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The Association Between Socioeconomic Status and the Incidence of Osteoarthritis in Mumbai and Its Rural Periphery

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ABSTRACT:

OBJECTIVE: *This case study was set up to investigate if there is an association between the socioeconomic status and the incidence of osteoarthritis in Mumbai and it's rural periphery.*

METHODS: *A regional exploratory case study was conducted with 19 Indian physicians working in orthopedic practice based in government hospital or private clinics. They were interviewed to collect data about their osteoarthritis patients. Information regarding patients' socioeconomic status, incidence of osteoarthritis as well as demographic data were documented in a case report form. The socioeconomic status was calculated based on a modified version of Kuppuswamy's socioeconomic scale.*

RESULTS: *The results showed a higher average incidence of osteoarthritis in rural areas (53.8%) compared to urban Mumbai (20.8%). The socioeconomic status was lower in rural Raigad (12.8 points) compared to urban Mumbai (18.3 points). On average, women were more often affected than men. The highest incidence of osteoarthritis was found in women from rural areas (39.4%).* ***Conclusion:*** *Findings of the case study indicated association between high incidence of osteoarthritis and low socioeconomic status. Thus, the findings of this case study offer a solid template for future research.*

KEY WORDS: *Socioeconomic status, osteoarthritis, incidence, prevalence, risk factors, health insurance, Mumbai, Raigad, India*

I. INTRODUCTION:

Osteoarthritis (OA) has a high prevalence in industrialized nations and is the most frequently occurring musculoskeletal disease (1). The prevalence of OA increases with age. At age < 45 men are more often affected than women, whereas above 55 women are more frequently affected. Approximately, worldwide 9.6% of men and 18% of women ≥ 60 years suffer from OA. As life expectancy grows, the prevalence of OA is very likely to increase. In 2020 OA is expected to be the fourth leading cause of disability (2), (3). It will not only cause more expenses for health care but also produce high indirect costs, since people affected by symptomatic OA are not able to add to the economic performance of a country, causing a loss of productivity and profits (2). In the past, studies on OA and its risk factors primarily focused on physical risk factors, e.g. obesity, old age, female gender, or joint injury (4). Nonetheless, recent studies have indicated that there is an association between the socioeconomic status (SES) and the incidence and prevalence of OA. SES, is categorized as low, middle and high (9). SES can be measured in terms of income, wealth, poverty, education, occupation, and area level measures (10), (11), (12).A study by Callahan et al. found that both education and SES were independently associated with knee OA (5). Two large surveys conducted in India by Chopra et al. focusing on Western India and the Pune region revealed a significantly higher prevalence of knee pain in the rural compared with the urban community (13.7% vs. 6.0%) in the adjusted comparison (6), (7). Studies by Joshi et al. basically focused on the rural-urban divide and did not collect data on the SES of its subjects. In summary, there is very little data on the correlation between the SES and the incidence of OA in modern India (7). Since the study by Joshi et al. is based on data of 2001 it may also be of interest to investigate the incidence and prevalence of OA nowadays, with India's economy and society developing rapidly and life expectancy rising.

II. MATERIALS AND METHODS:

Doctors from government hospital or private clinic from Mumbai or periphery (Raigad) were selected randomly based on their professional qualification. Data acquisition was based on the interview technique and documented on a paper based case report form. Queries were resolved immediately, if any. Data were entered in study specific Microsoft Excel sheet and analyzed by

Microsoft Excel as well as Graph Pad Prism™. In order to evaluate the SES of patients a modified version of Kuppuswamy's SES scale was developed. Kuppuswamy's SES scale is a composite measure based on the subject's occupation, education and income. In order to calculate the final modified version of SES score based on Kuppuswamy's SES scale, scores for occupation, education, and income had to be calculated in the first place. It was calculated as follows:Beginning with occupation, all values of single subdivisions of this category, which comprise 'unemployed', 'unskilled worker', 'semi-skilled worker', 'skilled worker', 'clerical/shop-owner/farmer', 'semi-professional', and 'professional' in terms of percent were converted to absolute numbers, which were equivalent to the number of patients. Then, absolute numbers were multiplied by Kuppuswamy's point score to calculate the total score. Total score values of the separate subdivisions were added and divided by the sum of all absolute numbers (patients) in order to obtain the occupation score. The same calculation was done for education and income. After calculating scores for education, occupation, and income, all three scores were added to get a final composite modified version of SES score based on Kuppuswamy's SES scale for each doctor's patient pool.

