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Manhattan Vision Screening and Follow-up Study (NYC-SIGHT): Vision and refractive error results

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Abstract

Clinical relevance: Optometrists can play a key role in providing access to eye care in underserved populations by organising community-based eye health screenings that include optometric exams to detect vision impairment and uncorrected refractive error.

Background: Community-based eye health screenings and optometric exams were conducted in the NYC-SIGHT Study.

Methods: A sub-analysis of vision impairment and refractive error results within a 5-year prospective, cluster-randomised clinical trial. Eligible individuals (age ≥40 years) were recruited from 10 affordable housing developments in Upper Manhattan. Developments were randomised into usual care (received glasses prescription only) and intervention (free glasses) groups. Participants with 6/12 visual acuity or worse, intraocular pressure 23–29 mmHg, or an unreadable fundus image were scheduled with the study optometrist for refraction and a non-dilated exam. Visual improvement data were obtained by comparing the presenting acuity at screening compared to the best corrected acuity after refraction by the optometrist. Chi-square, two-sample t-tests, and a stepwise multivariate logistic regression model were used to determined factors associated with improvable visual impairment.

Results: Seven hundred and eight participants completed screening, 308 received an optometric exam. Those with improvable vision impairment (n = 251), mean age: 69.8 years, 70.5% female, 53% African American, 39.8% Hispanic, >95% had health insurance. Refractive error diagnosed

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in 87.8% of the participants; lines of improvement: 2 lines (n = 59), 3 to 5 lines (n = 120), and ≥6 lines (n = 72). Stepwise multivariate logistic regression analysis showed that participants with visual acuity 6/12 or worse (odds ratio 16.041, 95% confidence interval 6.009 to 42.822, p = 0.000) or a normal fundus image (odds ratio 2.783, 95% confidence interval 1.001 to 7.740, p = 0.05) had significantly higher odds of improvable vision impairment.

Conclusion: This innovative, targeted community-based study included an optometrist who detected high rates of refractive error and improvable vision impairment in an underserved population living in New York City.

Keywords

Community-based optometrist examination; eye health screening; refractive error; underserved population; vision impairment

Introduction

According to the Lancet Global Health Commission, uncorrected refractive error is one of the most common causes of vision impairment and the second leading cause of blindness worldwide.[1] As of 2020, 1.1 billion people globally were visually impaired due to uncorrected refractive error, causing an estimated $410 billion of lost productivity.[1] In the United States alone, it is estimated that approximately 12 million people over the age of 40 are visually impaired and 8 million have vision impairment due to uncorrected refractive error.[2]

Vision impairment often impacts an individual's life on multiple levels and can lead to decreased social, emotional, and physical well-being, reduced productivity, difficulties with daily activities, lower quality-of-life and potentially increased mortality rates.[3–6] *Healthy People 2030 Goals* focus on preventing, diagnosing, and treating vision disorders in people of all ages and includes objectives aimed at reducing vision impairment due to uncorrected refractive error.[7]

Socioeconomically disadvantaged and underserved populations who have poor access to eye care are experiencing a disproportionate burden of vision impairment, leading to worse outcomes and eye health disparities.[8–10] According to the New York State Department of Health, 14.9% of New Yorkers over age 40 have distance vision impairment and higher rates are seen in women, individuals who self-identify as African American or Hispanic ethnicity, those with less than high school education, and those with an annual household income below $25,000.[11] These high-risk populations may distrust physicians, have poor access to eye care, and are less likely to receive annual eye exams, further exacerbating eye health disparities across all age groups.[12]

According to the National Academies Report *Making Eye Health a Population Health Imperative: Vision for Tomorrow*, innovative eye health screening methods and early detection strategies to address the rising trend of avoidable vision loss are needed to reduce eye health disparities in high-risk populations.[13]

In 2019, the Centers for Disease Control and Prevention Vision Health Initiative funded three 5-year research grants to develop innovative community-based eye health screening interventions that target high-risk populations in order to generate evidence to ensure access to and utilisation of eye care services. The *Screening and intervention for Glaucoma and Eye Health Through Telemedicine* studies are taking place in New York City (NYC), Alabama, and Michigan (SIGHTSTUDIES.org).[14] In NYC, the Manhattan Vision Screening and Follow-up Study (NYC-SIGHT) was designed to target underserved populations where they live to ensure access to and utilisation of eye care services in those who are least likely to seek eye care.[15]

The NYC-SIGHT Study was conducted in Harlem and Washington Heights neighbourhoods and initiated during the COVID-19 pandemic beginning in 2020.[16] This paper describes a sub-analysis of vision impairment and refractive error rates in the NYC-SIGHT Study population and presents significant factors associated with improvable vision impairment (IVI) and refractive error in enrolled participants.

