Diabetes free life expectancy (DFLE) by gender in India: Evidence from a large-scale national survey

Introduction

Health and its associated factors play a prime role in ageing and longevity. Currently, there has been demographic shift with increasing proportion of ageing population across the globe, as in 2020, the number of older adults (60 years and above) surpassed children aged below 5 years suggesting a greater increase from the past (World Health Organization[WHO], 2022). This phenomenon of population ageing that evident in developed nations has become a major demographic shifts seen in developing nation too (Ismail et al., 2021). WHO predicted that by 2050, 80% of aged population will be located in low and middle income countries (World Health Organization[WHO], 2022). There has been a rising concern and public health challenge ahead with 8% of the global population being aged and projected to increase to 20% in next 20 years (Berrío Valencia, 2012). Further, this increase is attributed to the life expectancy and quality of health care along with increased labour participation (Kim et al., 2023). It is noteworthy that with increase in life expectancy there has been apprehension in the disability adjusted life years (DALYs) with non-communicable diseases (NCDs) (Lancet, 2017) and population ageing (Prynn & Kuper, 2019).

The NCDs are the current global health challenge and curtailing it is a public health target. As on 2019, 42,034,124 deaths have recorded worldwide due to NCDs compared to less than 8 million deaths due to communicable diseases, further with an increase in DALYs with NCDs (Shu & Jin, 2023). This epidemiologic transition from infectious diseases to NCDs at global (Atiim & Elliott, 2016) and national level is attributed to rapid changes in various aspects of socio-economic factors. Although the concept of epidemiological transition holds certain limitations (McKeown, 2009; Santosa et al., 2014), it is undeniable that the cases of NCDs have increased from the past orienting to the drastic life style changes (Sun et al., 2024). Globally, 74% of deaths are attributed to NCDs and of all 77% occur in low and middle income countries due to prime NCDs such as cardiovascular diseases, cancer, respiratory diseases and diabetes (WHO, 2023). Among these, the risk of diabetes increased with ageing (Yan et al., 2023) being a leading cause of disability and mortality (Ong et al., 2023). Considering, WHO data, about 422 million individuals are living with diabetes worldwide, with majority hailing from low- and middle-income countries and diabetes is considered to be the cause of 1.5 million deaths each year with an increase of 3% in mortality rates by age between 2000 to 2019 (WHO,

2023). This brings the need for a healthy ageing as diabetes and its complications potentially leads to disability (Kotwas et al., 2021; Oyewole et al., 2023) reducing quality of life (Gómez-Pimienta et al., 2019; Tamornpark et al., 2022).

The diabetes and its management is a global public health concern as it holds life changing and threatening complications (Al-Lawati, 2017). Diabetes being a metabolic and lifestyle disease it significantly impacts physical, social and psychological well-being of an individual (Kalra et al., 2018). Essentially, diabetes management requires consistent self-management and life-long changes in their life style where the psychological factors, health beliefs and interpersonal factors plays a crucial role in the self-care behaviour among individuals (Harvey, 2015; Rao et al., 2021). Considering the diabetes distress, fear associated with complications and hypoglycaemia along with psychological insulin resistance (Robinson et al., 2018), it adds up to the mental health concerns. As diabetes management with these factors double the risk of depression among individuals living with diabetes (Moulton et al., 2015; Snoek, 2022). Furthermore, the diabetes management also incurred economic burden (Zawudie et al., 2022) along with the physical and psychological burdens at an individuals and global level (Bommer et al., 2018).

As the public health burden and challenge is well-established in terms of ageing population and increasing cases of diabetes, globally. India being a middle-income country is not immune to these health burdens. Furthermore, India is the second country that holds higher number of ageing population (Bloom et al., 2021) and individuals living with diabetes between the age group 20- 79 years (Maiti et al., 2023, pp. 2019–2021). The demographic transition have paved for increased life expectancy in India, however, years are lost with disability due to NCDs (Menon et al., 2022) and with alarming life time risk of diabetes (Luhar et al., 2021). With this said, it is essential to bring changes at community and policy level to manage the public health concerns. Therefore, the present study tries to understand the diabetes epidemiology among ageing adults in India along with its difference in gender and locality.

