Case study

When and how to use multivariable analysis for identifying intersectional inequalities

How intersectionality informs Sightsavers' research on avoidable blindness in Kogi, Nigeria

Sightsavers

INCLUSIVE DATA CHARTER

Sightsavers is a founding Champion of the Inclusive Data Charter (IDC), a global multi-stakeholder network launched in 2018. The IDC works to advance the availability and use of inclusive and disaggregated data so that governments and organizations better understand, address, and monitor the needs of marginalized people and ensure that no one is left behind.

Effective analysis is an essential part of intersectional approaches to data. This case study can help practitioners understand the practical steps involved in deciding on an appropriate statistical data analysis method to identify intersectional inequalities. It demonstrates one example of how multivariable techniques can be used for intersectional analysis. Multivariable statistics refers to techniques that examine the influence of several variables on an outcome simultaneously.

The case study discusses these techniques broadly, highlighting what is involved and when these techniques may be useful. It is intended to be read by quantitative researchers, analysts, and project/program managers that have some knowledge of statistics already. The aim is to highlight the benefits and drawbacks of this analysis approach, situating it in Sightsavers' research practice and outlining other aspects to consider to show how intersectionality informs their approach.

Key messages

There are no standard methods for statistical analysis in intersectional approaches to data. Analysts need to pick a method that takes intersectionality into account. This case study exposes the underlying thinking and decision-making of the Sightsavers research team, explaining what they did and why.

- **Intersectional statistical data analysis needs to consider how multiple factors compound to influence an outcome. Multivariable regression analysis can be used to do this.**
- **Analysts need to question where data comes from and whether individual characteristics were measured appropriately in the first instance.**
- **Analysts must also question their results and whether multivariable models reflect the logical mechanism and pre-existing evidence behind observed relationships when analyzing and interpreting data.**
- **The benefit of multivariable techniques for intersectional analysis is that they enable the quantification of the combined effect of specific characteristics on a particular outcome.**
- **Drawbacks of multivariable techniques are the amount of data, skills, and resources that are needed to perform this type of analysis. Intersectional approaches question who is doing the analysis and develops ways for data analysis to be inclusive.**

The Intersectional Approaches to Inclusive and Disaggregated Data series

Different aspects of a person's identity – such as their ethnicities, gender, religion, disability, or sexual orientation – can influence the amount or type of discrimination or exclusion a person faces. 'Intersecting inequality' refers to when aspects of a person's identity overlap and worsen the discrimination or exclusion they experience. People who face intersecting inequalities are the most likely to be left behind by development.

The IDC is a global multi-stakeholder network that advances the availability and use of inclusive and disaggregated data so that governments and organizations better understand, address, and monitor the needs of marginalized people and ensure no one is left behind. The Intersectional Approaches to Inclusive and Disaggregated Data series contributes resources and practical insights to help practitioners in their work to resolve intersecting inequalities.

This case study should be read alongside other resources in the Series, which unpack intersectionality definitions, data processes and value chains, and other intersectionality concerns.

The context of Sightsavers' work

Sightsavers is an international organization that collaborates with partners in developing countries to eradicate preventable blindness and promote equal opportunity for people living with disabilities. This case study concentrates on the research in support of their work to prevent avoidable visual impairment in Kogi, Nigeria, funded by the UK Foreign, Commonwealth & Development Office via the Inclusive Futures program.

Avoidable visual impairment refers to eye health conditions that could be treated or prevented. A leading cause of avoidable blindness globally is cataracts (WHO, 2021). Without treatment, blindness has enormous impacts on individuals and society, as individuals may face a loss of freedom and capability, finding it harder or impossible to work or care for themselves or their family.

Cataracts are cost-effective to treat, but many developing countries' health systems lack the necessary infrastructure and trained ophthalmologists. There are, however, other reasons why a person may not have access to treatment.

