gender distribution, age distributions, duration of stay in hospital and those patients who required surgical intervention. We also studied the distribution of micro-organisms isolated from the cases, by means of pus culture or tissue culture from the samples obtained. Those cases of cellulitis in which there was no abscess or pus, or those in which no sample could be obtained ,or those in which no growth of micro-organisms was seen were grouped as equivocal. We also tried to estimate the burden of the disease by calculating the average duration of hospital stay of patients with cellulitis. To assess its severity we divided the study population into groups who were managed conservatively with antibiotics and analgesics and those who needed any surgical intervention in the form of fasciotomy, debridement of dead tissue and amputation of limb or a part of limb. Through our study we also tried to list the most common risk factors for cellulitis in the study population. The risk factors that were studied were diabetes mellitus, hypertension. Behavioural risk factors like alcohol consumption and smoking were also studied.

III. Results

The incidence of cellulitis is more common in males than in females as depicted in Figure 1.This was observed in all the 3 years included in the study.

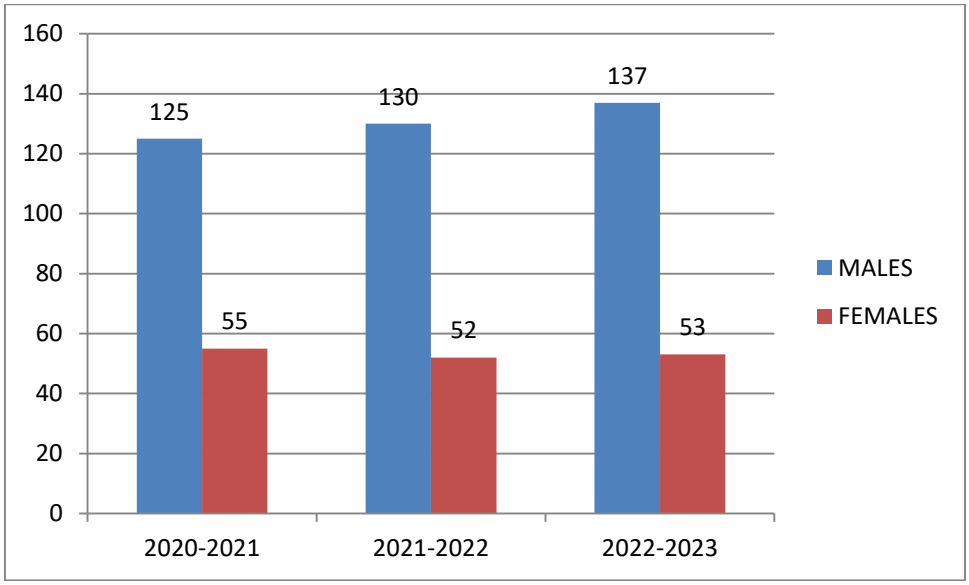

Figure 1 Proportion of males to females hospitalizations for cellulitis

We found increased susceptibility of population belonging to age group 40-60 years (Figure 2) which could be explained by the fact that they constitute major proportion of working population.