Methods

Study design

The NYC-SIGHT Study is a 5-year prospective, 2:1 cluster-randomised clinical trial. The methods and cost analysis have been previously described in detail and are highlighted below.[16,17]

This research was reviewed by an independent ethical review board and conforms with the principles and applicable guidelines for the protection of human subjects in biomedical research. Columbia University Irving Medical Center Institutional Review Board/Ethics Committee (#AAAR9162) approval was obtained and all aspects of the study were conducted in accordance with the Declaration of Helsinki and compliance with Health Insurance Portability and Accountability Act. Informed consent was obtained from all participants prior to enrolment and the study was registered on ClinicalTrials.gov (NCT04271709) on 2/13/20.

Target population

Ten affordable housing developments in Harlem and Washington Heights were selected by the New York City Housing Authority, which provided access to 6640 residents, with a target enrolment of 1500 people (Figure 1, Sample Frame). These developments were selected due to their close proximity to Harlem Hospital and the Columbia University Ophthalmology Department to facilitate follow-up in-office eye exam appointments. A high proportion of potentially high-risk, adults and seniors living at or below the NYC.gov poverty measure are living in these developments[18] (Figure 1). These ten developm ents were considered the cluster and randomisation was conducted by the study biostatistician.

Intervention versus usual care groups

Participants living in the seven developments randomised to the Intervention Group who failed the eye health screening and needed vision correction, received complimentary

eyeglasses. If they were referred to ophthalmology, they received enhanced support from patient navigators who assisted with scheduling in-office eye exam appointments over a 1-year period. Participants living in the three developments randomised to the Usual Care Group who failed the eye health screening and needed vision correction were given an eyeglasses prescription only and a list of optical shops. No enhanced support related to in-office eye exam appointments was given to the Usual Care Group. Both groups received all the basic level of eye care services provided during the eye health screening and optometric exam.

Inclusion criteria

Individuals over age 40 living independently in a New York City Housing development and were willing to consent for a baseline eye health screening were recruited.[16,17] Those who met the inclusion criteria were consented over the telephone or in person, in English or Spanish, by the bilingual study coordinators. The screening and optometric exams were conducted in the community room or senior centre located within the housing development.

Participant recruitment

Recruitment took place from October 2020 to September 2022 and English and Spanish Institutional Review Board-stamped approved flyers were distributed to apartments, posted in elevators and lobbies, sent via email by the housing development, and distributed during community and food donation events, vaccination events, and health fairs.

Pre-screening assessments

Participants were asked over the telephone or in-person about demographics, social determinants of health, access to an eye doctor, and year of last dilated eye exam. Ocular and medical history, ocular medications, use of prescription eyeglasses, and family history of glaucoma or blindness were captured during the pre-screening assessment.

Falls risk assessment was based on the Stopping Elderly Accidents, Deaths, and Injuries algorithm.[19] Participants were asked: 1) Do you worry about falling and feel unsteady when standing or walking? 2) Have you fallen in the past year? If you have fallen, how many times? 3) Were you injured from falling and visited the Emergency Department or hospitalised due to falling in the past year? Clinical conditions related to falls risk assessment were integrated into the medical history, including problems with cardiac issues, blood pressure, heart rate and/or arrhythmia, cognitive impairment, incontinence, depression, arthritis or osteoporosis, hearing problems, and foot problems.[19]

Initial community-based eye health screening

Visual acuity was measured by trained community health workers using the Snellen eye chart at 6m (20 feet) and measured monocularly, with correction if available. Visual acuity was converted to the logarithm of the minimum angle of resolution (log MAR) for analysis. Those with visual acuity 6/12 or worse in either eye failed the screening and were referred and scheduled for an optometric exam by the study optometrist within 3 weeks in the same location.

