Cities on three continents: A study of post-COVID ridership

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ABSTRACT

The COVID-19 pandemic resulted in an unprecedented shift in public transport use globally that has not fully recovered. This study evaluated and compared urban public transport ridership in four cities (London, New York, Sydney, and Warsaw) on three continents before, during, and after the COVID-19 pandemic. A longitudinal analysis was conducted, and concentration was placed on comparing ridership recovery in relation to both pre-COVID ridership and pre-COVID projected ridership. Results showed that while the maximum percentage decline of public transport use during COVID was aligned for the four cities, the recovery rates differed.

Keywords: COVID-19, Journeys, London, New York, Public Transport, Sydney, Warsaw

INTRODUCTION

The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020, and since then, there have been significant social and economic impacts both locally and globally even after the end of the pandemic was declared on May 5, 2023 (*1-2*). Government reactions and resulting impacts on urban public transport operations during the pandemic varied at both local and national levels, but it is evident that the pandemic resulted in an unprecedented shift in public transport use globally. Most cities and regions in Europe, the United States, and Australia had relaxed or removed COVID restrictions at least one year prior (*3-6*).

London experienced three national lockdowns over 18 months. Residents and businesses within the United Kingdom (UK) were operating under a tiered system with varying degrees of restriction ranging from face coverings and social distancing in public to complete at home lockdown. This tiered system was in place from March 2020 to July 2021 at which point all restrictions were lifted (*3*). Throughout the pandemic, public transport in London was still operational. However, in addition to health and safety measures being implemented, minimum services were operating to meet the lower than usual demand (*4*). While significant literature exists on COVID-19 impacts mobility in London. Most literature is focused on community health, bicycle use, and detailed behavior change at a micro level and does not address pre- and post-COVID ridership comparisons (*7-9*).

Similar to the UK, New York entered a form of lockdown in March of 2020 and experienced various levels of restrictions. However, restrictions remained in effect until March 2022 (*5*). Face covering use of public transport was still required until September 2022. Public Transport operations during COVID were modified including changes in service frequency, the halting of overnight subway (metro) services, supplementing bus services to accommodate overnight subway passengers, and instituting rear door boarding on buses (*6*). Substantial COVID-related literature on transport in New York is available on the topics of health, mode shift during COVID, and the environment. Additionally, detailed analysis of ridership has been conducted for public transport and bikeshare (*10, 11*). There is a gap in literature where decline in projected ridership of public transport in New York pre-COVID compared to post-COVID ridership is not addressed.

Although far geographically removed, Australia, and more specifically Sydney, began COVID response in March 2020 as well. However, unlike in London and New York, very stringent lockdowns began in 2021 with stay-at-home orders being instituted for 154 days of the year (*12*). While New York restrictions ended in March of 2022, restrictions in Sydney did not end until September of 2022 (*13*). Mohri et al. and Qu both completed detailed studies on the impact of COVID on ridership in Sydney (*14, 15*). Ridership-related literature published to date does not include 2022 ridership data which is critical since restrictions were still ongoing in Sydney in 2022.

Poland is known for its quick response at the start of the pandemic with stringent measures enforced such as face coverings, limited gatherings, and financial penalties for those who did not comply. Border restrictions and stay at home orders were also put in place during the first wave of COVID-19 in the spring of 2020. Like other cities, there were three waves of COVID with varying levels of restrictions. Public transport in Warsaw was impacted during COVID and operational changes were implemented such as timetable changes, per vehicle capacity limits, crowd monitoring, and vehicle disinfecting. (*16*). In March of 2022, all COVID restrictions were lifted in Poland (*17*). Research on transport in Warsaw during and post-COVID has been conducted and provides insight into health, environmental, mode shift, and ridership impacts in the city (*16, 18, 19*). Research on Warsaw ridership COVID and post-COVID ridership data compared to other non-European economic centers has not been published.

Multi-city comparative research on ridership during and after COVID is known to have been conducted on cities in Sweden, Australia, Austria/Norway, and the United States (*20-23*). The research conducted was concentrated on a local region and does not provide comparative analysis against geographically dispersed cities. This paper provides cross-regional information on post-COVID public transport ridership both in relation to pre-COVID ridership data and public transport authorities'

forecasted ridership data in regionally large metropolitan areas across three continents: London, United Kingdom, New York, United States of America, Sydney, Australia, and Warsaw, Poland.