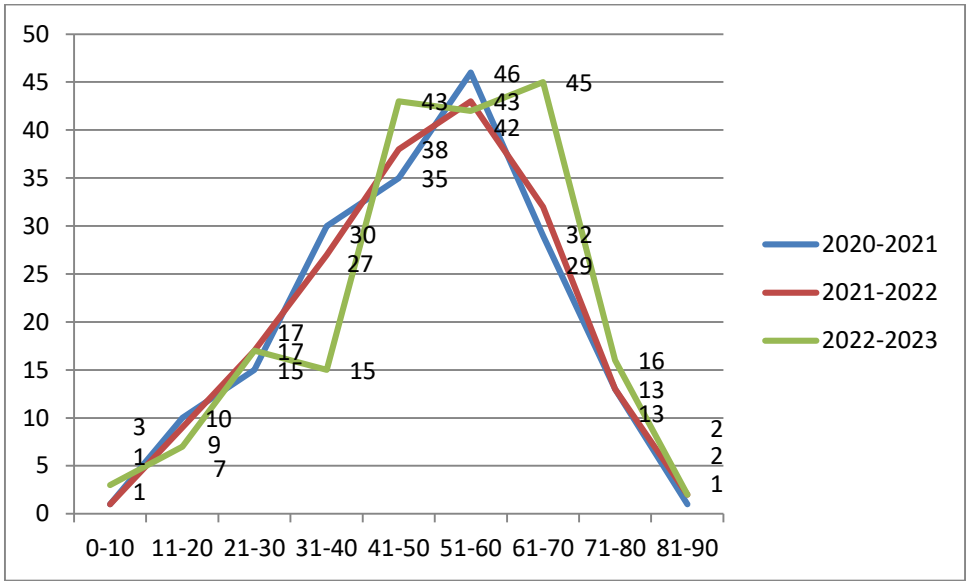

Figure 2 Age distribution of patients and susceptibility of different age groups

We found patterns of bimodal distribution in seasonal trends and clustering of cellulitis cases in particular months of a year as depicted in figure 3. Incidence of cellulitis showed a gradual rise in the month of May, peaking up in June and a steady fall in July and August. But there was another peak in incidence of cases with abrupt rise in early September and gradual fall in October. The bimodal distribution of occurrence of cases could be well explained by the distribution of rainfall in the islands over the past three years. There is a direct association of moist damp climate soon after rainfall and increase in occurrence of cellulitis as observed in Figure 3 (a and b).