The intraocular pressure was checked bilaterally by the study technician, with the Ic100 iCare rebound tonometer (iCare, Helsinki, Finland), and those with intraocular pressure 23 to 29 mmHg in either eye were rechecked and the average value was recorded. If the intraocular pressure was 23–29 mmHg, the participant failed the screening and was scheduled to see the study optometrist. If the intraocular pressure was ≥30 mmHg, the participant was considered 'fast tracked' and referred and scheduled to see an ophthalmologist for an in-office evaluation within 2 days.[20–21]

Fundus images were taken by the study ocular photographer using an auto-focus, non-mydriatic, hand-held fundus camera (Volk Pictor Prestige, Volk Optical, Mentor, OH, USA). Each eye was evaluated, and an overall reading for the worse eye was determined as either 1) normal or abnormal without significant findings, 2) abnormal with significant findings, or 3) unreadable. Those with an unreadable image were also scheduled to see the study optometrist within 3 weeks. Those with an abnormal image were contacted immediately and referred to ophthalmology for an in-office evaluation rather than the study optometrist.

Participants with an abnormal fundus image were not included in this sub-analysis since no refraction was conducted in the community and their best corrected visual acuity and IVI could not be assessed by the study optometrist.

Community-based optometric exam within 3 weeks

The study optometrist obtained baseline refractive error measurements using a portable auto refractor (QuickSee Auto refractor, Plenoptika, Cambridge, MA, USA). A manifest refraction was then conducted using loose lenses and a trial frame (Goldenwall Adjustable Trial Frame Optical Trial Lens Frame PD 54–70 mm TF-BT). Near acuity was evaluated with a reading card (Rosenbaum Pocket Vision Card, Amazon) so that any add could be determined through further loose lens refraction. Best corrected near visual acuity was recorded in both eyes in Jaeger notation and refractive error was recorded in minus cylinder form. All participants were given a copy of their eyeglass prescription.

The optometrist used a portable slit lamp [(PSL, 3010-P-2000 1) Keeler USA, Malvern, PA] and direct ophthalmo-scope (Welch Allyn Panoptic 3.5 V, Skaneateles Falls, NY, USA) to perform a non-dilated ocular health evaluation. After the evaluation, participants were educated on their ocular diagnosis and referred for an in-office evaluation for a dilated eye exam, further ocular testing, treatment, and cataract surgery if warranted.

Visual impairment and refractive error

Per the International Classification of Disease, mild vision impairment: visual acuity based on the worse eye: 6/12 to 6/18 (log MAR 0.3–0.50), moderate vision impairment: visual acuity from 6/18 to 6/60 (log MAR 0.54–1.0), severe vision impairment: visual acuity from 6/60 to 3/60 (log MAR 1.0–1.3) and blindness, including visual acuity worse than 3/60, count fingers, hand motion, light perception, and no light perception (log MAR > 1.3).[22]

Levels of vision impairment were determined by the presenting visual acuity, with habitual correction if eyeglasses were worn at the initial screening. Evaluations of improvable vision impairment were based on previous research papers in this field; the goal was for

study participants to achieve two or more lines of improvement, which was considered a substantial vision change, that could have an impact on quality-of-life.[9] This measurement was not an evaluation of their general eye health or optometric care, rather a simple measurable outcome of visual improvement for a community-based setting.

Participants were determined to have IVI if they presented with 6/12 or worse vision in their better seeing eye and improved by at least two Snellen lines in either eye after refraction. The statistical analysis compared participants with vision impairment who had 2 or more lines of improvement to those with vision impairment that could not be improved (6/12 or worse vision not correctable by at least 2 lines).

Demographics, social determinants of health data, as well as ocular and medical history, were evaluated to determine significance between those who had IVI and those who did not have improvable vision impairment. Refractive error was defined as myopia greater than 0.50D or hypermetropia greater than 0.75D.

Statistical analysis

Study data were collected and managed using Research Electronic Data Capture (REDCap, Vanderbilt University, Nashville, TN) software hosted at Columbia University. Statistical analyses were performed in IBM Statistical Package for Social Sciences for Windows version 25 (IBM, Armonk, NY) and R Language and Environment for Statistical Computing version 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria).

Participant characteristics were summarised for the entire sample using means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Outcome measures included demographic characteristics, social determinants of health, (ethnicity, race, age, sex, employment, education level, marital status, insurance), eye health screening results, and rates of suspected glaucoma and other eye diseases in the study population.

