

## Spatial distribution and clustering of the proportion of disabled individuals by districts in Punjab

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### Abstract

Disabilities are globally endemic and will increase with population ageing and ubiquitous prevalence of non-communicable diseases. The Pakistan Social and Living Standards Measurement survey conducted in 2019-20 is the only district-level representative survey that provides proportion of disabled individuals. The survey used a standardized and validated six-questions from the 'Washington Group Questions' that identify functional disabilities pertaining to difficulty in the domains of sight, hearing, walking/climbing steps, remembering/concentrating, self-care (washing/dressing), and communicating/being understood. Disabilities were more common in men in both urban and rural areas of districts. Clustering of highest percentage of disabled persons were found in the north-western districts, while lower percentages were seen on the north-eastern districts. Test for the spatial autocorrelation of cumulative disability in the entire study area of Punjab province was found to be statistically significant. Findings underscore the need for better targeted health and social services for the disabled individuals in the Punjab province.

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### Introduction

Disability is a universal phenomenon that is experienced by every individual during their lives, either temporarily or permanently, with increasing probability and prevalence owing to population ageing and an increase in the non-communicable diseases globally.<sup>1,2</sup> It is a global public health and human rights concern.<sup>1,2</sup> The first world report on disability jointly produced by the World Health Organization (WHO) and the World Bank in 2011, stated that "Disability is the umbrella term for impairments, activity limitations and participation restrictions, referring to the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors)".<sup>1</sup>

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Disabilities are endemic globally and according to the WHO, the estimated number of individuals with significant disabilities is 1.3 billion globally.<sup>3</sup> Individuals with disabilities are twice as likely to experience depression, injuries and chronic conditions like stroke and diabetes.<sup>3,4</sup> Several studies on disabilities emanating from various types of conditions and their sequelae have been reported from Pakistan in varied socio-demographic groups.<sup>5-7</sup> The 'WHO global disability action plan 2014-2021' called for strengthening the collection of relevant and internationally comparable data on disability for supporting research and provision of pertinent services to disabled people.<sup>8</sup>

In Pakistan district level representative indices on disabilities have not been reported. The Pakistan Social and Living Standards Measurements (SLM) survey conducted in 2019-20 is the only survey that provided nationally, provincially, as well as the district-level representative proportions of individuals with disabilities in the country. The objectives of this study were to map disability proportions for the Punjab province districts, cumulatively and based on gender, residency status, and the differences by gender and residency status. Secondly, to analyze the clustering of cumulative proportions of disabled individuals in the districts of Punjab.

### Methodology

The Pakistan Social and Living Standards Measurements surveys are conducted by the Pakistan Bureau of Statistics (PBS), Ministry of Planning Development and Special Initiative. These surveys provide national, provincial, and district level – including urban and rural breakdowns at the district level – health indices in addition to other indices for monitoring various Sustainable Development Goals. The twelfth and most recent round was conducted from October 2019 to March 2020 (PSLM2019-20), that covered 195,000 households based on 6,500 urban and rural clusters/Primary Sampling Units (PSU), across the country based on 2017 Census. Thirty households were selected from each enumeration block i.e. PSU, which on average included 200 to 250 houses in urban areas; whereas in rural areas villages were divided into blocks with clearly delineated boundaries and each block within a village was treated as a PSU. The sampling frame for the PSLM201920 entailed 168,944 enumeration blocks (EB) across the

country i.e. four provinces, AJK, GB, and Islamabad Capital Territory; there were 87,003 EBs for the Punjab province with 3,267 urban and 59,841 rural EBs. However, owing to security and COVID19 restrictions/lockdowns 607 EUs were dropped from the sampling frame with 188 EUs dropped from the Punjab province (31 urban & 157 rural). Two-stage stratified sample design was used for the PSLM2019-20; with EUs/PSUs selected based on probability proportional to size, while households of sample PSUs were used as Secondary Sampling Units (SSU).