Table 1: Calculation of modified version of Kuppuswamy's socioeconomic score

(Example no° 1 - Occupation)

Example calculation of the occupation scale based on data of one participating doctor from Mumbai:

CRF no° 2	**Number of OA patients in this facility: 300**				
Occupation scale:	**Numbers [%]**	**Absolute numbers (patients)**	**Kuppuswamy's point score**	**Total score**	**Occupation score**
Unemployed:	50	150	1	150	
Unskilled worker:	0	0	2	0	
Semi-skilled worker:	5	15	3	45	
Skilled worker:	10	30	4	120	
Clerical, shop owner,farmer	10	30	5	150	
Semi-Professional	10	30	6	180	
Professional	15	45	10	450	
Total:	**100**	**300**		**1095**	**3.65**

First, percentage values for each occupational subdivision were converted into absolute numbers (see column 2 and 3). Then, absolute numbers (see column 3) were multiplied by Kuppuswamy's point score (see column 4) to calculate the total score (see column 5). Altogether, the sum of all total scores (see bold number in column 5) was divided by the total absolute number of all patients (see bold number in column 3) to obtain the final occupation score (see column 6). In this example, the occupation score was **3.65** points**.**The same procedure was repeated using correspondent data to obtain values for an education and income score. In this example, the education score amounted to **6.0** points, and the income score was **10.2** points (see appendix Table 15 and Table 16). To obtain the final modified SES score the sum of the three previously calculated values was used, which made a final SES of **19.85** points. The average patient in this setting has a modified SES score of 19.85 points, which means the patient belongs to the upper middle class (9).

Incidence and prevalence were calculated using following formulas:

Calculation of Incidence and Prevalence

Incidence Rate = (Naïve patients with OA) / (Patients with Musculoskeletal Disease – Patients with known OA) Prevalence Rate = (Number of patients with OA / Number of patients with Musculoskeletal Disease) x 100

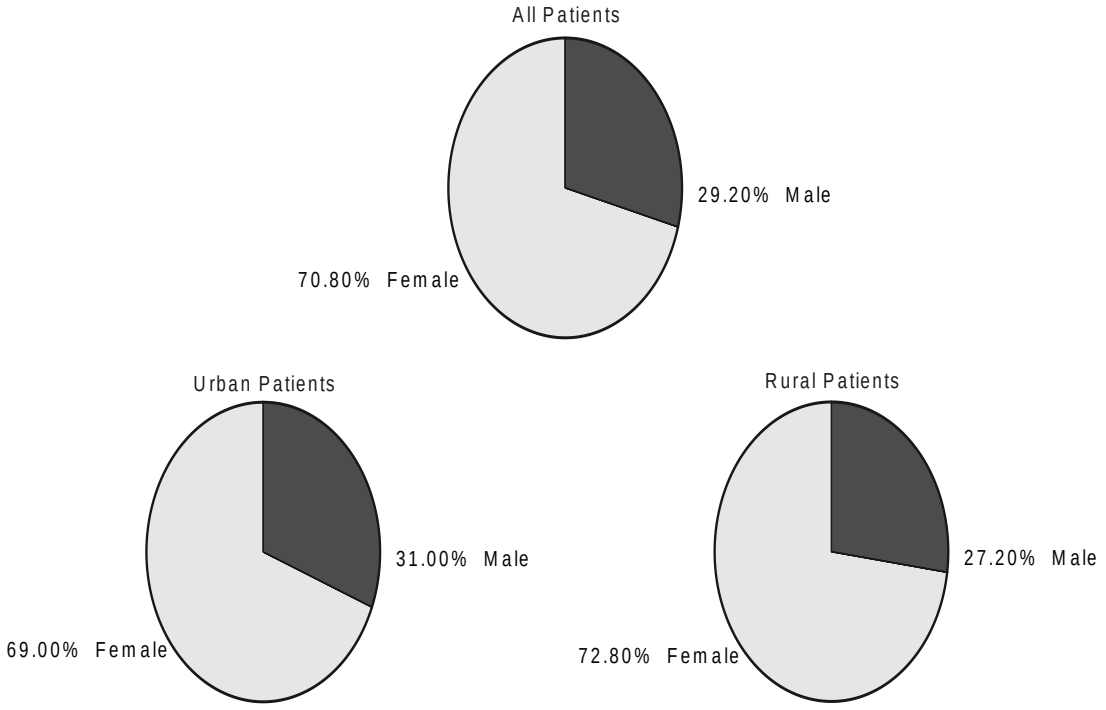
III. RESULTS:

In total 19 doctors were interviewed out of which ten were from Mumbai and nine were rural Raigad district.