Chi-square test and two-sample t-tests were used to determine the significance between those who had IVI and those with vision impairment not improvable by at least 2 Snellen lines. A stepwise multivariate logistic regression model was constructed using the significant variables from the chi-square and two-sample t-test to identify possible predictors/factors associated with IVI 6/12 or worse using log MAR to determine odds ratios at the 95% confidence intervals. Factors included in the model were demographics, social determinants of health, and clinical characteristics. At each step, variables were added based on the alpha-to-enter significance level of 0.05 and the alpha-to-remove significance level was set at 0.1 to exclude variables in the final model.

For all analyses, p values of ≤ 0.05 were considered statistically significant and all tests performed were two-sided. All variables entered into the stepwise multiple logistic regression were adjusted for other variables that were also significant. All variables were accounted for as they may impact the odds of IVI.

Results

Enrollment demographics and social determinants of health

Demographics, social determinants of health, clinical characteristics, telehealth findings, and eye health screening results of those with IVI are shown in Tables 1–3 and Figure 1. There were no statistically significant differences in the demographics between the groups.

Clinical characteristics of those with improved vision impairment

As shown in Table 2, there were significantly higher rates of foot problems in the IVI group ($p < 0.01$), and higher rates of self-reported glaucoma in the vision impairment uncorrectable group ($p < 0.05$). While not a statistically significant difference between the groups, of note only 27.5% of participants with IVI reported that they have their own eye doctor. A total of 143 (57%) of IVI participants had not had a dilated eye exam in the past 2 years including 53 participants who could not remember their last eye exam or never had an eye exam.

Of those with IVI, self-reported ocular conditions (pre-existing) included cataract (29.1%), glaucoma (6.8%) and a family history of glaucoma (21.5%). A total of 177 participants (70.5%) with IVI wore prescription eyeglasses. Self-reported medical conditions of those with IVI included hypertension (67.7%), diabetes (30.7%), arthritis (51.0%), and asthma/COPD (19.1%).

Eye health screening and telehealth findings

As anticipated by the screening failure criteria, the majority of participants with IVI (94.8%) failed the community eye health screening due to having a visual acuity 6/12 or worse, while those who had vision impairment that was not improved still had high rates of screening failure (51.4%) ($p < 0.00$). A total of 365 participants were invited to see the on-site optometrist; 308 attended the optometric exam (adherence rate: 83%) and 286 were found to have vision impairment (Figure 1).

The mean intraocular pressure for those with vision impairment was 14.8 mmHg ± standard deviation 3.93 mmHg, taking into account the average between the right and left eyes (Table 3). Based on telehealth image data from the worse eye for those with IVI, 143 (57%) were normal, 11 (4.4%) were abnormal with no significant findings and 97 (38.6%) had an unreadable image. Those with an abnormal image ($n = 286$) were not included in this analysis, as they never received a refraction, therefore whether or not they had IVI could not be assessed (Figure 1, Table 3). Those with IVI were significantly more likely to have a normal fundus image result from the screening and less likely to have an unreadable image ($p < 0.05$) compared to those who only had 0–1 Snellen line of improvement (Table 3).

Falls history

There were no significant differences between the IVI and uncorrectable vision impairment groups regarding falls history or risk, but close to half (47.4%) of those with IVI who self-selected to participate in the screening stated they worry about falling or feel unsteady when standing or walking. More than half of participants with IVI (56.2%) and 48.6% of

those with uncorrectable vision impairment were invited to conduct falls assessment tests in the field during their eye health screening (Table 3).

Visual improvement after refraction

As shown in Figure 1, the majority (87.8% 251/286) of participants examined by the optometrist and diagnosed with refractive error had at least two lines of improvement, with some participants having as much as nine Snellen lines of improvement compared to their presenting vision. A total of 59 participants had 2 lines of improvement, 120 participants had 3 to 5 lines of improvement, and 72 participants had ≥ 6 lines of improvement (Figure 1).

Factors associated with improvable vision impairment

As shown in Table 4, all odds ratios were adjusted for other variables that were also significant. Stepwise multivariate logistic regression analysis showed that participants with visual acuity 6/12 or worse (odds ratios 16.041, 95% confidence interval 6.009 to 42.822, $p = 0.000$) or those with a normal fundus image (odds ratios 2.783, 95% confidence interval 1.001 to 7.740, $p = 0.05$) had significantly higher odds of IVI. Participants who had pre-existing glaucoma/suspect had significantly higher odds of only 0 to 1 Snellen line improvement (odds ratios 0.222, 95% confidence interval 0.071 to 0.698, $p = 0.01$).