METHODS

A longitudinal analysis was conducted, and concentration was placed exclusively on metropolitan public transport services. Criteria for selection of cities for analysis included coverage of different nations and geographic regions, differing impacts of the first COVID wave, major economic centers for the respective regions, transport modes, and availability of data. London, United Kingdom, New York City, United States of America, Sydney, Australia and Warsaw, Poland were selected for analysis.

Data collection

Two types of data were collected, actual ridership data and project ridership data for London, New York, Sydney, and Warsaw (**Table 1**). Warsaw projected data was not available. Actual ridership included historical journeys taken on public transport. Projected ridership was the future forecasted ridership data prior to the start of the COVID-19 pandemic. The actual ridership data for London was collected from TfL's dataset in the Greater London Authority's London Datastore (*24*). Modal ridership data collected for London included bus, Docklands Light Railway (DLR), tram, Overground, and TfL Rail. Ferry data was not publicly available. It is important to note that TfL Rail includes the Elizabeth Line, which is considered a metro service. However, historical datasets make use of the legacy name.

New York City actual ridership data was collected from numerous sources including the MTA's published reports, City of New York (NYC Open Data), and NYC Ferry published reports (*25-29*). Modal ridership data collected for New York City included bus, ferry, and subway. There are no light rail or trams operating in New York City. It is important to note that there are several data sources available for New York city buses and subway and selection of datasets was based on data source and completeness of data (mode and breakdown).

Sydney actual ridership data was collected from the Transport for New South Wales (TfNSW) data and insights reporting and the Transport Audit Reports published from the Audit Office of New South Wales (*30-32*). Ridership data collected for Sydney included bus, ferry, light rail, and metro.

Warsaw actual ridership data was collected from 2017 to 2022 Public Transport Authority of Warsaw's (ZTM) Annual Reports (*33-38*). Modal ridership data collection included bus, metro, and tram.

Projected ridership data for 2020 to 2022 was collected from the Transport for London Business Plan 2019/20 to 2023/24 and the MTA 2020 Budget and 2020-2023 Financial Plan Adoption Materials (*39, 40)*. New York projected ridership does not include ferry journeys. Sydney projected ridership was collected from the March 2019 Transport Modelling Report for Sydney prepared for Infrastructure Australia whereby projected ridership was available only for 2031 (*41*). ZTM Warsaw projected ridership was obtained from the 2015 Warsaw City Hall Transport Sustainable Plan (*42*).

Due to the lack of consistency in commuter rail services across regions and clarity of data, commuter rail was excluded from the assessment.

TABLE 1 Ridership Data Sources

City	Data Source	Data Consumed
London	Greater London Authority: London Datastore	2017 – 2022 bus, DLR, tram, Overground, and TfL Rail ridership (*24*)
	Transport for London Business Plan 2019/20 to 2023/24	2020 – 2022 ridership projections (*37*)
New York	MTA	2017 – 2021 MTA Bus, NYCT Bus and Subway ridership (*27*) 2022 January – November MTA Bus, NYCT Bus and subway ridership (*28*)

	MTA (via NYC OpenData platform 'MTA Bus Hourly Ridership', 'MTA Subway Hourly Ridership' Dataset)	2022 December MTA Bus, NYCT, and Subway ridership (*29*)
	New York City Department of Transportation (DOT) (via NYC OpenData platform)	2017 – 2022 Staten Island Ferry ridership (*26*)
	NYC Ferry	2017 – 2022 New York City Ferry ridership (*25*)
	MTA 2020 Budget and 2020-2023 Financial Plan Adoption Materials	2020 – 2022 ridership projections (*40*)
Sydney	New South Wales Auditor General's Report Transport for 2017 and 2018	2017 – 2018 ridership (*30, 31*)
	TfNSW	2019 – 2022 bus, light rail, metro, and ferry ridership (*32*)
	Infrastructure Australia Transport Modelling Report for Sydney March 2019	2016 and 2031 forecasted ridership for bus, light rail, ferry, metro, and train with ridership percentage increase by mode (*41*)
Warsaw	Zarząd Transportu Miejskiego *(Public Transport Authority of Warsaw)* Annual Reports (2017 – 2022)	2017 – 2022 bus, tram, and metro ridership (*33-38*)
	March 2015 Transport Sustainable Plan Collective for Warsaw including public transport organized on the basis of agreements with neighboring municipalities	2014 actual and 2030 projected ridership for all public transport modes (*42*)

Data Analysis

Data cleansing was completed to ensure the dataset was inclusive of data beginning January 1, 2017, to December 31, 2022. The London actual ridership data was reported against TfL fiscal years (April to March) and was normalized based on monthly data to ensure alignment with calendar years. However, for London's projected ridership data, monthly data was not available, and thus the fiscal year data were retained in the analysis.