Table 2: Overview of patients with OA and musculoskeletal disorders

	Total [numbers]	**Mumbai [numbers]**	**Raigad [numbers]**
Number of patients with OA	4804	1254	3550
Number of patients with musculoskeletal disorders	9447	3647	5800

Figure 1: Gender distribution of all OA patients



On average, 70.8% of all OA patients were female, whereas only 29.2% of all OA patients were male. In Mumbai, 69% of OA patients were female compared to 31% male OA patients. In Raigad (Rural), 72.8% of OA patients were male and 27.2% were female. The average age of all patients was 57.5 years (60.0 years in males and 55.0 years in females).

Table 3: Overview of average number of naive and repeat patients

57.2% of all patients were naïve and 42.8% were repeat patients. In Mumbai the number of naïve patients was lower (42.6%) as compared to Raigad (73.3%). The number of repeat patients was 57.4% in Mumbai and 26.7% in Raigad.

	Total [%]	**Mumbai [%]**	**Raigad [%]**
All naïve patients	57.2	42.6	73.3
All repeat patients	42.8	57.4	26.7
Female naïve patients	71.1	69.5	72.8
Male naïve patients	29.0	30.5	27.2
Female repeat patients	71.6	70.5	72.8
Male repeat patients	28.4	29.5	27.2

Figure 2: Overview of average patients' occupational status

On Average, 8.1% of the total number of patients were unemployed. In Mumbai 15.3% of patients were unemployed. The results showed that in Raigad no patients were unemployed. On average, 13.4% of all patients were unskilled. Numbers of unskilled workers in Mumbai (12.5%) and Raigad (14.4%) were similar. The total number of semi-skilled workers was 16.2%. There were more semi-skilled workers in Raigad compared to Mumbai (23.3% vs. 9.8%). 11.4% of all patients of the case study were classified as skilled. In Mumbai 10.1% were skilled workers and 12.8% of rural patients were said to be skilled. On average, 19.7% of total patients belonged to the group of clericals, shop owners or farmers. In urban areas only 8.5% of patients were counted in this group in comparison to 32.2% of rural patients. 14.0% of all patients were semi-professional. In Mumbai 11.5% patients were semi-professional, whereas in Raigad 16.7% were semi-professional. Furthermore, 17.3% of all patients were declared as professional. In Mumbai 32.3% of patients were professionals, whereas 0.6% of Raigad patients belonged to this group.