Discussion

Main findings

The Manhattan Vision Screening and Follow-up study is one of the first cluster-randomised clinical trials that conducted community-based eye health screening and optometric exams targeting New York City residents living in affordable housing developments. The study aimed to detect vision impairment in a high-risk, underserved population of predominately older individuals of African American race and Hispanic ethnicity.

While the evaluation of the adherence to in-office eye exam appointments for those referred to ophthalmology between the intervention and the usual care group is ongoing, the authors believe that they have effectively identified and engaged a diverse population most at risk for vision impairment and provided access to and utilisation of eye care services. Results reveal high rates of refractive error and vision impairment in the study population, mostly IVI (87.8%) providing strong evidence that community-based eye health screenings are beneficial when they include an optometric exam and eyeglasses partner.

More than 50% of the participants in both groups had not had an eye exam in at least 2 years, could not remember their last dilated eye exam, or never had an eye exam, demonstrating a need to improve access to eye care in this community. The optometrist also referred 80% of those with uncorrected refractive error (all of whom had an unreadable image) and 67.3% of those with IVI for an in-office comprehensive dilated eye exam.

If a participant had any level of vision impairment and a normal fundus image, they were very likely to have vision impairment that was improvable, as shown with ≥ 2 Snellen lines of improvement. In contrast, participants who self-reported having glaucoma, which was

confirmed if they were taking eye pressure-lowering medication, were less likely to have improvable vision impairment.

Benefits of the optometrist

Attendance at the community-based optometric exam was at least 80%, which provides evidence that including optometric exams in the same location following eye health screenings is an important way to provide access to eye care services, especially for those who have IVI. Doctors of optometry are uniquely qualified to provide eye health screenings due to their training in ocular health and vision science.

The ability of optometrist to diagnose and educate study participants about eye health and provide visual improvement with refraction positively impacted study participants with IVI. The optometrist also reinforced the importance of attending annual dilated eye exams, especially in participants with diabetes, pre-existing glaucoma, and those who had visually significant cataracts and were recommended for cataract surgery.

Other studies

In contrast to most causes of vision impairment, the root issue is not in finding and implementing a cure, but simply making eye care available to those who need it the most. The World Health Organization named uncorrected refractive error one of the leading causes of vision impairment worldwide, which is supported by findings from the Manhattan Vision Screening and Follow-Up Study.[1] The rates and types of refractive error found were largely equivalent to what was found in other large, older population-based studies.[23–26]

This study also supports previous research showing a correlation between advancing age and prevalence of hyperopia and an increased proportion of individuals diagnosed with myopia worldwide.[27] This is likely due in part to the self-selecting nature of this study, people who are near sighted and wear eyeglasses are accustomed to eye exams and may be more likely to attend, and the mean age of the study population.

Strengths

This community-based study was conducted during and after the COVID-19 pandemic in New York City. Therefore, the Institutional Review Board permitted consenting and pre-screening questionnaires to be conducted over the telephone, which allowed us to see more participants and reduce waiting times. The study staff recruited, enrolled, and screened a diverse sample size of underserved adults and seniors, which included 51.8% African Americans and 42% Hispanic participants, spanning an age range from 40 to 99 years.

Limitations

The targeted population who attended the initial eye health screening and all follow-up eye exams was self-selected and voluntary. The rates of vision impairment may be overestimated due to bias from enrolled participants who are aware of vision changes and participate in eye health screenings, but this was a targeted screening in a known high-risk population. Visual

acuity was tested alone, which is not the full picture of the visual ability of the participants. Contrast sensitivity or peripheral vision evaluation (visual fields) were not performed in the community, but are both useful determinants of the functional vision of participants.[24]

Conclusions

Vision impairment can detrimentally affect quality-of-life and the ability to participate in society.[4] The targeted eye health screening and optometric exam protocol are generalisable and scalable to a national level and can be conducted in senior centres, Federally Qualified Health Centers, primary care settings, and public housing facilities. The hope is that by presenting these high rates of vision impairment that was improved in this high-risk targeted population, further community-based interventions can be conducted to those who need it the most.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials. All deidentified participant data, study protocol, statistical plan, and informed consent will be made available by the corresponding author upon email request. The data will be made available with investigator support after approval of a proposal and a signed data access agreement is fully executed. Study materials are available at SIGHTSTUDIES.org.