The MTA New York City Transit's 'Financial and Ridership Reports' were not available for December of 2022, so instead NYC OpenData 'MTA Bus Hourly Ridership' and 'MTA Subway Hourly Ridership' dataset was used for December of 2022 (*29*). Dataset information noted that the NYC OpenData ridership excludes ridership from cash paying passengers which equated to six to eight percent of the total ridership. To correct for this, seven percent of rides were added to the December 2022 bus ridership data. This correction was applied only to the bus dataset as cash payment is not available for subway rides. This correction resulted in an overall potential error range of plus or minus 329,053 journeys for New York which equates to approximately 0.02378% of 2022 total New York ridership.

Sydney projected ridership growth percentage data was provided for 2016 to 2031. The data was interpolated for the years 2020, 2021, and 2022 assuming a linear progression of the percentage growth of the projected ridership from 2016 to 2031. Warsaw projected ridership growth percentage data was provided for 2014 to 2030. The data was interpolated in the same way as Sydney data.

Regional public transport experts then completed a data review and confidence check for each respective city. Subsequently, mode terminology was standardized to complete a direct comparison analysis (**Table 2**). Data was recoded to reflect four transport modes: bus, ferry, metro, and tram.

TABLE 2 Modal Categorization of City Public Transport Services

	Aggregated Modal Category			
City	**Bus**	**Ferry**	**Metro**	**Tram**
London	TfL bus	Data not Available	DLR TfL Rail Underground	TfL Tram
New York	MTA bus NYCT bus	NYC Ferry Staten Island Ferry	MTA Subway	Not Applicable
Sydney	TfNSW bus	TfNSW Ferry	Sydney Metro	TfNSW Light Rail
Warsaw	ZTM bus	Data not Available	ZTM Metro	ZTM Tram

A ridership comparison analysis by city was completed using percentage relative change calculations using 2019 as a baseline as shown in **Equation 1**. 2019 was used as a baseline because that is the last available data point prior to the start of the COVID-19 pandemic.

$$J_i = 100 \, x \, (V_i - V_n) / V_n \qquad (1)$$

J_i is the actual ridership relative change against the 2019 baseline where *i* represents year, *V* represents actual ridership and *n* represents 2019. This calculation was completed for the years 2017 through 2022 at both a modal level, and at a city level for London, New York, Sydney, and Warsaw. A comparative analysis of ridership recovery across defined cities was then calculated.

Projected ridership data from the years 2020 to 2022 for London, New York, and Sydney was introduced and relative change was calculated against the 2019 baseline as shown in **Equation 2** (*39-41*).

$$K_i = 100 \, x \, (P_i - V_n) / V_n \qquad (2)$$

K_i is the projected ridership relative change against the 2019 actual ridership baseline where *i* represents year, *V* represents actual ridership, *P* represents projected ridership, and *n* represents 2019. Using the relative change of the projected ridership, the delta of the percentage of relative change of the actual ridership [J_i] and the projected ridership relative change [K_i] was calculated to determine the ridership recovery against the projected ridership allowing for a cross-comparison of recovery to pre-pandemic ridership levels and government projected ridership levels for 2020 through 2022.

RESULTS

Public Transport Actual Ridership Results

Aggregated Modes Results

Pre-pandemic, from 2017 to 2019, ridership decreased in London (0.75%) and New York ridership (5.78%), while Sydney and Warsaw ridership increased by 2.58% and 0.05% respectively. All cities had the maximum decline in ridership from the 2019 baseline in 2020 except for Sydney where this occurred in 2021. Against the 2019 baseline, maximum ridership decline reached 52.76% for London, 57.02% for New York, 52.27% for Sydney and 39.57% for Warsaw (**Table 3)**(**Figure 1)**.

TABLE 3 Total actual ridership (in millions rounded to the nearest thousand) and relative change using 2019 as a baseline

Year	London	New York	Sydney	Warsaw

	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change
2017	3,995,850	0.7%	2,543,520	5%	341,000	-3.0%	1,143,900	-5.0%
2018	4,005,370	1.0%	2,479,293	3.1%	358,700	2.5%	1,183,850	-1.5%
2019	3,966,263	0.00%	2,404,450	0.0%	350,034	0.00%	1,201,500	0.0%
2020	1,873,500	-52.8%	1,033,454	-57.0%	208,838	-40.3%	726,100	-39.6%
2021	2,129,005	-46.3%	1,157,569	-51.9%	167,066	-52.3%	809,431	-32.6%
2022	3,105,095	-21.7%	1,383,733	-42.5%	227,349	-35.1%	863,446	-28.1%

From 2020 to 2022, London and New York are averaging a ridership increase of 15.5% and 7.3% per year, respectively. Sydney and Warsaw are averaging a ridership increase of 2.6% and 5.7% respectively.