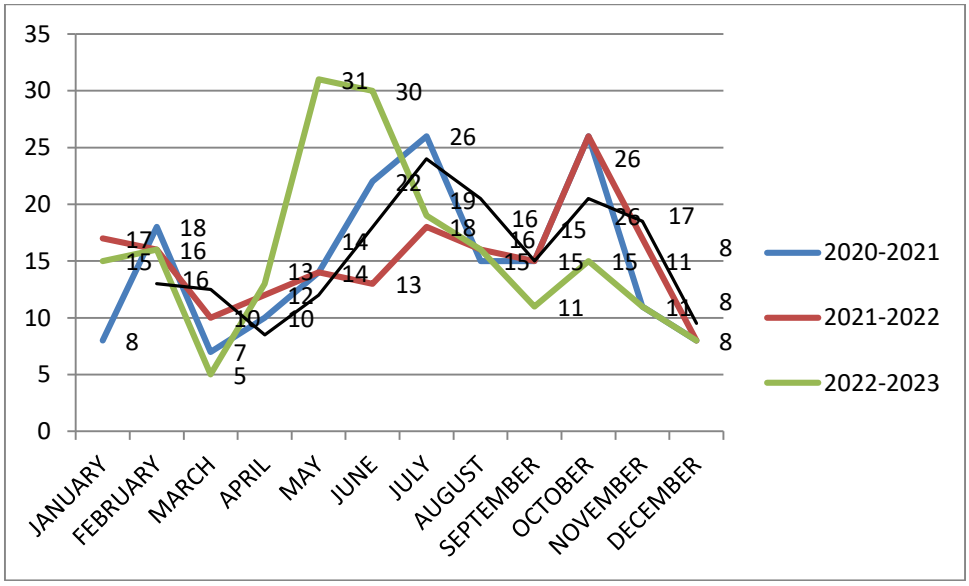

Figure 3a) Seasonal trends in hospitalizations for cellulitis over past 3 years

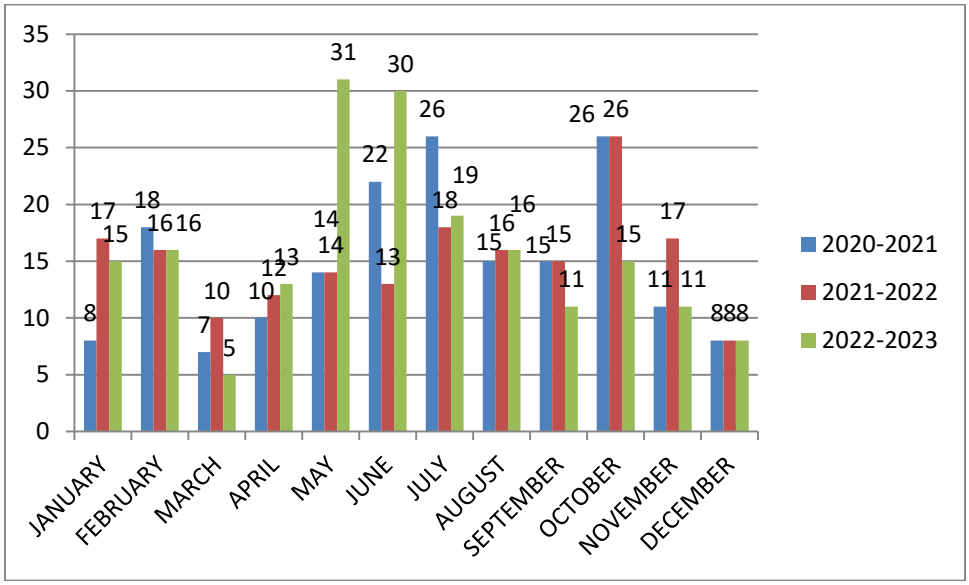

Figure 3b) Seasonal trends in hospitalizations for cellulitis over past 3 years

MONTH	2020-2021	2021-2022	2022-2023
JANUARY	8	17	15
FEBRUARY	18	16	16
MARCH	7	10	5
APRIL	10	12	13
MAY	14	14	31
JUNE	22	13	30
JULY	26	18	19
AUGUST	15	16	16
SEPTEMBER	15	15	11
OCTOBER	26	26	15
NOVEMBER	11	17	11
DECEMBER	8	8	8

Table 1 Seasonal trends in hospitalizations

We also tried to study the distribution of micro-organisms isolated from the cases, by means of pus culture or tissue culture from the samples obtained. Those cases of cellulitis in which there was no abscess or pus, or those in which no sample could be obtained ,or those in which no growth of micro-organisms was seen were grouped as equivocal. According to our study the most common organisms isolated from the pus and tissue samples were Staphylococcus aureus, Psuedomonas aeruginosa, Acinetobacter baumannii, Escherichia coli, Klebsiella pnemoniae and Coagulase negative Staphylococcus aureus (in decreasing order of their frequency) as depicted in Figure 4, Table 1.

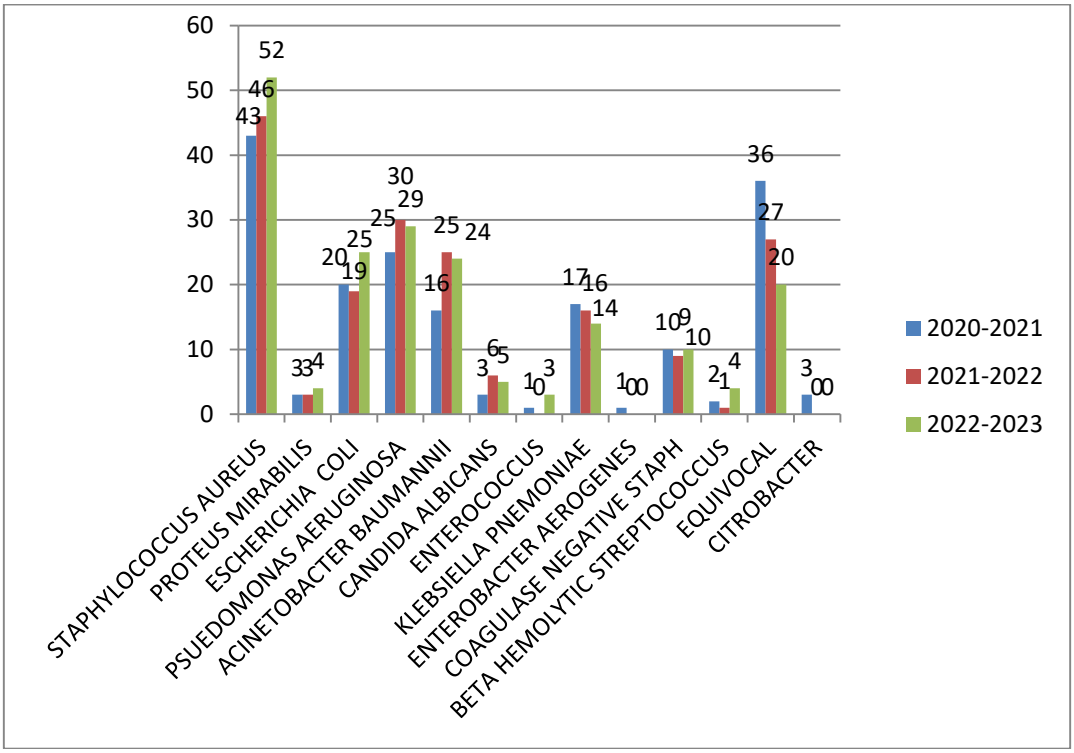

Figure 4 Distribution of micro-organisms isolated from cases of cellulitis through pus or tissue culture.