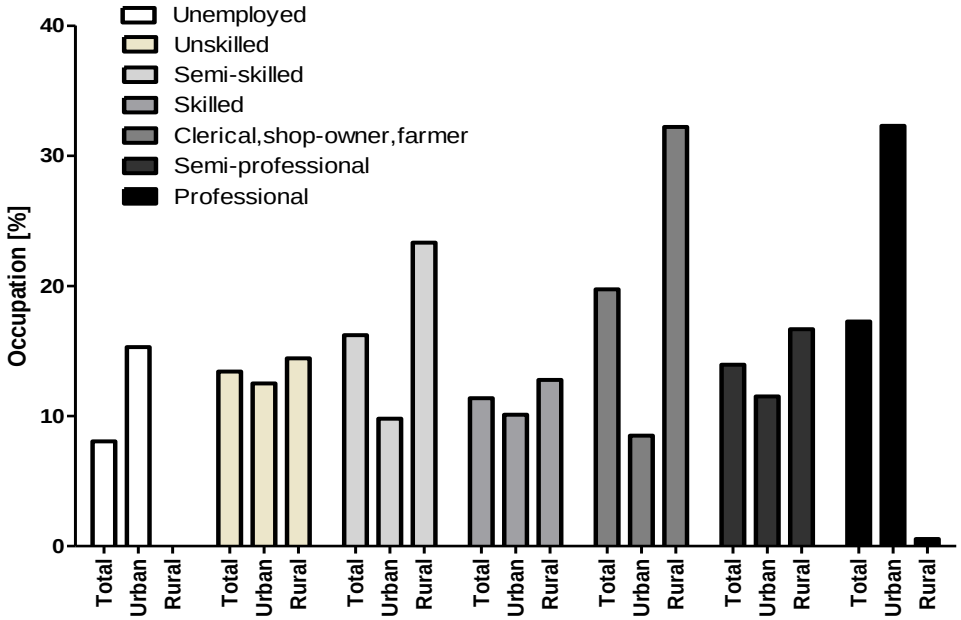


Figure 3: Overview of average patients' educational status

Regarding education status, 3.7% of all patients were illiterate, 21.8% of all patients finished education with a primary school diploma, 20.5% with a middle school diploma, and 20.8% with an intermediate or post high school diploma. 22.1% of the total number of patients were classified as graduates, whereas 11.1% were said to have a professional education. In Mumbai, 6.5% of their patients were illiterate. 11.5% had a primary school diploma, 19.0% a middle school diploma, and 15.5% had an intermediate or post high school diploma. 27.0% were assessed to be graduates, who thus constitute the biggest subgroup in the urban arm. 20.1% of Mumbai patients were professionals, thus forming the second largest subgroup. In Raigad only 0.6% as illiterate. 33.3% finished primary school, thus forming the biggest subgroup in the rural arm. 22.2% of Raigad patients had a middle school diploma and 26.7% had an intermediate or post high school diploma. 16.7% of Raigad patients were graduates and only 0.6% were assessed to be professionals.

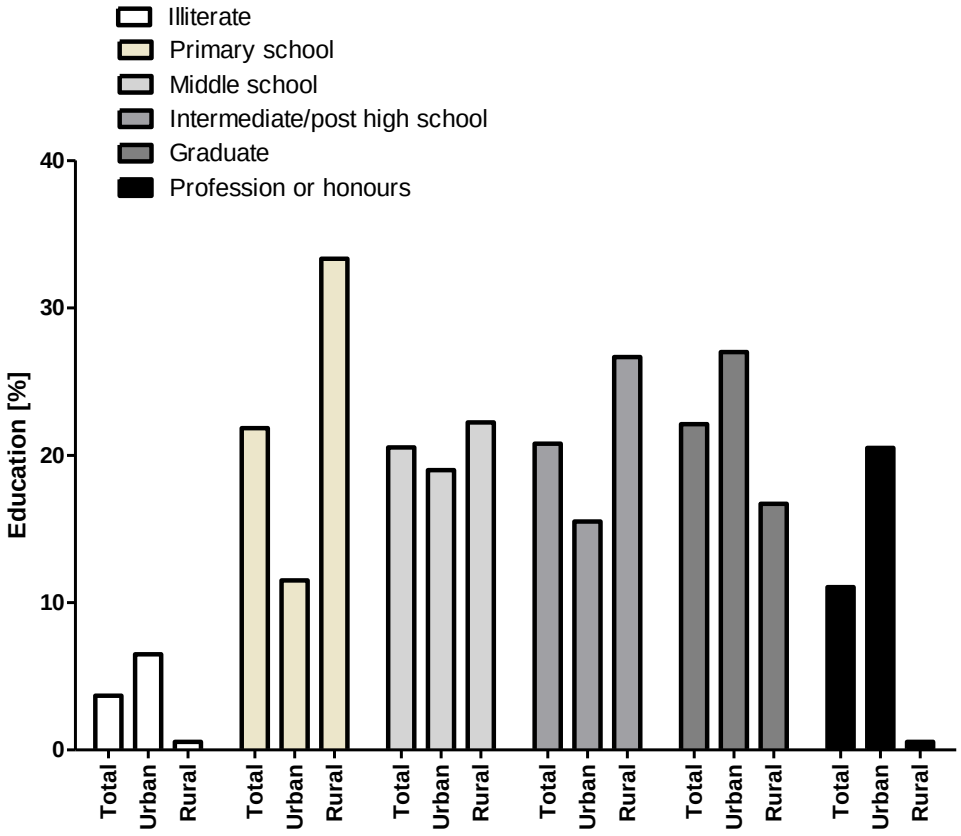
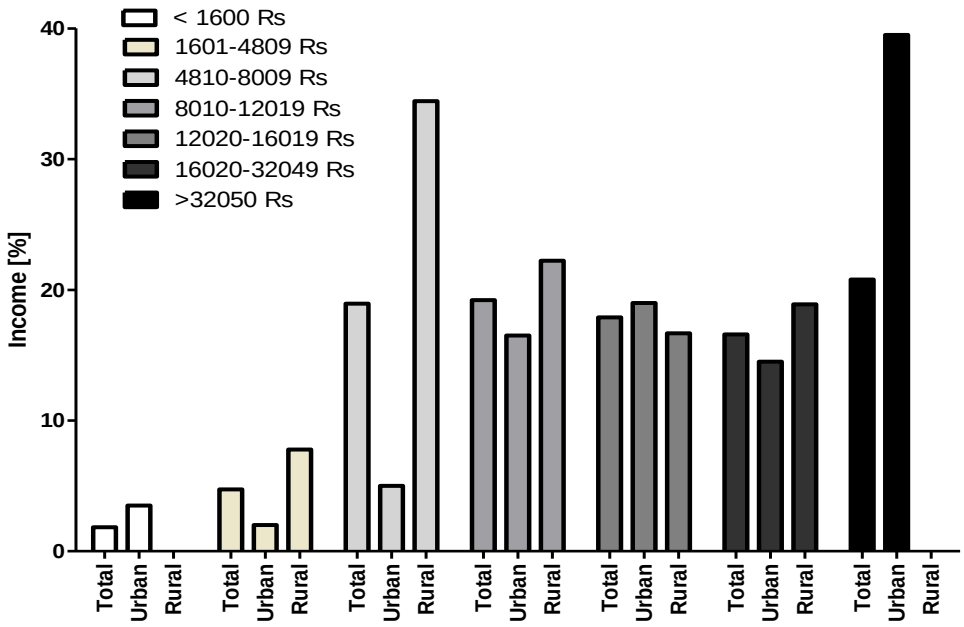