2022 data shows a 2019 ridership delta of 21.71%, 42.45%, 35.05%, 28.14% for London, New York, Sydney, and Warsaw, respectively (**Table 3**). The recovery from the lowest point of ridership and the ridership of 2022 was 31.05% for London, 14.6% for New York, 17.2% for Sydney, and 11.43% for Warsaw.

Figure 1 London, New York, Sydney, and Warsaw actual ridership relative change over time using 2019 as a baseline

Bus Results

Bus ridership trends across cities from 2017 and 2019 varied with London (-3.1%) , New York (-6.5%), and Sydney (-2.1%) declining while Warsaw (1.4%) increased. All cities studied had a consistent decrease in bus ridership between 40% and 50% between 2019 and 2020. London bus ridership increased at an average rate of 13.6% from 2020 to 2022. New York bus ridership stagnated between 2020 and 2021 and subsequently decreased by 4.8% from 2021 to 2022. The average rate of bus ridership in New York from 2020 to 2022 was -4.7%. Sydney buses reached the lowest ridership across all cities in 2021 with a -56.1% delta from 2019 ridership. Between 2021 and 2022, ridership has increased and was at -43.7% of 2019 ridership. This value is close to the 2020 ridership in Sydney. Of the cities studied, Warsaw bus ridership percentage decreased the least with a 41.16% decrease in 2020. The average rate of increase of bus ridership in Warsaw from the 2019 baseline from 2020 to 2022 was 4.3% per year. (**Table 4**) (**Figure 2**).

TABLE 4 Actual bus ridership by mode type (in millions rounded to the nearest thousand) and relative change using 2019 as a baseline

Year	London		New York		Sydney		Warsaw	
	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change
2017	2,250,983	3.13%	724,835	6.52%	315,000	2.06%	590,700	-1.39%
2018	2,252,782	3.31%	690,809	1.95%	332,000	7.62%	608,110	1.54%
2019	2,180,627	0.00%	677,588	0.00%	308,497	0.00%	598,900	0.00%
2020	1,144,602	-47.51%	382,424	-43.56%	175,160	-43.22%	352,400	-41.16%
2021	1,294,113	-40.65%	383,325	-43.43%	135,579	-56.05%	400,170	-33.18%
2022	1,737,605	-20.32%	350,727	-48.24%	173,764	-43.67%	403,033	-32.70%