PSLM2019-20 is the first ever survey that included a 'Disability' module, which entailed standardized and validated six questions from the 'Washington Group Questions' that identify functional disabilities pertaining to difficulty in the domains of sight, hearing, walking/climbing steps, remembering/concentrating, self-care (washing/dressing), and communicating/being understood. The replies are coded on an ordinal scale of four categories ranging from 'no difficulty' to three increasing levels of disability i.e. 'some difficulty', lot of difficulty, and 'cannot do at all'.<sup>9</sup>

The PSLM2019-20 disability module was administered to individuals aged 5 years and older. Percent of individuals suffering from functional limitation in at least one disability domain and who reported as 'a lot of difficulty' or 'cannot do at all' were combined and coded as disabled individuals. Percent of these individuals, by district in the Punjab province, were analyzed in this study. PSLM2019-20 data and narrative reports are freely available for download on the PBS website.<sup>10</sup> The PSLM2019-20 report with proportion/percentage data presented as tables was downloaded and entered into Excel and subsequently joined with Punjab districts shapefile (GIS file).

Descriptive indices were calculated for percentage of disabled persons by districts, disaggregated by gender, urban/rural residency status, and the differences between these categories. Means were calculated after testing for normality of distributions using the Shapiro-Wilk test. Choropleth maps were created based on the district level percentage of population who reported disability; disaggregated by gender, urban, and rural residency status. Additional maps were created showing the differences in district level gender, urban, and rural residency status. Spatial analysis entailed cluster analysis of percent disabled individuals in the Punjab districts. Test for the presence of spatial association (spatial autocorrelation) of disability in the entire study area i.e. the Punjab province was tested using Global Moran's I, and pseudo-P values were computed using 999 permutations. While Local Indicators of Spatial Association (LISA) was used to test for the presence, type, and statistical significance of spatial

clustering of districts. Mapping and spatial cluster analysis was done using ArcMap 10.7 and GeoDa 1.14.

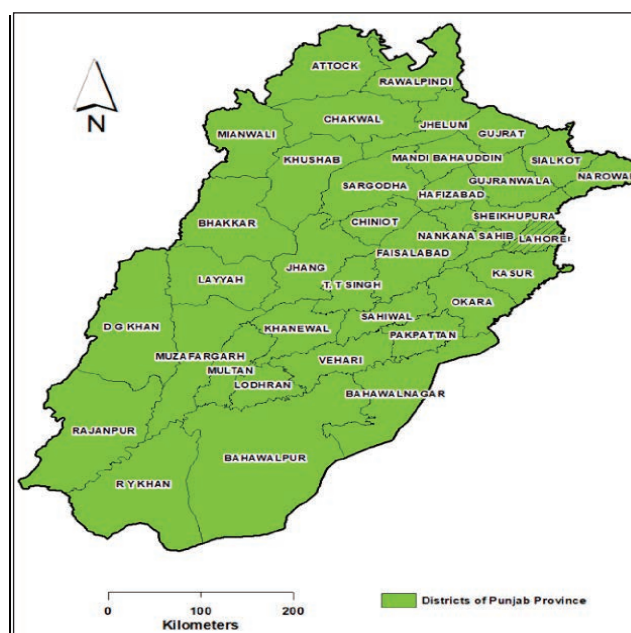
## Results

The cumulative prevalence of disability in Punjab was 3.84%, with 4.14% prevalence for males and 3.52% for females. While cumulative prevalence in urban areas was 3.59% (males: 3.83%; females: 3.35%) and in rural areas 3.98% (males: 4.33%; females: 3.62%). Table shows the summary measures for disability indices in terms of minimum, maximum, mean, and standard deviations. Figure 1 shows the Punjab districts map, while figure 2 shows the cumulative – in terms of urban, rural, male and females – spatial distribution of percent disabled persons, all males, and all females i.e. urban and rural, by districts in