ISOLATED MICRO-ORGANISMS	2020-2021	2021-2022	2022-2023
STAPHYLOCOCCUS AUREUS	43	46	52
PROTEUS MIRABILIS	3	3	4
ESCHERICHIA COLI	20	19	25
PSUEDOMONAS AERUGINOSA	25	30	29
ACINETOBACTER BAUMANNII	16	25	24
CANDIDA ALBICANS	3	6	5
ENTEROCOCCUS	1	0	3
KLEBSIELLA PNEMONIAE	17	16	14
ENTEROBACTER AEROGENES	1	0	0
COAGULASE NEGATIVE STAPH	10	9	10
BETA HEMOLYTIC STREPTOCOCCUS	2	1	4
EQUIVOCAL	36	27	20
CITROBACTER	3	0	0

Table 2 Distribution of micro-organisms

Through our study we also tried to assess the burden of cellulitis on our society and its severity, for which we tried to distribute the patients of our study population into those who were managed conservatively, those who needed debridement of the dead and necrotic tissues, and those who needed release fasciotomy to save the limb. The patients who needed amputation of the limb in order to prevent sepsis and systemic inflammatory response were also included in this group. A count of total number of death (case fatality rate) was also kept. Through our study we concluded that most patients needed conservative management only with intravenous antibiotics and fluids and wound dressings. Debridement of necrotic tissue and fasciotomy were the most common surgical intervention required, whereas amputation of the affected limb was seldom done to prevent dire complications. Death of the patient was inevitable in very rare and very severe cases inspite of surgical interventions due to multi-organ failure and systemic inflammatory response. (Figure 5).

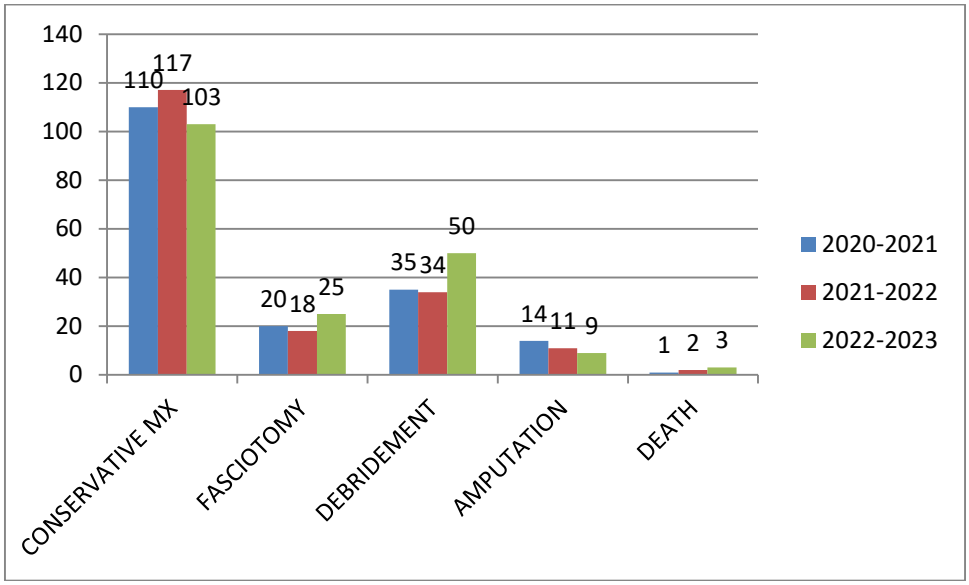

Figure 5 Surgical intervention in cases of cellulitis; a measure of severity of the disease.