Methods

The concept of Life Expectancy (LE) is inevitable in public policy as there has been a continuous improvement in average years one live at birth. However, improvement in LE may not necessarily provide clarity as this represents only survival years. It is possible that a person may spend a portion of the total LE in unhealthy years due to health shocks such as diseases, disability, falls etc. Therefore, total LE of a person is a product of healthy and unhealthy years. In this case estimating Healthy Life Expectancy (HLE) may offer better clarity for policy inputs. In this specific study we aim to estimate diabetic specific healthy and unhealthy years for the Indian middle aged and older adults.

Data and sample:

To estimate Diabetes Free Life Expectancy (DFLE), we used mortality and morbidity (prevalence of diabetes in the current study) data. The mortality data was collected from the abridged life tables for the years 2016-20 published by the Sample Registration System (SRS) of the office of the General and Census Commissioner, India. It provides probability of death and survival of population of a cohort at different ages. The abridged life tables by SRS are published for four years. The diabetes prevalence data was collected from the Longitudinal Ageing Study in India (LASI – Wave 1) which was conducted in 2017-18 and therefore we have considered abridge life table matching the mid-year. Using LASI age specific diabetic prevalence data for the Indian ageing population was obtained separately by gender and place of residence. Since the study consider middle aged and older population sample population was specified into five-year interval group starting from 45-49 years to 85 year and above (this last group was an open-ended group). The LASI was conducted as a scientific investigation of health, socioeconomic, and other relevant aspects of population aging in India. The survey was executed during April 2017 and December 2018, with the funding support by the Ministry of Health and Family Welfare, Government of India, the National Institute of Aging and, United Nations Population Fund-India. The International Institute for Population Sciences (IIPS), Mumbai designed and executed the survey with technical support from the Harvard T H Chan School of Public Health (HSPH), the University of Southern California (USC) and several other institutions. The LASI intended to provide national-level scientific estimates on demographic, and economic profile of households, health outcomes (such as diagnosis- and symptom-based chronic health conditions, functional and mental health, healthcare utilization, and biomarkers), socio-economic wellbeing (i.e. work and employment, social security, social

networking, and support) of older adults (International Institute for Population Sciences, 2020). LASI, a longitudinal prospective study by design, covered a sample of 72,250 individuals aged 45 years and above and their spouses (irrespective of age) across 34 states and union territories of India except Sikkim. The present study considered only older adults aged 45 years and above with a sample of 65562 individuals (of which 31464 were aged 60 years and above).

Diabetic prevalence:

The prevalence of diabetes among Indian ageing population by age category was calculated by utilising health module of LASI. The prevalence of diabetes was calculated based on self-reported cases and was assessed using the question; "has any health professional ever diagnosed you with diabetes or high bold sugar". The response was wither coded as "Yes" or "No".

Analytical approach:

Abridge life tables with mortality data along with morbidity data from the LASI were combined to estimate the DFLE by applying the Sullivan Method (Sullivan, 1971). Five-year age group was considered for the study population to estimate their respective LE and DFLE by sex and place of residence. Further, for a better understanding of gender differentials DFLE in place of residence, we have estimated DFLE for males and females separately for rural and urban population. To test the equality of the estimated DFLE by gender and place of residence standard error and p values were estimated (Hauet, E, 2001).

Results

The present study aimed to estimate the life expectancy and diabetes free life expectancy among middle aged and older adults in India. The table 1 presents the prevalence of diabetes among middle aged and older adults in India during 2017-2018. The overall prevalence was higher among males (12.51%) compared to females (12.20%). In terms of gender, the diabetes prevalence was highest among males aged between 75-79 years (16.74%) followed by 64-69 years and 70-74 years with 15.58% and 15.15%, respectively. Further, the highest prevalence of diabetes was identified among females aged between 70-74 years with 17.71% followed by 15.17% among 64-69 years.The age groups with lower prevalence were 45-49 years (Male= 6.69%; Female = 8.31%) and 85+ years (Male = 8.61%; Female = 8.1). Considering the place of residence, rural older adults aged between 70-74 years had the highest prevalence of diabetes (9.82%). Strikingly, the same age counterparts in urban location had triple the prevalence (31.91%) followed by 24.67% and 21.62% in the age ranges 75-79 and 55-59 years, respectively. Overall, the prevalence was highest among urban ageing adults (21.52%) compared to their rural counterparts (8.15%).