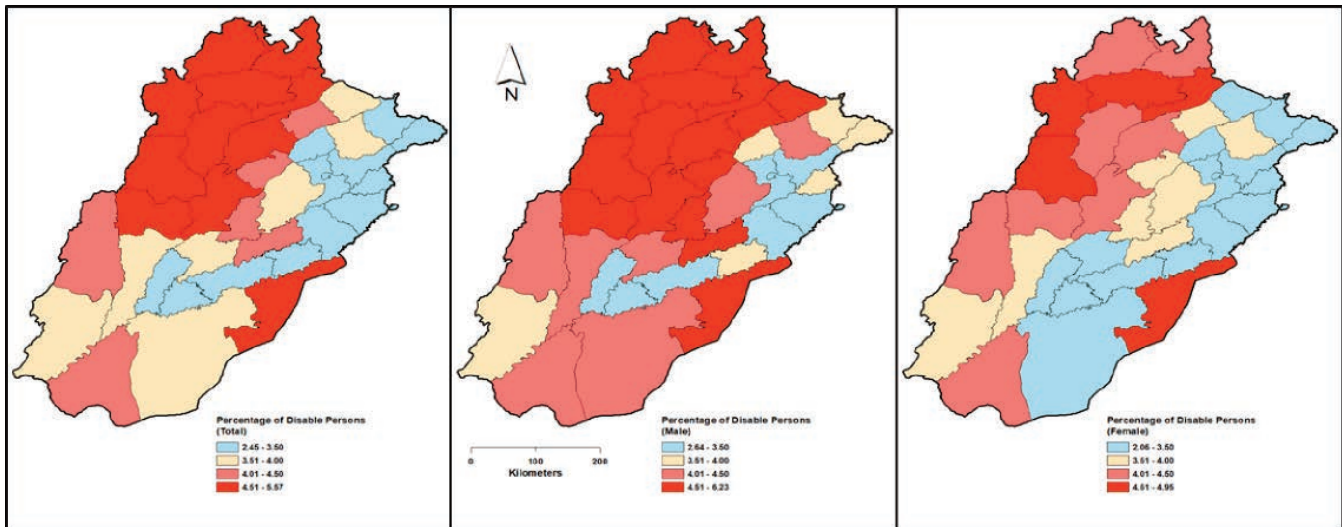
**Table:** Summary measures of each disability variable for the 32 districts of Punjab

Disability	Minimum	Maximum	Mean±SD**
Total	2.45	5.57	3.94±0.84
Total Male	2.64	6.23	4.30±0.94
Total Female	2.06	4.95	3.60±0.80
Total Urban	1.98	5.91	3.76±0.93
Total Rural	2.40*	5.48	4.05±0.90
Urban Male	1.73	6.44	3.99±1.09
Urban Female	1.44	6.11	3.54±1.03
Rural Male	2.61*	6.18	4.40±1.00
Rural Female	1.93*	4.92	3.66±0.87
Total Male minus Total Female	-0.1	1.51	0.70±0.42
Total Urban minus Total Rural	-1.54*	1.29	-0.28±0.67
Urban Male minus Urban Female	-2.49	2.7	0.45±1.02
Rural Male minus Rural Female	-0.25*	2.01	0.78±0.48

\* Minimum values and mean for rural areas were computed after removing the record for Lahore district as it does not contain rural area; \*\* Means were calculated after testing for normality of each variable using Shapiro-Wilk test.