Figure 4: Overview of average patients' income status

In terms of income only 1.8% of the total number of patients earned less than 1600 rupees per months. 4.7% earned 1601-4809 rupees, 19% between 4810-8009 rupees, 19.2% earned up to 8010-12019 rupees, and 17.9% earned between 12020-16019 rupees. 16.6% of all patients were rewarded for their work with 16020-32049 rupees, and 20.8% were paid more than 32050 rupees per month. In Mumbai average salaries were higher compared to salaries in Raigad. In Mumbai only 3.5% of urban patients earned less than 1600 rupees per month, 2.0% earned between 1601-4809 rupees and 5.0% were paid 4810-8009 rupees. 16.5% of patients from Mumbai were paid 8010-12019 rupees, 19.0% earned up to 12020-16019 rupees, and 14.5% were paid 16020-32049 rupees per month. The biggest subgroup of urban patients, amounting up to 39.5%, was paid more than 32050 rupees per month. Neither did any of the patients from Raigad earn less than 1600 rupees, nor did any of them earn more than 32050 rupees per month. 7.8% were paid between 1601-4809 rupees per month. Most of the rural patients (34.4%) earned between 4810-8009 rupees per month. 22.2% were paid 8010-12019 rupees, 16.7% were rewarded with 12020-16019 rupees, and 18.9% earned up to 16020-32049 rupees per month.



On average, the SES of all patients was 15.8 points. The average SES score in urban areas was 18.4 points, which means that urban patients belonged mostly to the upper middle class.

Table 4: Overview of average patients' socioeconomic status (SES)

	Total [points]	**Urban [points]**	**Rural [points]**
Patients	15.8	18.4	12.8

Patients treated by eight out of ten urban doctors were classified to belong to the upper middle class and the patients of the two remaining doctors belonged to the middle/ lower middle class according to the modified version of Kuppuswamy's SES scale. The average rural SES score counted 12.8 points, thus on average rural patients belonged to the middle/lower middle class. Regarding patients from rural Raigad, two doctors primarily treated patients belonging to the upper middle class, four doctors dealt with patients counted to the middle/lower middle class, and three doctors primarily helped patients who belonged to the lower/upper lower class on average.