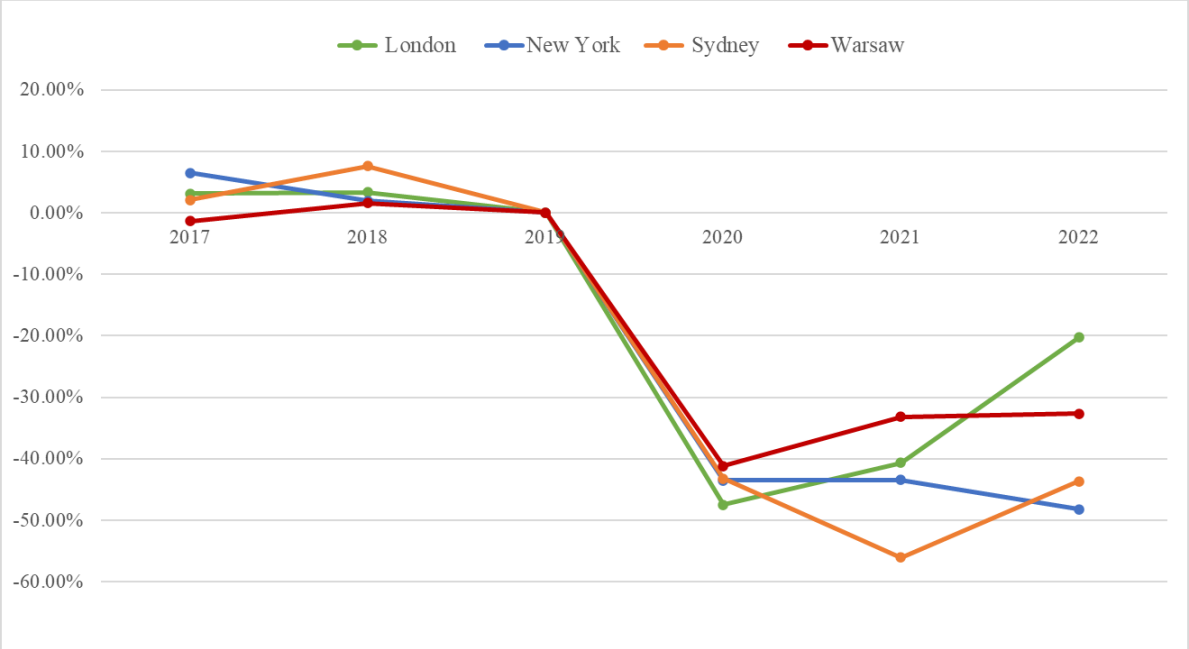

Figure 2 London, New York, Sydney, and Warsaw actual bus ridership relative change over time using 2019 as a baseline

Ferry Results

Ferry data was available for New York and Sydney. Warsaw and London have ferries operational in the cities, but data was not available. Ferry ridership from 2017 to 2019 increased by 7% in New York and decreased by 3% in Sydney. New York experienced the largest drop in ridership from the 2019 baseline in 2020 with a reduction of 60% of ridership. Sydney experienced the largest drop in ridership from the 2019 baseline in 2021 with a reduction of 65% of ridership. Overall ridership between 2020 and 2022 increased in both New York and Sydney. 2022 ridership was down from 2019 by 33% and 30% for New York and Sydney, respectively. (**Table 5**)(**Figure 3**).

TABLE 5 New York and Sydney actual ferry ridership (in millions rounded to the nearest thousand) and relative change using 2019 as a baseline

Year	New York		Sydney	
	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change
2017	27,091	-7%	16,000	3%
2018	29,618	2%	16,400	5%
2019	29,074	0%	15,553	0%
2020	11,489	-60%	6,782	-56%
2021	14,267	-51%	5,399	-65%
2022	19,442	-33%	10,933	-30%

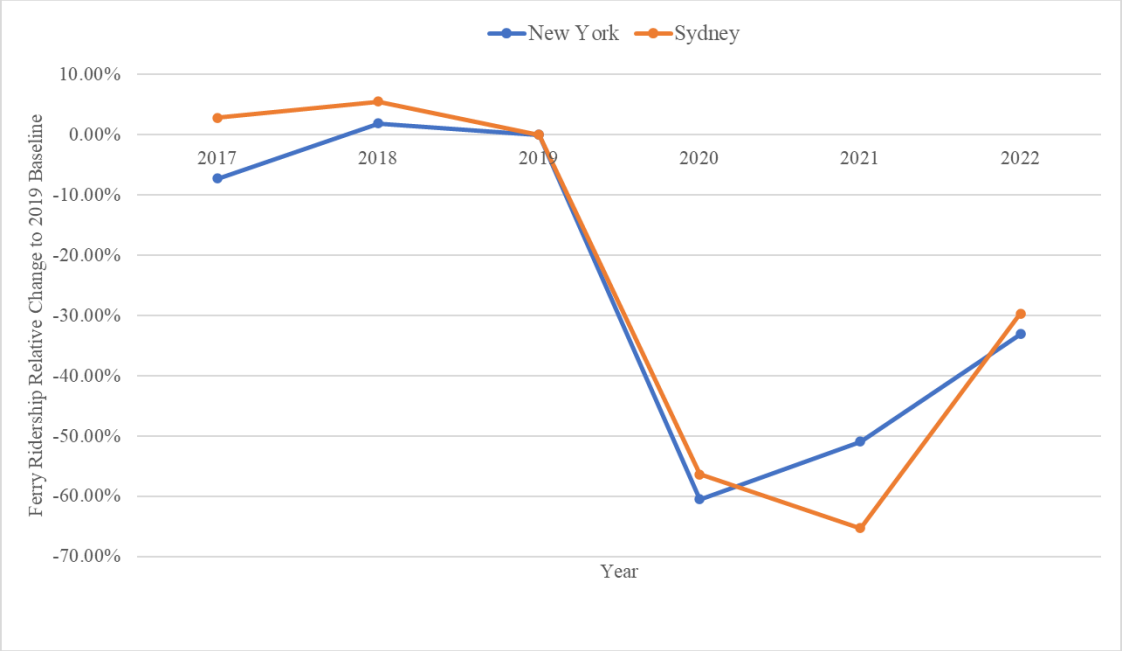

Figure 3 New York and Sydney actual ferry ridership relative change over time using 2019 as a baseline