Table 1: Prevalence of diabetes among middle aged and older adults in India - 2017-18

Age group	Gender		Place of residence	
	Male	Female	Rural	Urban
45-49	6.69	8.31	4.54	13.67
50-54	12.96	9.48	7.26	18.33
55-59	11.53	14.56	9.3	21.62
60-64	13.95	13.45	9.45	24.62
64-69	15.58	15.17	9.64	28.2
70-74	15.15	17.71	9.82	31.91
75-79	16.74	10.68	9.3	24.67
80-84	12.12	9.78	8.7	16.74
85+	8.61	8.1	6.63	12.97
Total	**12.51**	**12.20**	**8.15**	**21.52**

It is evident from the results of the prevalence of diabetes among ageing adults by gender and place of residence (table 2) that the prevalence of diabetes was high among males

in urban areas than rural areas (21.82% Vs 8.52%). Similarly, compared to females from rural areas the prevalence of diabetes was higher among older adults from urban area (21.30% Vs 7.84%). Overall, diabetes prevalence was higher among older adults aged 60 to 79 years in both the residential setting. Noteworthily, the prevalence of diabetes was more than double in urban locality compared to their rural counterparts for the males and females.

Table 2: Prevalence of diabetes among middle aged and older adults among males and females by place of residence

Age group	Rural		Urban	
	Male	**Female**	**Male**	**Female**
45-49	4.58	4.51	11.46	15.06
50-54	8.83	5.91	20.44	16.38
55-59	8.92	9.59	16.89	25.53
60-64	8.87	9.96	27.48	22.22
64-69	10.79	8.52	28.22	28.19
70-74	10.01	9.63	29.12	33.97
75-79	10.31	8.34	32.04	16.89
80-84	8.25	9.16	24.9	11.14
85+	5.38	7.6	17.17	9.51
Total	**8.52**	**7.84**	**21.82**	**21.30**

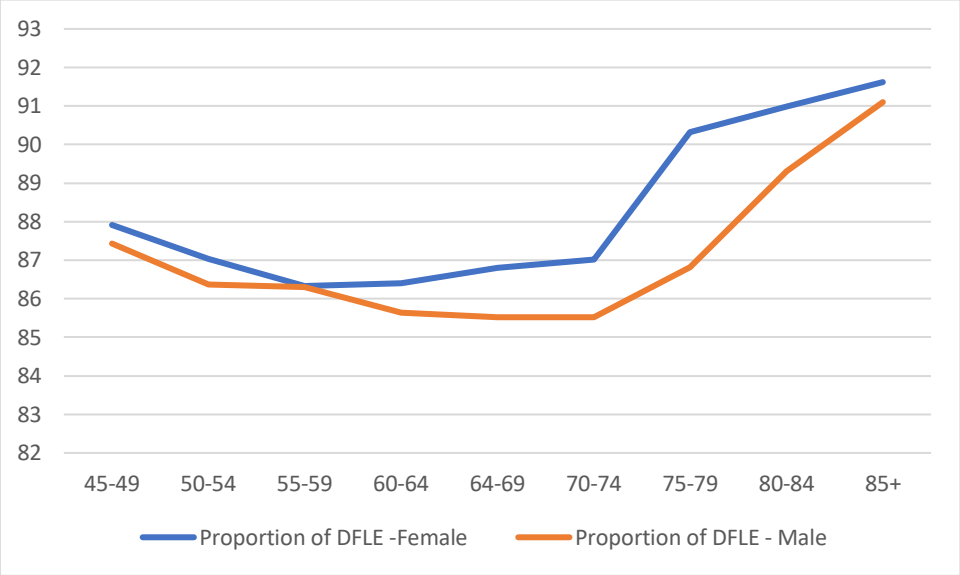
The table 3 shows the Life Expectancy (LE) and difference in Diabetes Free Life Years (DFLE) among middle aged and older adults in India by gender during 2017-18, it is evident from these results that females had higher LE and DFLEin all age groups compared to the males. As expected, the DFLE was highest among older adults in 45-49 years while it decreased gradually with age. Females aged 45-49 years had 27.77 years of DFLE (87.91% of LE) compared to males with 25.53 years of DFLE (87.44% of LE) at the same age (SE = 2.24, $p<0.001$). Similarly, females aged 60-64 years had 16.59 years of DFLE in comparison with 14.99 years DFLE among males for the same age group (SE= 1.60, $p<0.001$). Although, this pattern was evident across the age groups between females and males, at 85+ years there exists no significant difference (SE= 0.21, $p<0.10$) between males and females in terms of DFLE.