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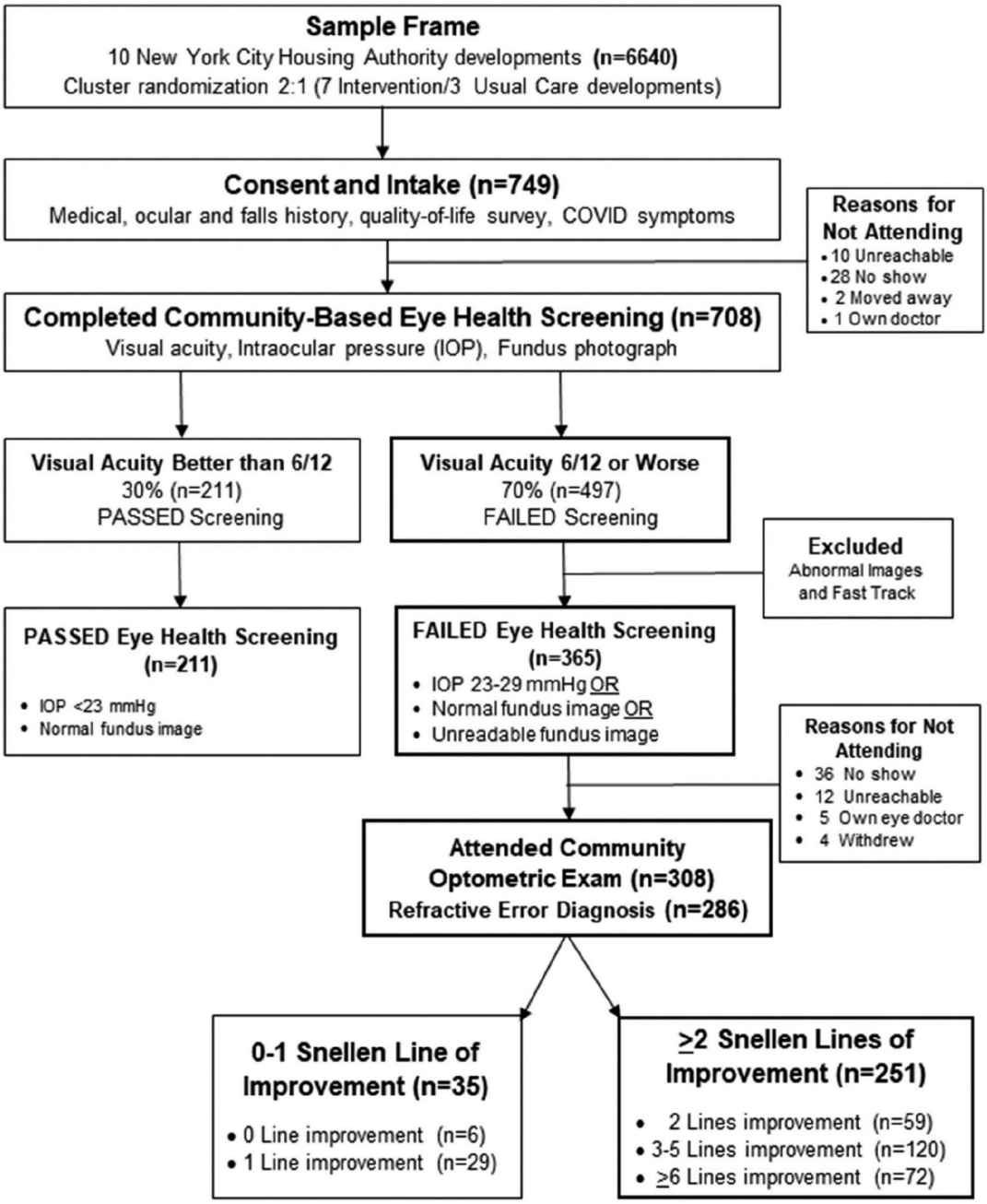

Figure 1.