Metro Results

London, New York, and Warsaw metro ridership increased between 2017 and 2019 with 2%, 2%, and 8% increases, respectively. The metro was not operational in Sydney before 2019. New York experienced the greatest drop in comparative ridership with a decrease of 62%, followed by London with a decrease of 59%, 33% in Warsaw, and 20% in Sydney. As of the end of 2022, metro ridership in London was 23% less than 2019, metro ridership in New York was 40% less than in 2019, Sydney ridership was 14% less than 2019, and Warsaw was 33% less than 2019. (**Table 6**)(**Figure 4**).

TABLE 6 Actual metro ridership (in millions rounded to the nearest thousand) and relative change using 2019 as a baseline

Year	London		New York		Sydney		Warsaw	
	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change
2017	1,715,378	-2%	1,727,367	2%	Not Applicable		224,800	-8%
2018	1,723,893	-2%	1,680,060	-1%	Not Applicable		234,600	-3%
2019	1,757,982	0%	1,697,787	0%	14,213	0%	241,800	0%
2020	713,629	-59%	639,541	-62%	12,911	-9%	162,200	-33%
2021	818,092	-53%	759,977	-55%	11,354	-20%	180,603	-25%
2022	1,347,123	-23%	1,013,564	-40%	16,267	14%	160,819	-33%

Figure 4 London, New York, Sydney, and Warsaw actual metro ridership relative change over time using 2019 as a baseline

Tram Results

Sydney and Warsaw tram ridership increased by 18% and 10% between 2017 and 2019 while London tram ridership decreased by 6%. New York does not have trams. London experienced the greatest comparative reduction in ridership to pre-COVID rides with a reduction of 45% of tram ridership in 2020, followed by Warsaw with a 43% decrease in 2020 and Sydney with a decrease of 25% in 2021. As of the end of 2022, tram ridership in London was 26% less than 2019, tram ridership in Sydney was 124% greater than in 2019, and Warsaw tram ridership was 46% less than 2019 (**Table 7**) (**Figure 5**).

TABLE 7 Actual tram ridership (in millions rounded to the nearest thousand) and relative change using 2019 as a baseline

Year	London		Sydney		Warsaw	
	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change	Actual Ridership	2019 Relative Change
2017	29,493	6%	10,000	-18%	269,200	-10%
2018	28,694	4%	10,300	-12%	286,510	-3%
2019	27,655	0%	11,771	0%	296,500	0%
2020	15,269	-45%	13,986	19%	168,900	-43%
2021	16,799	-39%	14,734	25%	185,872	-37%
2022	20,368	-26%	26,385	124%*	160,819	-46%