Interestingly, females and males aged between 55-59 years had almost equal proportion of DFLE with 86.33% and 86.30%, respectively, (Figure 1).

Table 3: LE, and difference in DFLE among middle aged and older adults in India by gender – 2017-18

Age group	Females			Males			Difference in DFLE between males and females (standard error)	P value
	LE	DFLE	Proportion of DFLE	LE	DFLE	Proportion of DFLE		
45-49	31.6	27.77	87.91	29.2	25.53	87.44	2.24	<0.001
50-54	27.2	23.67	87.03	25	21.59	86.37	2.08	<0.001
55-59	23	19.86	86.33	21	18.12	86.30	1.73	<0.001
60-64	19.2	16.59	86.41	17.5	14.99	85.64	1.60	<0.001
64-69	15.5	13.45	86.80	14.2	12.14	85.52	1.31	<0.001
70-74	12.4	10.79	87.01	11.4	9.75	85.52	1.04	<0.001
75-79	9.6	8.67	90.33	8.9	7.73	86.82	0.95	<0.001
80-84	7.2	6.55	90.98	6.8	6.07	89.31	0.48	<0.001
85+	5.4	4.95	91.62	5.2	4.74	91.10	0.21	<0.10

Figure 1: Proportion of Diabetes Free Life Years by gender

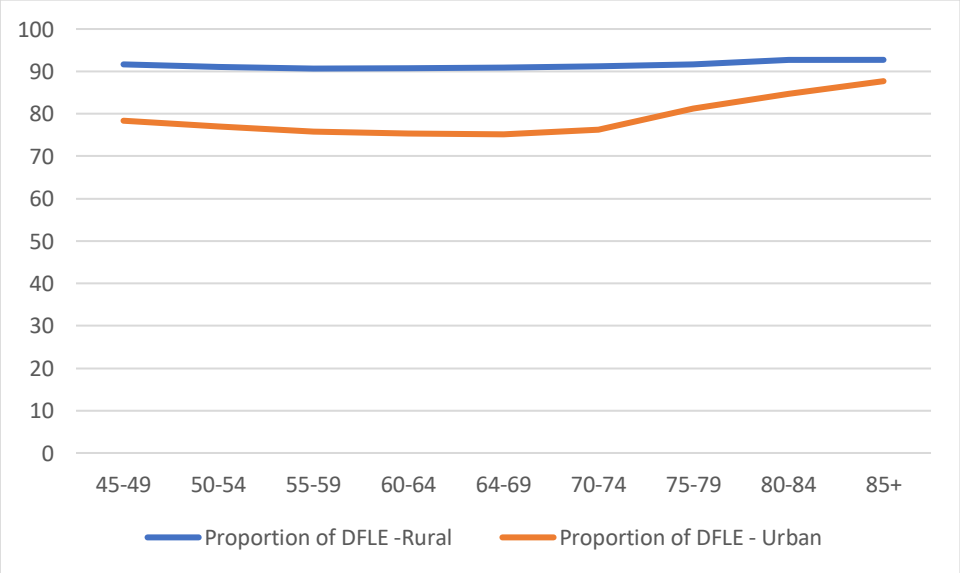


The LE and difference in DFLE among older adults by place of residence is presented in table 4, the results suggests that older adults residing in rural areas had lower LE compared to their counterparts in urban setting. However, interestingly older adults residing in rural locality had higher proportion of DFLE (greater than 90%) in comparison to older adults living at urban locality (Figure 2). Further, older adults aged 45-49 years residing in rural areas had LE of 29.6 years, DFLE of 27.15 years with proportion of 91.72%, while their urban counterparts had a LE of 32.1 years, DFLE of 25.14 years with proportion of 78.33 (SE = 0.132, $p<0.001$). Similarly, older adults aged 60-64 years residing at rural locality had 16.08 years of DFLE (90.82%) compared to the urban residing older adults with DFLE of 14.85 years (75.37%) (SE = 0.123, $p<0.001$). Noteworthily, we can observe a shift in the DFLE years among rural older adults in advanced years like those aged 75-79 years 80-84 years and 85+ years had 8.07, 6.02 and 4.54 DFLE years, that is lower DFLE years compared to older adults at urban areas.