Consolidated Standards of Reporting Trials (CONSORT) diagram study flowchart. Participants were recruited via flyer distribution (Top centre). Verbal informed consent, intake data, and COVID-19 history were obtained via the call centre prior to eye health screening (second row). All enrolled participants were scheduled for eye health screenings at the New York City Housing Authority Developments and Department for the Ageing senior centers (third row). Reasons for not attending eye health screening (third row right). Visual acuity better or worse than 6/12 (fourth row), excluding fast track and abnormal image (fourth row right). Eye health screening outcome of normal or failed screening (fifth

row). All participants who failed the eye health screening were scheduled with the on-site optometrist (sixth row). Reasons for not attending (sixth row right). Optometrist refractive error diagnoses (seventh row) and 0 to 1 Snellen line improvement (seventh row left) and ≥2 Snellen lines of improvement (seventh row right).

Table 1.

Manhattan Vision Screening and Follow-up Study (NYC-SIGHT): demographics and social determinants of health results in participants with improvement in vision impairment.

Variables	0–1 Snellen Line of Improvement (*n* = 35)	≥2 Snellen Lines of Improvement (*n* = 251)	*P*
Mean Age ±SD (Years)	73.3 ± 11.2	69.8 ± 11.7	0.096 **
Age Categories			0.093
40–59 years, **n (%)**	2 (5.7)	53 (21.1)	
60–79 years, **n (%)**	24 (68.6)	148 (59.0)	
≥80 years, **n (%)**	9 (25.7)	50 (19.9)	
Sex, n (%)			0.912
Female	25 (71.4)	177 (70.5)	
Male	10 (28.6)	74 (29.5)	
Ethnicity/Race, n (%)			0.547
Hispanic/Latino	11 (31.4)	100 (39.8)	
African American, non-Hispanic	22 (62.9)	133 (53.0)	
Other (Multiracial, White, Asian, American Indian)	2 (5.7)	18 (7.2)	
			0.842
Education Level, n (%)			
Less than high school	12 (34.3)	74 (29.5)	
High school	11 (31.4)	83 (33.1)	
Some college, college graduate, or graduate degree	12 (34.3)	94 (37.5)	
Employment Status, n (%)			0.777 *
Employed (full-time, part-time)	5 (14.3)	42 (16.7)	
Unemployed	3 (8.6)	23 (9.2)	
Retired	25 (71.4)	157 (62.5)	
Disabled/Unable to work	2 (5.7)	29 (11.6)	
Marital Status, n (%)			0.832
Single, divorced, or widowed	28 (80.0)	195 (77.7)	
Married/Domestic partner	7 (20.0)	56 (22.0)	
Primary Language, n (%)			
English	25 (71.4)	150 (59.8)	0.462
Spanish	9 (25.7)	97 (38.6)	
Other	1 (2.9)	4 (1.6)	
Needs Transportation, n (%)			0.067 *
Yes	5 (14.3)	14 (5.6)	
No	30 (85.7)	237 (94.4)	
Has Health Insurance, n (%)	34 (97)	240 (95.6)	0.500

Bold p-value indicates statistical significance at the $p < 0.05$ level.

*Fisher's Exact Test;

**2-sample t-test; NO*Chi-square test; SD; Standard deviation.

Table 2.

Manhattan Vision Screening and Follow-up Study (NYC-SIGHT): ocular and medical history in participants with improvement in vision impairment.