Table 5: Overview of patients' socioeconomic class

Socioeconomic Class Total	**Socioeconomic Class Urban**	**Socioeconomic Class Rural**
N= 19 (Doctors)	N= 10 (Doctors)	N= 9 (Doctors)
Upper middle (II): 10	Upper middle (II): 8	Upper middle (II): 2
Middle /Lower middle III: 6	Middle/Lower middle III: 2	Middle/Lower middle III: 4
Lower/Upper lower IV: 3	-	Lower/Upper lower IV: 3
Average SES Score and Class	**Average Rural SES Score and Class**	**Average Rural SES Score and Class**
15.8 points: → Upper middle (II)	18.4 points: → Upper middle (II)	12.8 points: → Middle/Lower middle (III)

The prevalence of OA among all patients with musculoskeletal diseases being treated by doctors participating in the study was 50.9% on doctors' level. On average, in urban Mumbai the prevalence amounted to 34.4%. In rural Raigad, prevalence of OA was almost double as high, amounting to 61.2%. In all female OA patients prevalence was 72.4%. In male OA patients the prevalence was 27.6%. In Mumbai, prevalence of OA in females was 69.7%, compared to rural areas where it was 73.3%. In male patients prevalence of OA was 30.3% in urban and 26.7% in rural areas as seen in Table 6.

Table 5: Overview of average prevalence of OA

	Total [%]	**Urban [%]**	**Rural [%]**
All patients	50.9	34.4	61.2
Female patients	72.4	69.7	73.3
Male patients	27.6	30.3	26.7

Generally, the average incidence of OA among all OA patients from both Mumbai and Raigad was 41.1% on doctors' level. In Mumbai the average incidence of OA was 20.8%, whereas it was higher in Raigad. (53.8%). The calculated incidence of OA was highest in female patients from rural areas, amounting 39.4%. In contrast, female patients from Mumbai had an incidence of 14.6%. Regarding male patients, the incidence of OA was generally lower compared to female patients. In rural areas the incidence was 14.3% and in urban areas it was only 6.1% as shown in Table 7.

Table 6: Overview of average incidence of OA

	Total [%]	**Urban [%]**	**Rural [%]**
All patients	41.1	20.8	53.8
Female patients	29.9	14.6	39.4
Male patients	11.2	6.1	14.3

Table 7: Overview of treatment of patients subdivided by Gender and Origin

84.1% of patients were treated with drugs and 15.9% was treated surgically as seen in the Table 8.

	Total [%]	**Urban [%]**	**Rural [%]**
All patients treated on drugs	84.1	86.8	81.1
All patients treated on surgery	15.9	13.2	18.9
Male patients treated on drugs	31.6	35.5	27.2
Female patients treated on drugs	68.4	64.5	72.8
Male patients treated on surgery	26.1	25.0	27.2
Female patients treated on surgery	73.9	75.0	72.8

On average, 23.7% of all patients were obese. In Mumbai, 38.0% of all patients were obese, whereas only 7.8% of patients consulting a doctor in rural areas were obese.

Table 8: Overview of average patients' obesity

	Total [%]	**Urban [%]**	**Rural [%]**
Obesity (all patients)	23.7	38.0	7.8
Obesity (male patients)	28.1	33.1	23.1
Obesity (female patients)	71.9	66.9	76.9

Table 9: Overview of average number of patients doing moderate exercise

Results showed that 22.6% of male and 16.6% of all female OA patients were doing moderate exercise.

	Total [%]	**Urban [%]**	**Rural [%]**
Male patients doing moderate exercise	22.6	33.5	10.6
Female patients doing moderate exercise	16.6	23.0	9.4

Moreover, in urban areas 31.6% of all OA patients had comorbidites, in comparison to only 11.0% of all OA patients from rural areas. Also, it was seen that average consultation time in urban areas was 14 minutes. In rural areas consultation time was shorter, lasting only five minutes. Average consultation fees were 585 rupees in Mumbai and 77.8 rupees in Raigad. All in all, on average, 83.8% of all patients did not have any health insurance. 13.8% were insured by a private health insurance and 1.8% were insured by the RSBY program.