Table 4: LE, and difference in DFLE among middle aged and older adults in India by place of residence – 2017-18

Age group	Rural			Urban			Difference in DFLE between rural and urban (standard error)	P value
	LE	DFLE	Proportion of DFLE	LE	DFLE	Proportion of DFLE		
45-49	29.6	27.15	91.72	32.1	25.14	78.33	2.00 (0.132)	<0.001
50-54	25.3	23.05	91.10	27.7	21.32	76.97	1.73 (0.123)	<0.001
55-59	21.3	19.31	90.67	23.6	17.87	75.73	1.44 (0.126)	<0.001
60-64	17.7	16.08	90.82	19.7	14.85	75.37	1.23 (0.122)	<0.001
64-69	14.3	13.01	90.96	16.2	12.18	75.16	0.83 (0.120)	<0.001
70-74	11.3	10.31	91.23	13.2	10.07	76.28	0.24 (0.122)	<0.05
75-79	8.8	8.07	91.68	10.4	8.45	81.21	-0.38 (0.123)	>0.20
80-84	6.5	6.02	92.69	8.2	6.95	84.74	-0.92 (0.127)	>0.20
85+	4.9	4.54	92.73	6.3	5.53	87.70	-0.98 (0.141)	>0.20

Figure 2: Proportion of Diabetes Free Life Years by place of residence



The table 5 presents the LE, differences in DFLE among older adults by gender in rural and urban areas, we can observe from the results that, females had higher LE irrespective of their place of residence compared to males. Similarly, females in rural locality had significantly higher DFLE than males residing in rural areas and females in urban had significantly higher DFLE than males residing in urban areas. The females and males aged 45-49 years in rural areas had DFLE of 28.49 years (92.19% DFLE) and 25.90 years (91.51% DFLE), respectively (SE = 2.59, $p<0.001$). A similar result was witnessed in urban locality where females aged 45-49 years had DFLE of 26.30 years (79.20% DFLE), while the males had 24.16 years DFLE (77.69% DFLE) (SE= 2.14, $p<0.001$). This gender differences were identified in both the locality across age groups. In support, the females and males aged between 60-64 in rural locality had DFLE of 16.94 and 15.25 years, respectively (SE = 1.69, $p<0.001$). In terms of urban locality, at age 60-64, females had DFLE of 15.89 years and males had DFLE of 13.85 years (SE= 2.05, $p<0.001$). Interestingly, we notice from figure 3 that, after 79 years the DFLE proportion of rural males were higher than the females. Contrastingly, in urban locality the males remained to have lower DFLE proportion compared to females (Refer to figure 4).

Table 5: LE, and difference in DFLE among middle aged and older adults in India by gender in rural and urban areas – 2017-18

	Rural								Urban							
Age group	Females			Males			Difference in DFLE between males and females (standard error)	P value	Females			Males			Difference in DFLE between males and females (standard error)	P value
	LE	DFLE	Proportion of DFLE	LE	DFLE	Proportion of DFLE			LE	DFLE	Proportion of DFLE	LE	DFLE	Proportion of DFLE		
45-49	30.9	28.49	92.19	28.3	25.90	91.51	2.59	<0.001	33.2	26.30	79.20	31.1	24.16	77.69	2.14	<0.001
50-54	26.5	24.24	91.46	24.2	21.93	90.61	2.31	<0.001	28.7	22.44	78.20	26.8	20.31	75.77	2.14	<0.001
55-59	22.4	20.35	90.86	20.2	18.33	90.75	2.02	<0.001	24.4	18.80	77.04	22.8	17.05	74.80	1.74	<0.001
60-64	18.6	16.94	91.09	16.9	15.25	90.26	1.69	<0.001	20.5	15.89	77.53	19.1	13.85	72.50	2.05	<0.001
64-69	15.1	13.73	90.94	13.6	12.30	90.46	1.43	<0.001	16.8	13.02	77.48	15.7	11.37	72.45	1.64	<0.001
70-74	11.9	10.82	90.91	10.8	9.80	90.74	1.02	<0.001	13.6	10.84	79.72	12.7	9.31	73.27	1.54	<0.001
75-79	9.2	8.40	91.32	8.5	7.73	90.91	0.67	<0.001	10.7	9.31	87.05	10.1	7.52	74.41	1.80	<0.001
80-84	6.7	6.15	91.85	6.3	5.89	93.50	0.26	<0.02	8.4	7.51	89.35	7.9	6.26	79.20	1.25	<0.001
85+	4.9	4.56	93.10	4.8	4.53	94.28	0.04	>0.20	6.5	5.86	90.14	6.2	5.13	82.72	0.73	<0.02