In 2019, Sightsavers sought to identify the social inequalities that influence access treatment for cataracts in Kogi, Nigeria (see Gascone et al., 2020). Kogi State, located in the North Central geopolitical zone, is estimated to be home to over four million people (NBS, 2017). While Lokoja is the state capital, the majority of Nigerians live in rural areas where households are more likely to experience poverty (NPC & ICF, 2019).

Summary of the research conducted in Kogi, Nigeria

Prior research concludes that many causes of visual impairment are age-related, leading to a higher burden of disease in older age groups (Burton et al., 2021). There is also a higher burden of visual impairment among women (Burton et al., 2021; WHO, 2019). In low resource settings, people living in rural communities may have less access to water, sanitation, and health services. This means that they can have both a higher likelihood of disease and a lower chance of being able to seek care for it.

Evidence around how people with additional, non-visual impairments is sparse, but anecdotal data suggests that people with disabilities often have lower access to health services (WHO, 2011). Sightsavers aimed to investigate how a person's socio-economic or disability status affected their eye health and access to services.

The research design incorporated a standardized survey methodology called the rapid assessment of avoidable blindness (RAAB) which is designed to measure the magnitude and causes of visual impairment (Mactaggart et al., 2019). The standard RAAB included information about participant age and gender, and Sightsavers added validated tools to measure disability and wealth, to pinpoint locations, and to understand how different personal characteristics affect access to services.

Over 4000 people, aged 50 and over, participated in the survey. The results showed clearly that, although the prevalence of visual impairment did not appear to differ significantly between men and women, there does appear to be a difference in how they access treatment, with coverage among women lower than that among men. Moreover, people with non-visual disabilities

were more likely to have a visual impairment than others and were also less likely to access treatment. The next section describes how intersectionality informed the key analytic steps taken to come to these conclusions.

How Sightsavers carried out the multivariable statistical analysis

There are multiple ways to conduct multivariable analysis, and methods tend to vary across sectors and disciplines. This section explains what the Sightsavers team considered when selecting and implementing their intersectional analysis method, which may help analysts develop an appropriate method to suit their own situation.

Considering the context: Knowing which factors to measure and test was informed by existing research is the first step. This includes understanding the constraints of the eye health care system and structural factors including, gender inequality, rural populations, and higher poverty rates.

Ensuring that the measures used in the survey are justified: The Kogi RAAB incorporated validated measures to ensure that each factor – eye health, socio-economic status, disability, gender, and access to treatment – was measured effectively. There are many ways to measure poverty, for example, so it is important to consider whether the measure, or tool, adequately captures the issues under investigation. It is also important to understand the extent to which tools for measuring both outcome variables and explanatory factors have been tested for reliability and validity in the populations you are working with. Good quality translation and cognitive testing in local languages can help avoid measurement errors in the data that can lead to bias within the results.

Preparing the data and descriptive statistics: Sightsavers collected and cleaned the RAAB data, disability data, and wealth data using the statistical software package Stata version 15. Experienced epidemiologists carried out typical data preparation, including addressing missing values, looking for outliers, and examining descriptive statistics. It is important that all steps to change or transform the data and who was working with the data are recorded.

Testing for univariate associations: The next step was to look for specific associations between two variables only. Here, the Sightsavers team used their background knowledge to choose identity factors to examine against selected outcome variables such as having a disability, being blind, needing a cataract operation, or having had one. Examining the outcomes disaggregated by each category allowed the team to understand the crude relationships that exist between different groups, for example between males and females, and to identify any unexpected patterns emerging.

Testing for multivariable associations: For intersectional analysis, the purpose is to go beyond individual associations with the outcome and to understand how the relationships hold out once the other identity factors are accounted for. It is a useful technique to find which factors combine to produce a certain outcome (as above), and there are a number of methods to do this (Rouhani, 2014). The Sightsavers team adopted a multivariable method in which they developed a regression model by combining factors that they believed would have a relationship with the outcomes: age, sex, wealth, and disability. Since the outcomes they examined were binary, they chose to use a logistic regression model, which provided an output including odds ratios describing the strength of effect of each factor and a p-value representing the likelihood that the observed relationship occurred by chance.