IV. DISCUSSION:

Based on the study results there is a strong evidence indicating an association between the incidence of OA and the SES. The average incidence of recently diagnosed OA of all patients treated by doctors participating in the study was 41.1%. In Mumbai, the average incidence of OA was only 20.8% compared to an incidence more than twice as high, amounting to 53.8%, in Raigad rural orthopedic hospitals or practices. Correspondingly, the average prevalence of OA was also higher in rural Raigad compared to urban Mumbai (61.2% in Raigad vs. 34.4% in Mumbai). Overall, OA patients from urban Mumbai had a better education, higher income, and worked in more professionalized jobs. Consequently, the SES score calculated with the modified version of Kuppuswamy's SES scale was higher in urban patients. On average, in urban Mumbai OA patients belonged to the upper middle class, with a SES score of 18.4 points. Thus, this score was higher than the rural score, which counted only 12.8 points. Thus, on average OA patients from rural areas belonged to the middle/lower middle class. In 2009, Joshi et al. asked if there is a rural-urban divide regarding the prevalence of musculoskeletal diseases. Also dealing with OA, they found that OA had a lower prevalence in urban compared to rural communities, a fact which supports the finding of a lower incidence and prevalence of OA in urban Mumbai compared to rural Raigad. Yet, Joshi and his team did not look for the SES (7). This study shows that a lower SES correlates with a higher incidence of OA and may pose an additional risk factor for the development of OA. Besides investigating the association between the incidence of OA and the SES, this study also included questions on gender, age, obesity, moderate exercise and comorbidities as well as treatment of patients both in rural and urban areas.

Generally, the incidence of OA was higher in women than in men both in Mumbai and Raigad, with female patients from rural areas showing the highest incidence counting 39.4%. On average, 70.8% of all OA patients were female, whereas only 29.2% of all OA patients were male. However, research has shown that the disease generally appears more often in women than in men, a fact that is attributed to female biology, female hormones, and a certain genetic risk (15). Regarding the patients' age of average onset of the disease, the average age was 60 years in male and 55.0 years in female patients. It is worth mentioning that in Raigad male patients were diagnosed with OA aged 58.3 in comparison to male patients from urban Mumbai, where onset of OA seems to be later in life as on average they were diagnosed with OA aged 61.5. Possibly, increased physical labor in rural areas may pose an explanation to this finding.On average, 23.7% of all patients were obese. But obesity was a bigger problem in Mumbai, as 38% of all OA patients from the city were overweight, whereas on average only 7.8% of rural OA patients were obese. Regarding gender distribution, the majority of obese OA patients were female (28.1% of all male OA patients vs. 71.9% of all female OA patients). In contrast to industrialized countries, where people with a low SES are more often overweight. India shows higher prevalence of obesity in people living in cities, having a higher educational attainment and being affluent (16). According to the National Family Health Survey, women are more often overweight than men (17). As mentioned before, obesity is one of the major risk factors for the development of OA (18), (19). Nevertheless, incidence of OA was higher in OA patients from rural Raigad, where obesity was less prevalent than in Mumbai. As analysis of the case report forms revealed, in rural areas the majority of OA patients worked in jobs associated with physical labor, with only 17.3% of patients being professionals and semi-professionals. Basically, working on a farm for 1-9 years increases the risk of OA about 4.5 times. Farming 10 or even more years will lead to a 9.3 elevated risk to suffer from OA (3). The Framingham OA study named physical labor and heavy lifting as main risk factors for OA (19).