Figure 3: Proportion of Diabetes Free Life Years in rural area

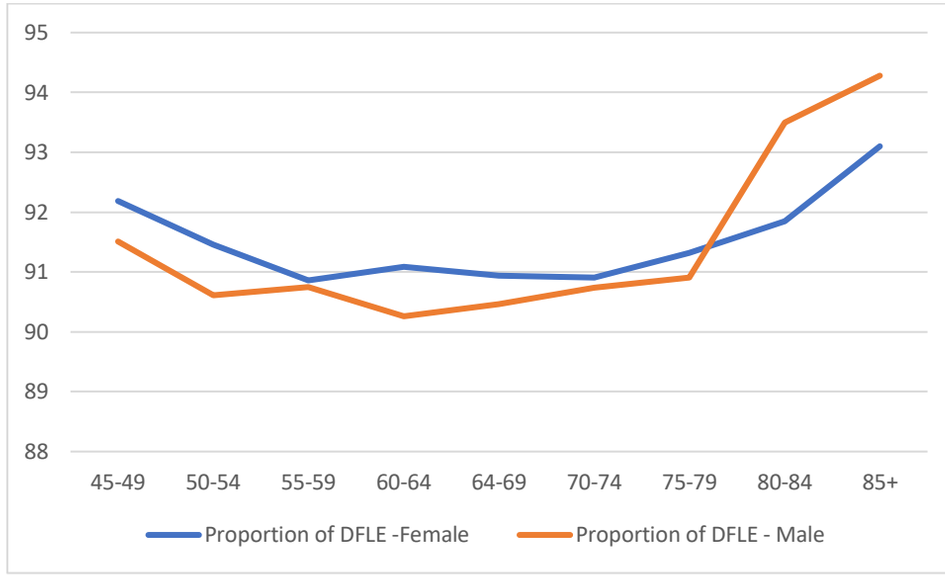
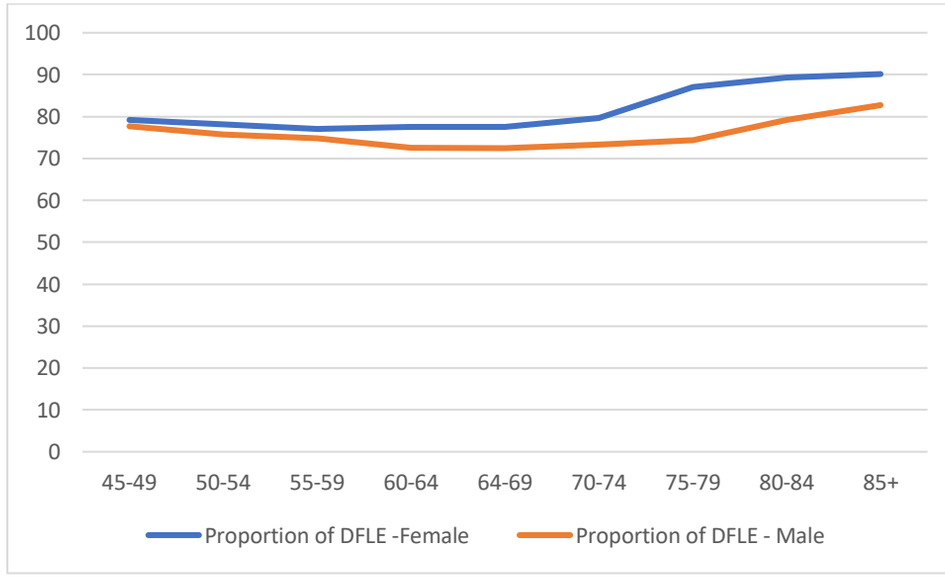


Figure 4: Proportion of Diabetes Free Life Years in urban area



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