The Sightsavers team went one step further in their exploration of intersectional effects and decided to test a pre-specified hypothesis that a particular sub-group of participants had a specific level of risk linked to a specific

combination of their identity factors. In this situation, they added an interaction term to their model which allowed them to explore whether the specific effects of disability were moderated by gender or age.

The Sightsavers team stresses the importance of thinking carefully about the model outputs and examining the direction and strength of the relationship, as described in this case by the odds ratio and the significance of the test or result represented by the p-value. In some situations, particularly where the sample size is relatively small, unusual results can occur by chance, and the logical mechanism and pre-existing evidence behind observed relationships when analyzing and interpreting data must be considered.

When is it appropriate to use this analytic approach and what are the alternatives to identify intersectional inequalities?

Using multivariable methods to find inequalities within and between groups of people in relation to a particular outcome is used in psychology and epidemiology (Agénor, 2020; Else-Quest & Hyde, 2016). However, these techniques are implemented less in development. Should this be an area in which your organization develops capacity? What are the advantages and disadvantages of this type of approach to intersectional analysis, and what are the alternatives?

Advantage: Detect intersectional differences rigorously

Multivariable analytic methods enable the quantification of the combined effect of specific characteristics on a particular outcome. In the Sightsavers research in Kogi, there were multiple, independent binary outcomes, and 'multivariable' reflects the multiple explanatory variables included in the model (see Appendix to consult the results). They also found significantly different effects when they added the interaction variable to the model. This enables the quantification and significance testing of intersectional differences.

To illustrate, in the first pass of statistical analysis, when the team tested for univariate associations between various personal characteristics and blindness as an outcome variable, they found that the proportion of the population with severe visual impairment or blindness was fairly evenly distributed across wealth quintiles (see Appendix). This indicates fairly good levels of equity with regards to wealth in accessing eye care services. This finding may be useful to investigate to better understand the factors that contributed to success and how it can be developed further in Kogi and elsewhere in Nigeria.

In contrast, significant variation in blindness and visual impairment was observed between people with additional, non-visual disabilities and people with no disabilities. After accounting for the influence of gender, age, and household wealth, the likelihood of being either bilaterally blind or severely visually impaired was on average 14 times higher for people with additional, non-visual disabilities than it was for the rest of the population.

When the interaction variable was added to the multivariable model to test for intersectional differences, important gender differences between men and women with non-visual disabilities were also observed. Compared to women, sample men with additional, non-visual disabilities were significantly more likely to be blind or visually impaired and this gender gap increased with age. Further analysis to understand the pathways through which disadvantage occurs for individuals with different physical, sensory, and mental and psychosocial disabilities is an important step to deliver services that are accessible to all. Without this intersectional analysis, the needs of aging men with non-visual disabilities could have been missed.

Disadvantage: Data, skills and resources required to perform this type of analysis

As noted above, obtaining the data required to perform this type of analysis can be challenging if there are no validated tools for measuring the aspects of identity. For instance, the measure that the Sightsavers team used for wealth is based on household asset ownership. One reason why wealth may not appear linked to access to services in this study is that household asset ownership does not adequately represent the ability and willingness to pay the direct, and shoulder the indirect, costs associated with getting a surgery.

There are also ethical concerns to consider if certain aspects of identity are sensitive or hard to classify. It is essential to consider whether a participant wants these aspects considered, whether they are comfortable disclosing this information, and whether the inclusion of characteristics poses reason to exclude participants from a survey.

Sample size is also a prominent concern. The potential to perform multivariable analyses diminishes if certain factors are not shared widely amongst the population sampled. In the Sightsavers research, if the medical conditions examined were quite rare, it would be difficult to include more than one or two factors in a model because of the low number of participants with the condition.