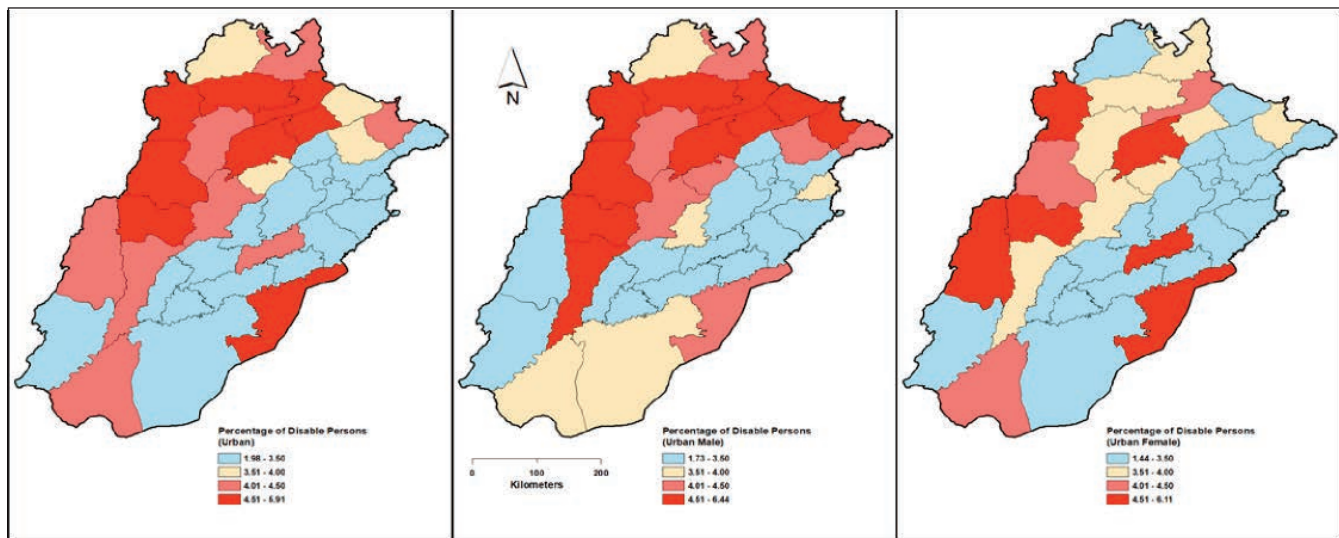


**Figure-1:** Punjab districts map.



**Figure-2:** Cumulative spatial distribution of percent disabled persons by districts in Punjab province.

*Cumulative percentage of disabled persons by district in Punjab province. Left map: total disabled persons; center map: male disabled; right map: female disabled..*



**Figure-3:** Urban spatial distribution of percent disabled persons by districts in Punjab province.

*Urban percentage of disabled persons by district in Punjab province. Left map: total disabled persons; center map: male disabled; right map: female disabled.*

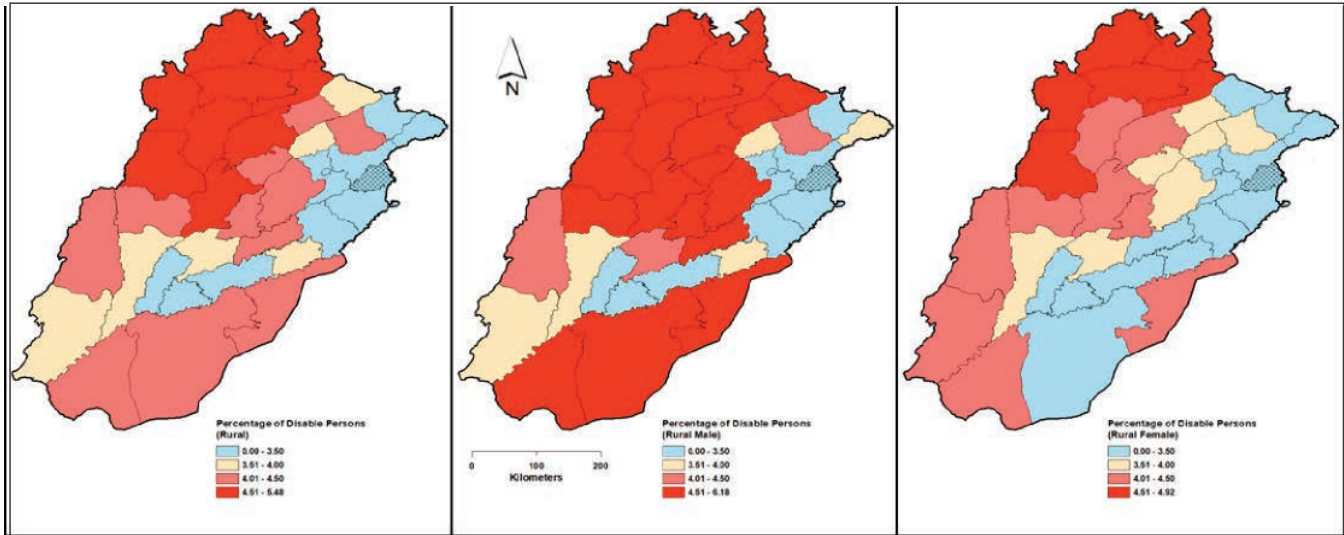
Punjab province. There was a clear clustering of highest percentage of disabled persons on the north-western districts for all three disability indices; while lower percentages were seen on the north-eastern districts.