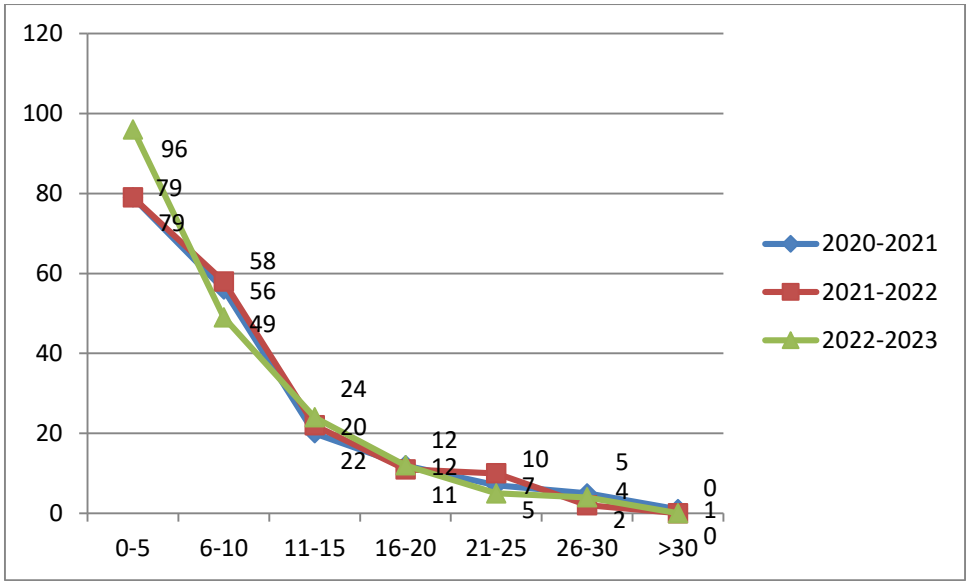

Figure 6 Average duration of hospitalization of patients with cellulitis.

DAYS OF HOSPITALIZATIONS	2020-2021	2021-2022	2022-2023
0-5	79	79	96
6-10	56	58	49
11-15	20	22	24
16-20	12	11	12
21-25	7	10	5
26-30	5	2	4
>30	1	0	0

Table 3 Average duration of hospitalization

We also estimated the average duration of hospitalization of patients with cellulitis to study the burden of disease. Most of the patients with cellulitis, on an average, needed hospital stay under 15 days. Very severe cases rarely needed more than 20 days of hospital stay to recover (Figure 6, Table 2).

Finally, we also studied the most common risk factors associated with cellulitis. Through our study, we found that diabetes mellitus was the most common risk factor, followed by smoking and hypertension. A major proportion of the study population had multiple risk factors as shown in Figure 7.

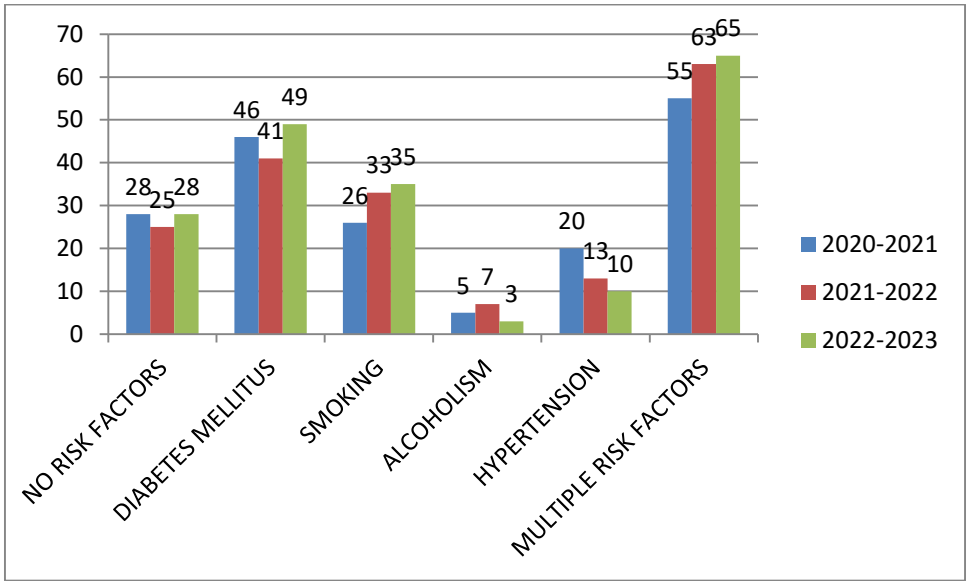

Figure 7 Most common risk factors observed in study population.