Physical labor seems to be a great risk factor for OA and may actually outweigh obesity as a main risk factor for OA in this case study. Thus, people from rural areas, especially women, being at higher risk for the development of OA should be the central target for primary, secondary, and tertiary prevention. Primary prevention includes prevention strategies for the development of OA. In Raigad people working in jobs demanding physical labor could be educated how to do physical labor the best way and the work environment could be adjusted to prevent OA from occurring. Secondary prevention comprises early diagnosis of OA to intervene as early as possible. Tertiary prevention is designed to prevent progress of the disease and to improve quality of life by reducing pain and disability caused by OA (20). It is also interesting to note that urban OA patients, who on average had a higher SES than rural OA patients, were said to suffer from comorbidities such as diabetes or arterial hypertension more often than rural OA patients. In urban areas 31.6% of all OA patients suffered from comorbidities in contrast to 11.0% of OA patients from rural areas (*figure 11*). These findings were coherent to a recent study by Corsi and Subramanian conducted in India in 2012. They found that groups with the highest SES had the biggest risk for type 2 diabetes (21). Moderate exercise is known to decrease the risk of cardiovascular comorbidities like diabetes type 2 (22). But even though OA patients from Mumbai were more likely to do moderate exercise (33.5% of male patients and 23.0% of female patients) than rural patients (10.6% of male patients and 9.4% of female patients) they had a higher rate of cardiovascular comorbidities (*please compare table 12 and figure 11*).

According to the results regarding the treatment of OA patients there was no obvious evidence for differences in the treatment of patients from urban and rural areas. All in all, the majority of patients (84.1% in urban and 81.1% in rural areas) was treated on drugs and only a small percentage (15.9% in urban and 18.9% in rural areas) was treated on surgery (*please view table 10*). Furthermore, inferences on the Indian health care system can be drawn. As results of the study reveal, most of OA patients both from urban and rural areas did not have any kind of health insurance (83.6% of all patients). Alarmingly, doctors participating in the survey from Raigad declared 100% of their patients to not have any kind of health insurance. As mentioned before, the Indian health care system has many problems that remain to be solved in order to achieve adequate health care for the Indian people. It is commonly known to burden patients with high out of pocket expenditures (8). Consequently, findings of this study reflect deficits of the Indian health care system. Furthermore, the poorest of the poor do not seek doctoral help when in need since they cannot afford the costs and the majority of them do not have any kind of health insurance. Thus, these patients are underrepresented in this case study. One may hypothesize that the incidence of OA may be even higher in groups with a very low SES, which remains to be proved in future studies. Once again, it becomes obvious that many steps need to be taken to improve health care in India.

V. CONCLUSION:

This case-study was done to determine if there is an association between the SES and the incidence of OA in Mumbai and its rural periphery as well as to identify new risk factors for the development of OA. Previous studies have indicated that there is a strong association between the SES and health (13), (1). This exploratory case study, was conducted to investigate the association between the incidence of OA and the SES. Results indicated that there is an association between low SES and high incidence of OA. Additionally, the study implies that a low SES comprising low educational attainment, a low occupational status, and a low income may pose an additional risk factor for the development of OA. In order to prove the association between the SES and the incidence of OA a confirmatory case-control study would be appropriate. A nationally representative cross-sectional household survey could be an alternative study design. Even though more OA patients from Mumbai were obese compared to rural OA patients, the incidence of OA was higher in rural Raigad, indicating that heavy physical labor is even a stronger risk factor for OA than obesity. Findings of this study yield strong evidence that there is an association between a high incidence of OA and a low SES and thus offer a template for future research.

Limitations of the study: Limitations of this study include that there was no randomization of participating doctors. Another limitation is the recall bias as doctors answered questions only based on their memories. It is likely that certain groups of patients are overrepresented and others are underrepresented due to recall bias (23). Furthermore, the case study only represents OA patients seeking help from an orthopedic specialist. Patients not affluent enough to afford medical help were not represented in the case study, thus the poorest of the poor are underrepresented. The study is also limited in terms of different methods regarding questioning of doctors. Doctors from Mumbai were questioned in interviews. In contrast, doctors from rural areas were sent the CRF via email and were not interviewed directly. In future studies one standardized interview technique should be chosen to ensure complete comparability. In some cases, certain questions may not have been answered correctly due to a lack of understanding the meaning of the question. Thus, certain results may be distorted. Furthermore, the CRF has certain weaknesses. The modified version of Kuppuswamy's SES scale in the CRF

lacked one sub-division regarding the patients' average educational attainment. OA patients having achieved a high school certificate were not listed in the modified version of Kuppuswamy's scale being part of the CRF. Two scores were on the verge of falling into another category (CRF no°18, SES amounting to 9.9 points in rural areas, and CRF no° 9, SES amounting to 14.5 points in urban areas). However, in order to change the final SES score of the two concerned CRFs doctors' statements on education would have needed to deviate dramatically from their original statements.

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