Figure 3 shows the maps of spatial distribution of percent disabled persons from urban areas, cumulatively, as well as by the gender, disaggregated by districts in Punjab province. The same pattern albeit much less pronounced clustering of high percentages of disabled persons is discernible in the north-western districts. This pattern was much noticeable for urban women. Figure 4 shows the rural spatial distribution of percent disabled persons – cumulatively as well as for rural males and females, disaggregated by districts in Punjab province. Cumulatively

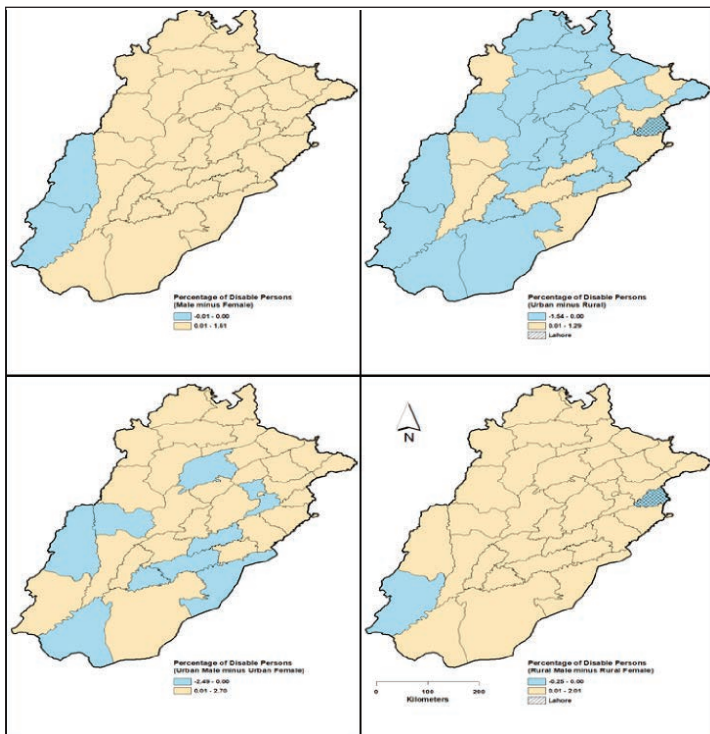
as well as for rural males, the pattern for the highest percentage of disabled persons was more distinct in the another-eastern as well as south-eastern districts of Punjab. The lowest percentages of rural dwelling disabled women was more noticeable in the north-eastern and eastern districts.

Figure 5 shows the gender and urban/rural differences in percent spatial distribution of disabled persons by districts in the Punjab province. Except for two districts of Rajanpur and D.G. Khan, cumulatively males had higher percentages of disability compared to women in all districts. In eleven districts urban dwellers had higher percentage disability compared to their rural counterparts. In general, urban males had higher disability percentages compared to





**Figure-4:** Rural spatial distribution of percent disabled persons by districts in Punjab province.  
*Rural percentage of disabled persons by district in Punjab province. Left map: total disabled persons; center map: male disabled; right map: female disabled.*



**Figure-5:** Gender and urban/rural differences in percent spatial distribution of disabled persons by districts in the Punjab province.  
*Gender and urban/rural differences in percent spatial distribution of disabled persons. Top left map: total male minus female; Top right map: urban minus rural; bottom left map: urban male minus urban female; bottom right map: rural male minus rural female.*

urban females. While rural males had higher percentages of disabilities compared to rural females in every district, apart from Rajanpur district.

Test for the spatial autocorrelation of cumulative disability in the entire study area of Punjab province was tested using