IV. Discussion

Our results show a striking degree of seasonality with admissions for cellulitis consistently peaking in rainy months and bottoming in winter. A similar study was conducted by Polgreen et al in 2017 at University of Iowa Health Ventures, which inferred a seasonality with incidence for cellulitis,with peak in hospitalizations in summer months. This could be explained by the difference in climate and geography of the places where both these studies were conducted. There is a direct association of moist damp climate soon after rainfall and increase in occurrence of cellulitis observed in Andaman and Nicobar Islands. Incidence of cellulitis showed a gradual rise in the month of May, peaking up in June and a steady fall in July and August. But there was another peak in incidence of cases with abrupt rise in early September and gradual fall in October. The bimodal distribution of occurrence of cases could be well explained by the distribution of rainfall in the islands over the past three years. A case study from France conducted by Young P et al [6] demonstrated an association between increased temperature and hospital admissions for cellulitis. The reason that incidence of cellulitis exhibits a seasonal pattern is unclear.

Our study showed a alarming association of Staphylococcus aureus with the majority of the cellulitis cases. Though other microbes like Psuedomonas aeruginosa, Acinetobacter baumannii, Escherichia coli, Klebsiella pnemoniae and candida species were also the causative organisms in remaining; in decreasing order of their frequency. We could infer from this that most of the cellulitis cases that needed hospitalizations, that is the more severe ones, were caused by Staphylococcus aureus mainly. This could be because the outpatient treatment options for Staphylococcus is limited. Alternatively, there is a rise in staphylococcal infections in the population.

A study conducted by Galia Zacay et al [7], showed the predisposition of diabetics towards cellulitis and other soft tissue infections. In the results of the study, multivariate logistic regressions for cellulitis showed a 1.4 fold increase among patients with HbA1c >7.5. in our study too, the most common risk factor for cellulitis was diabetes mellitus followed by hypertension. Behavioural risk factors like alcohol consumption and smoking also showed a strong association.

V. Limitations of our study:

1.Cellulitis is sometimes difficult to diagnose and can be confused with other non-infectious syndromes that can cause redness(erythema) and swelling like deep vein thrombosis, lymphedema of lower limb, filarial lymphangitis and lymphedema, chronic venous insufficiency and acute or chronic limb ischemia (arterial gangrene of lower limb).

2. There are no ICD code 10 referring to only cellulitis. Attempt was made to exclude all other forms of skin infections like erysipelas, soft tissue infections, surgical site infections , furuncle and skin abscess which bear same ICD codes.

3. We only included hospitalized patients as study participants and didnot observe the outpatients diagnosed and treated for cellulitis. So, we could not estimate the exact burden of the disease on our population. In that way, our study underestimates the thrust of the disease.

4.Our study did not include the patients who were readmitted with the same symptoms, which is likely to occur for severe cases of cellulitis. So, the total number of admissions might be an underestimate.
5.Our study's data source has some inherent limitations. We used data from medical records library and other administrative data. We have not incorporated medication or biochemistry laboratory data such as liver and renal function tests into our study, which is a draw back, as laboratory data is important to assess the severity of the disease.
6. The question that, what are the environmental risk factors for cellulitis, remains unanswered in our study and still remains a point of debate.

As a prospect for the future, investigations should focus on the direct effects of weather on the epidemiology of cellulitis. Such studies will help to understand the pathogenesis and risk factors for cellulitis in a better way. In addition, studies focusing on environmental risk factors may help in introduction of new preventive approaches and programmes to curb the disease. In the future , studies should focus on cost of hospitalizations in order to estimate the financial burden of cellulitis in the population.

VI. Conclusion

Despite of our limitations in study, we tried to conclude that, the incidence of cellulitis in the population increases in the rainy season in Andaman and Nicobar islands resulting in increased hospital admissions of cellulitis cases. Though most of the cellulitis cases are mild, but severe cases warrant surgical intervention and prompt management. Diabetic patients are at more risk of developing cellulitis even with trivial trauma. What are the environmental risk factors of cellulitis is a question that remains unanswered in our study and stills remains a point of debate. Staphylococcus aureus is the most common organism associated with cellulitis. At last, we have shown a striking seasonality in hospitalizations for cellulitis and highlight the need for future work to estimate the financial burden of the disease on our population.

Conflict of interests: There is no conflict of interests
Ethics committee approval: Approval was obtained from the institutional ethics committee.
Sources of funding: There is no source of funding.

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