**A new tram line was opened in Sydney in 2022*

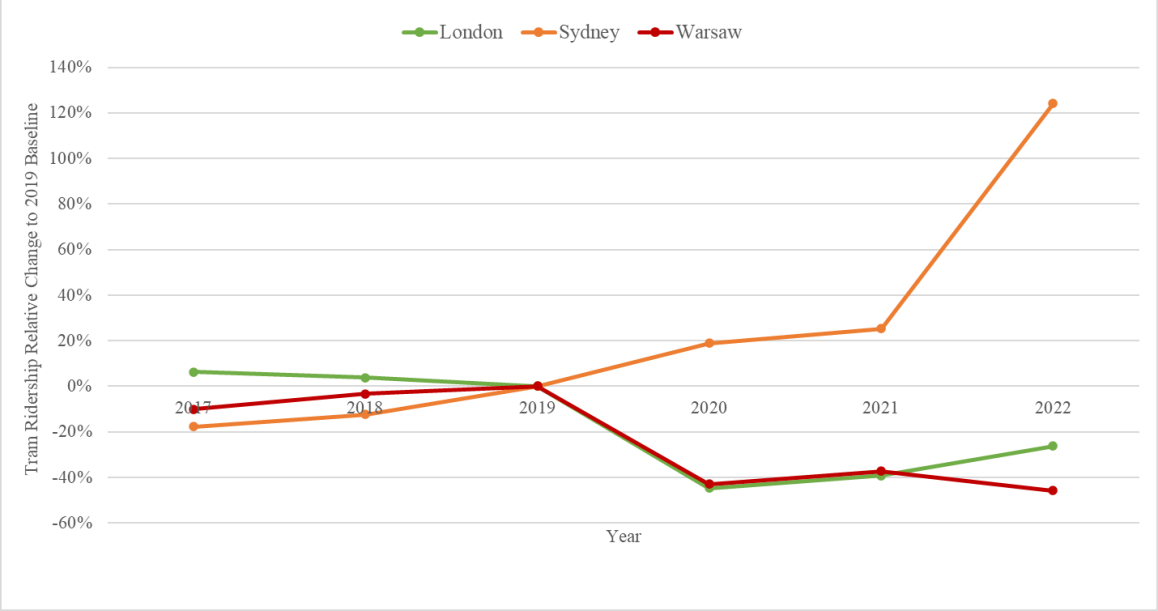

Figure 5 London, Sydney, and Warsaw actual tram ridership relative change over time using 2019 as a baseline

Projected Ridership Results

Projected ridership published in 2019 (last year before COVID-19) for years 2020, 2021, and 2022 show a previously expected ridership yearly average increase of 2.0% for London, 0.8% for Sydney,

5.9% for Warsaw, and a decrease of 2.5% for New York. Warsaw projected ridership, published in 2014, shows a previously expected ridership yearly average increase of 0.8%. (**Figure 6**).

The delta of actual ridership and projected ridership for ridership in 2022 is -24.9% for London, -35.0% for New York, -36.3% for Sydney, and -48.7% for Warsaw. In contrast, the delta of 2019 actual ridership and 2022 actual ridership is -21.71% for London, -42.45% for New York, and -35.05% for Sydney. New York projected ridership does not include ferry journeys. At peak ridership, between the years of 2017 to 2022, ferry journeys made up approximately 1% of total ridership in New York.

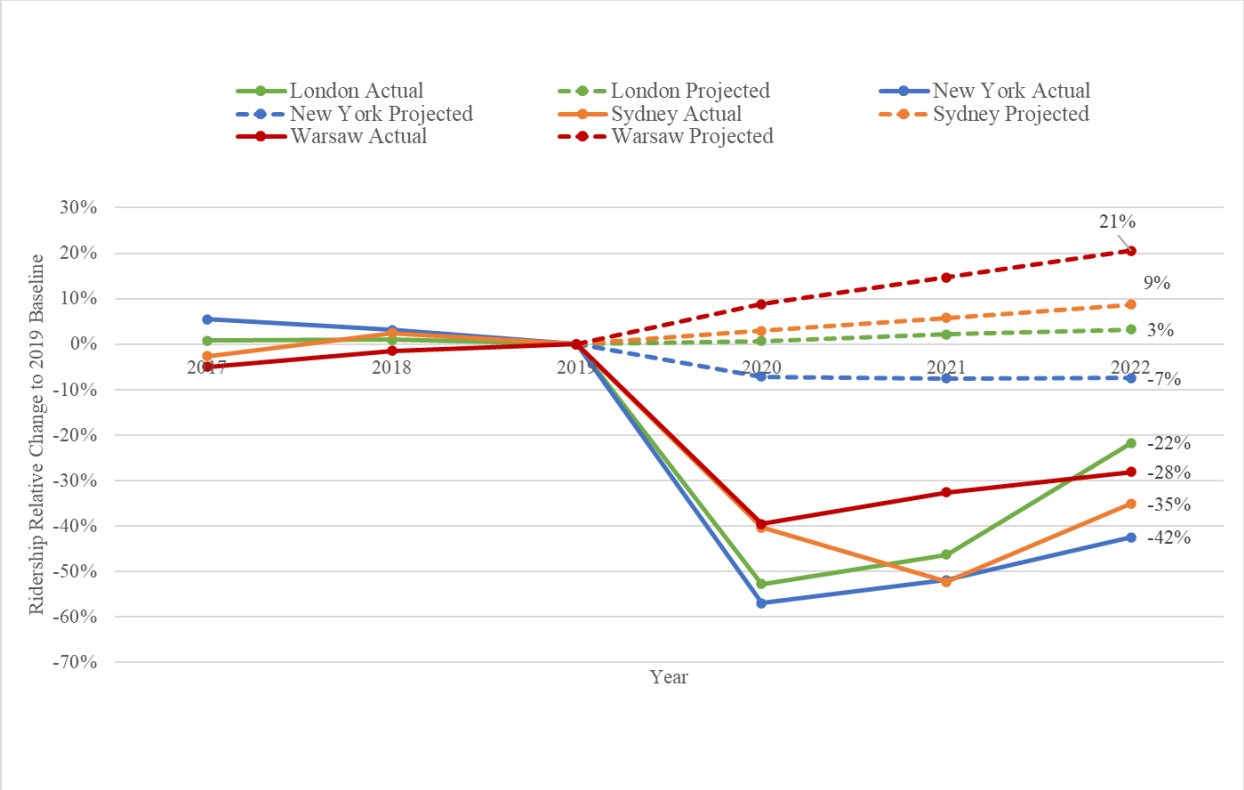

Figure 6 London, New York, Sydney, and Warsaw actual and projected ridership relative change over time using 2019 as a baseline (projected ridership forecasted in 2019) (does not include projected New York ferry journeys)