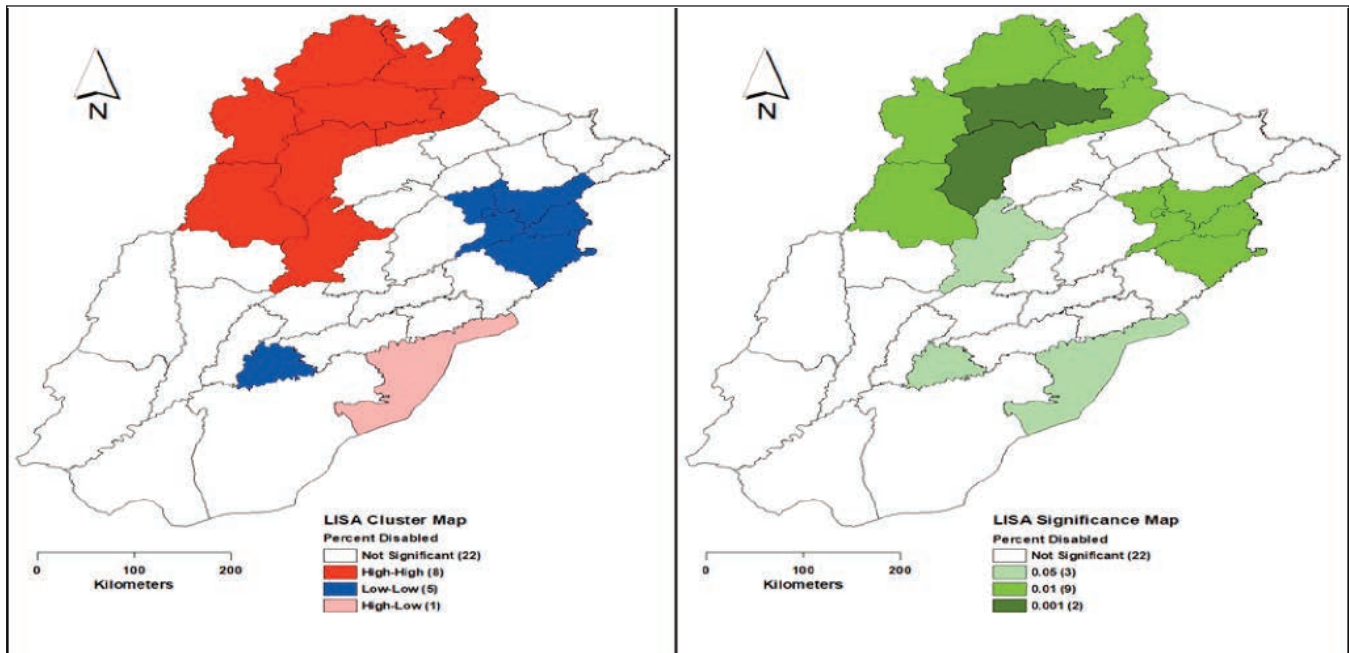
Global Moran's I; the Moran's I statistic was 0.6015, with the pseudo p-value of 0.001.

The LISA results are presented in figure 6. Out of 36 districts, 8 were found to be in the category of High-High, 5 were categorized as Low-Low, and 1 was classified as High-Low; the other 22 districts failed to reach statistical significance. Out of 8 High-High districts, two i.e. Chakwal and Khushab were statistically highly significant with the  $p=0.001$ .

**Discussion**

This is the first study providing spatial distribution of the proportions of disabled individuals by gender, urban/rural residency status, and the differences between gender and residency groups, by districts of Punjab; and clustering of the cumulative proportions of disabled individuals at the Punjab district level. As such, this devoid of district-level disabilities studies renders discussion limited to international literature that is more general. However, it is another imperative to further analyze PSLM data for more deeper insights. The cumulative proportion of disabled individuals aged 5 and over in Punjab was 3.84%, contrasting with 3.41% for Pakistan.<sup>10</sup> The proportions of disability for men were higher in both urban and rural areas; more pronounced in rural men compared to rural women. This finding contracts with the WHO's World Report on Disability 2011' which reported that disability is more common in women, older individuals, and those belonging to lower economic strata.<sup>1</sup>

The north-western districts of Punjab had the highest



**Figure-6:** Local indicators of spatial autocorrelation (LISA) cluster and statistical significance maps.

proportions of disabled individuals, this was true for both women as well as for both sexes combined in both urban and rural areas, while for men southern and central districts also reported higher proportions. The distribution of higher disability proportions in urban and rural areas somewhat mirrored this pattern albeit the pattern was less diffuse in the urban areas. The differences between two gender groups showed that apart from only two districts, males had higher disability proportions compared to women. While differences between urban and rural residents showed that rural denizens in eleven districts had higher disability proportions. The more granular comparisons between urban males and females revealed that in nine districts out of thirty-two, males had higher proportions of disabilities compared with women. However, there was a dramatic difference between rural males and females, where in all districts save one, males had higher proportion of disabilities vis-à-vis women.

The spatial distribution of higher cumulative proportions of disability i.e. for both men, women, urban, and rural areas, concentration in the north-western districts is also borne out in the clustering analysis. As LISA results show clustering of higher proportion of disability and their statistical significance in these districts.

Disabled individuals tend to have worse health status and encounter more barriers in accessing healthcare services.<sup>1,3</sup> The need for more granular analysis of the PSLM2019-20, including district-wise distribution of disability by age

groups could potentially reveal more insights for better targeted health and social services in Punjab province. Furthermore, future iterations of the PSLM need to include questions about disabled individuals access experiences to healthcare services, for crafting better health and social policies to improve the quality of life for these individuals.

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**Conflict of Interest:** None.

**Funding Sources:** None.

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