When planning data collection, it is important to be clear about the primary and secondary outcomes and base your sample size and sampling strategy on those needs. In cases where you are working with a defined population and your sample size is constrained, you may experience difficulties in calculating effect sizes or large margins of error. It's important to recognize when this is the case and interpret your data appropriately.

Lastly, intersectional approaches are holistic in nature, questioning not only what the analysis tells us, but who is doing the analysis. Sightsavers works in partnership to build local health systems' capacity to ensure sustainable and inclusive long-term outcomes. It seems unlikely that many of their partners have the statistical skills or resources (human or software) to collect and analyze the amount of data required for this type of analysis, such that alternatives should be considered. More collaboration between ministries of health, national statistics offices, and potentially academia may facilitate examining data in this way.

Alternatives: Breakdowns, visualizations, and storytelling

Sometimes, all that is needed to identify intersectional inequality is an explanation. Local Sightsavers staff and partners will readily explain why poor women living in rural Kogi fail to access cataract surgery more than others living in the city. Rather than evidence of the magnitude and intersectional causes of inequality afforded by multivariable analysis, perhaps decision-makers need primarily to know how many and where so that appropriate action can be taken to follow-up with individuals at risk of marginalization.

Other forms of data presentation, such as tables showing breakdowns of the survey results by characteristic or simple visualizations to show the percentages visually in a graph or chart, may suffice. Data breakdowns and visualizations can influence decision-makers to acknowledge problems.

Using data to tell a story by combining different types of data (for instance, the survey results, along with project or program documentation) can be used to communicate intersectional inequality effectively.

Key recommendations

- Multivariable statistical analysis can be very effective for identifying and quantifying intersectional inequalities. It is especially useful to determine the root causes of social inequality through larger studies or measure the impact of large-scale interventions (as opposed to, for instance, monitoring and evaluation of projects).
- Reflect on who will adopt and use the evidence, their expectations and needs, and how you might leverage their interests to use the analysis for targeted intervention to address the needs of individuals at greatest risk of marginalization or discrimination.
- Consider presenting data in breakdowns, visualizations and other forms of infographic or data storytelling to highlight intersectional inequality as alternatives. Support your partners to get involved in intersectional data analysis as much as possible.

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Appendix

Multivariable associations tested in the Kogi, Nigeria Sightsavers research: The odds that a personal characteristic contributes significantly to being blind or severely visually impaired in both eyes.

		Model 1			Model 2 (1)		
		OR	95% CI	p-value	OR	95% CI	p-value
Non-visual disability							
	No	-	-	-	-	-	-
	Yes	9.29	[5.49, 15.73]	<0.001	14.57	7.80, 27.23	0.609
Sex							
	Male	-	-	-	-	-	-
	Female	0.83	[0.61, 1.13]	0.242	1.11	0.75, 1.65	0.242
Age							
	50-59	-	-	-	-	-	-
	60-69	3.24	[1.98, 5.30]	<0.001	3.22	1.96, 5.29	<0.001
	70-79	4.92	[2.90, 8.37]	<0.001	4.77	2.79, 8.17	<0.001
	80+	12.89	[7.78, 21.33]	<0.001	12.73	7.72, 21.00	<0.001
Wealth							
	1st quintile	-	-	-	-	-	-
	2nd quintile	0.94	[0.57, 1.54]	0.802	0.92	0.56, 1.51	0.733
	3rd quintile	1.03	[0.62, 1.73]	0.897	1.00	0.59, 1.68	0.996
	4th quintile	0.69	[0.39, 1.20]	0.187	0.67	0.39, 1.17	0.158
	5th quintile	0.83	[0.48, 1.41]	0.484	0.81	0.47, 1.40	0.458
Non-visual disability* sex (2)							
		-	-	-	0.44	0.22, 0.89	0.021

(1) Two-way interaction model (non-visual disability with sex).
(2) Wald $\chi 2=5.30$, p=0.021.
Source: Gascoyne, et al. (2020, p. 20).

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