DISCUSSION

Aggregated mode actual ridership results show a consistent decline in ridership during 2020 with a spread of decline of only 6.4% across all cities studied (**Figure 1**). Peak ridership decline for all cities occurred except for Sydney which experienced a peak decline in 2021 and this may have been caused by the extended COVID health and safety measures kept in place well into the 2021 calendar year (*12*). Of interest is the limited maximum decline in ridership for Warsaw (-39.6%) compared to the other cities studied (**Table 2**). Reasons for this are unknown but may be related to the high repatriation rate of Poles to Poland in 2020 prior to and during COVID (*44*).

Comparatively, the 2022 ridership recovery as a percentage of 2019 total ridership is not consistent across cities where results show a significant discrepancy of 20.7%. Ridership increased the most from 2020 to 2022 in London resulting in it being 21.7% less than the 2019 ridership. It is known that London's COVID restrictions ended prior to all other cities studied (*3*). The longer timeline allowed for 'return to normal' activities may have contributed to the comparative increased ridership. As an example, the Australian international border opening for tourists did not occur until February 2022 when

covid restrictions ended in the UK in July of 2021 (*3, 44*). Additionally in London, a new metro line referred to as the Elizabeth Line opened in mid-2022. The opening of the Elizabeth Line resulted in 62.2 million trips from October to December 2022 with an additional unknown quantity of trips from May to October (*45*). It is not known whether those are new trips or rider conversions from different modes. It is important to consider that the opening of the line may not have only impacted ridership on the line, but also connected journeys on other service modes. As mentioned above, Warsaw had the smallest ridership decrease among the four cities with a recovery rate from 2020 that was aligned with New York (**Figure 1**).

The data shows that the relative recovery of ridership in New York is less than that of all cities studied. New York also experienced the largest decline in ridership among the cities studied. Unlike other cities, the projected ridership from 2019 expected a decrease of 7.5% by 2022 (**Figure 6**). There is a known error (less than +/- 1%) in this value due to ferry data not being included, but it should not significantly impact the findings. When reviewing results against projected ridership, the delta percentage of ridership recovery between Sydney and New York is only 1.3%. While there is alignment on this, the trajectory of Sydney ridership recovery from point of minimum ridership during COVID is greater than New York.

Known potential flaws in the research include data accuracy, granularity and error levels, external known and unknown factors, and all transport operational changes during and after COVID. While data sources used are reputable, it was unclear what the error levels in the original data sets were, whether they accounted for fare evaded trips, and any journey corrections that were made. There were known external factors that were not accounted for including, but not limited to economy change, inflation, professions and work from home information and city population change (Warsaw population increased due to migration of Ukrainian refugees). Transportation operational changes were made during COVID including the introduction of a metro line in London, introduction of new metro stations in Warsaw, new operations of a tram in Sydney, fare changes, among others. It is unknown whether these operational changes significantly impacted recovery.

CONCLUSIONS

Results presented show the significant impact that COVID-19 and government actions during and after the pandemic had on public transport ridership. Decline in ridership percentage was closely aligned across the four cities, but there was a significant gap in the percentage of ridership recovered in relation to 2019 data. While insightful, ridership data comparison of London, New York, Sydney, and Warsaw resulted in inquiries on the impact of external and operational change factors during and after COVID for each city. Future research should include additional years of post-COVID data that is not currently available to understand the actual recovery timelines for each city. Benefits can be gained from research on the association of population change of the cities during the recovery period to better understand this factor on ridership. In general, modelling and analyzing external factors that may have impacted the recovery for each city would provide additional, relevant insight.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: A. Dowling, K. Desai; data collection: A. Dowling, A. Denis, K. Desai; analysis and interpretation of results: A. Dowling; draft manuscript preparation: A. Dowling, A. Denis, K. Desai. All authors reviewed the results and approved the final version of the manuscript.

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