Variables	0–1 Snellen Line of Improvement (*n* = 35)	≥2 Snellen Lines of Improvement (*n* = 251)	*P*
Has Own Eye Doctor, n (%)	11 (31.4)	69 (27.5)	0.688
Last Dilated Eye Exam, n (%)			0.451
Within the past year	5 (14.3)	54 (21.5)	
Within 1 to 2 years	10 (28.6)	54 (21.5)	
More than 2 years	15 (42.9)	90 (35.9)	
Can't remember	2 (5.7)	36 (14.3)	
Never had an eye exam	3 (8.6)	17 (6.8)	
Family History of Glaucoma, n (%)	11 (31.4)	54 (21.5)	0.190
Family History of Blindness, n (%)	7 (20.0)	23 (9.2)	0.071 *
Wears Prescription Eyeglasses, n (%)	27 (77.1)	177 (70.5)	0.417
Ocular Conditions (Self-reported), n (%)			
Dry eye	21 (60.0)	120 (47.8)	0.177
Blurry vision	12 (34.3)	101 (40.2)	0.500
Cataract	15 (42.9)	73 (29.1)	0.098
Glaucoma	6 (17.1)	17 (6.8)	**0.05** *
Floaters	5 (14.3)	40 (15.9)	0.802
Double vision	2 (5.7)	16 (6.4)	1.000 *
Diabetic retinopathy	6 (2.4)	0 (.0)	1.000 *
Macular degeneration	1 (2.9)	0 (.0)	0.122 *
No ocular conditions	3 (8.6)	52 (20.7)	0.088
Medical Conditions (Self-reported), n (%)			
Hypertension	20 (57.1)	170 (67.7)	0.214
Diabetes	7 (20.0)	77 (30.7)	0.194
Arthritis/Osteoporosis	12 (34.3)	128 (51.0)	0.064
Foot problems	6 (17.1)	99 (39.4)	**0.010**
Heart problems	11 (31.4)	47 (18.7)	0.080
Depression	8 (22.9)	57 (22.7)	0.984
Asthma/COPD	9 (25.7)	48 (19.1)	0.361
Cancer	2 (5.7)	17 (6.8)	1.000 *
Other medical conditions	3 (8.6)	27 (10.8)	1.000 *
No medical conditions	2 (5.7)	22 (8.8)	0.750 *
Current Smoker, n (%)	4 (11.4)	36 (14.3)	0.798 *

Bold *p*-value indicates statistical significance at the $p < 0.05$ level;

*Fisher's Exact Test; NO*Chi-square test;COPD: Chronic Obstructive Pulmonary Disease.

Table 3.

Manhattan Vision Screening and Follow-up Study (NYC-SIGHT): telehealth findings, eye health screening results, and falls history in participants with improvement in vision impairment.

Variables	0–1 Snellen Line of Improvement (*n* = 35)	≥2 Snellen Lines of Improvement (*n* = 251)	*P*
Failed Screening, n (%)			
Visual acuity 6/12 or worse	18 (51.4)	238 (94.8)	**0.000** *
IOP 23–29 mmHg	5 (14.3)	14 (5.6)	0.067 *
IOP (mmHg), mean ±SD by eye			
Left eye	15.2 ±4.7	14.3 ±3.9	0.660 **
Right eye	16.5 ±5.1	14.7 ±4.1	0.051 **
Telehealth Image⁺Results by Worse Eye, n (%)⁺ *(abnormal images excluded)*			
Normal image	6 (17.1)	143 (57.0)	**0.000**
Abnormal image, no significance	1 (2.9)	11 (4.4)	1.000 *
Unreadable	28 (80.0)	97 (38.6)	**0.000**
Optometrist Referral to Ophthalmology, n (%)	28 (80.0)	169 (67.3)	0.129
Falls History (Self-reported), n (%)			
Worries about falling and feels unsteady when standing or walking	15 (42.9)	119 (47.4)	0.613
Fell in the past year 1X – 5X	11 (31.4)	67 (26.7)	0.556
Visited ER due to falling	4 (11.4)	20 (8.0)	0.512 *
Hospitalised due to falling	0 (0.0)	7 (2.8)	1.000 *
Conduct STEADI in the field	17 (48.6)	141 (56.2)	0.397

Bold p-value indicates statistical significance at the alpha = 0.05 level;

* Fisher's Exact Test;

** 2-sample t-test; NO* Chi-square test; IOP: Intraocular Pressure; SD: Standard Deviation; ER: Emergency Room; STEADI: Stopping Elderly Accidents, Deaths, and Injuries.

Table 4.

Manhattan Vision Screening and Follow-up Study (NYC-SIGHT): Stepwise * multivariate logistic regression model estimating factors associated with improvement in vision impairment.

Variables	Odds Ratio (95% CI)	*P* Value **
Glaucoma (Self-reported)	0.222 (0.071, 0.698)	**0.010**
Visual Acuity 6/12 or worse	16.041 (6.009, 42.822)	**0.000**
Normal fundus image	2.783 (1.001, 7.740)	**0.050**

Abbreviations: CI: confidence interval; IOP: intraocular pressure; SD: standard deviation; Ref:, Reference.

* At each step, variables were added based on the alpha-to-enter significance level of 0.05 and the alpha-to-remove significance level was set at 0.1 to exclude variables in the final model.

** Bold *P*-value indicates statistical significance at the $p \leq 0.05$ level.