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The functioning of the night public transport in Łodź

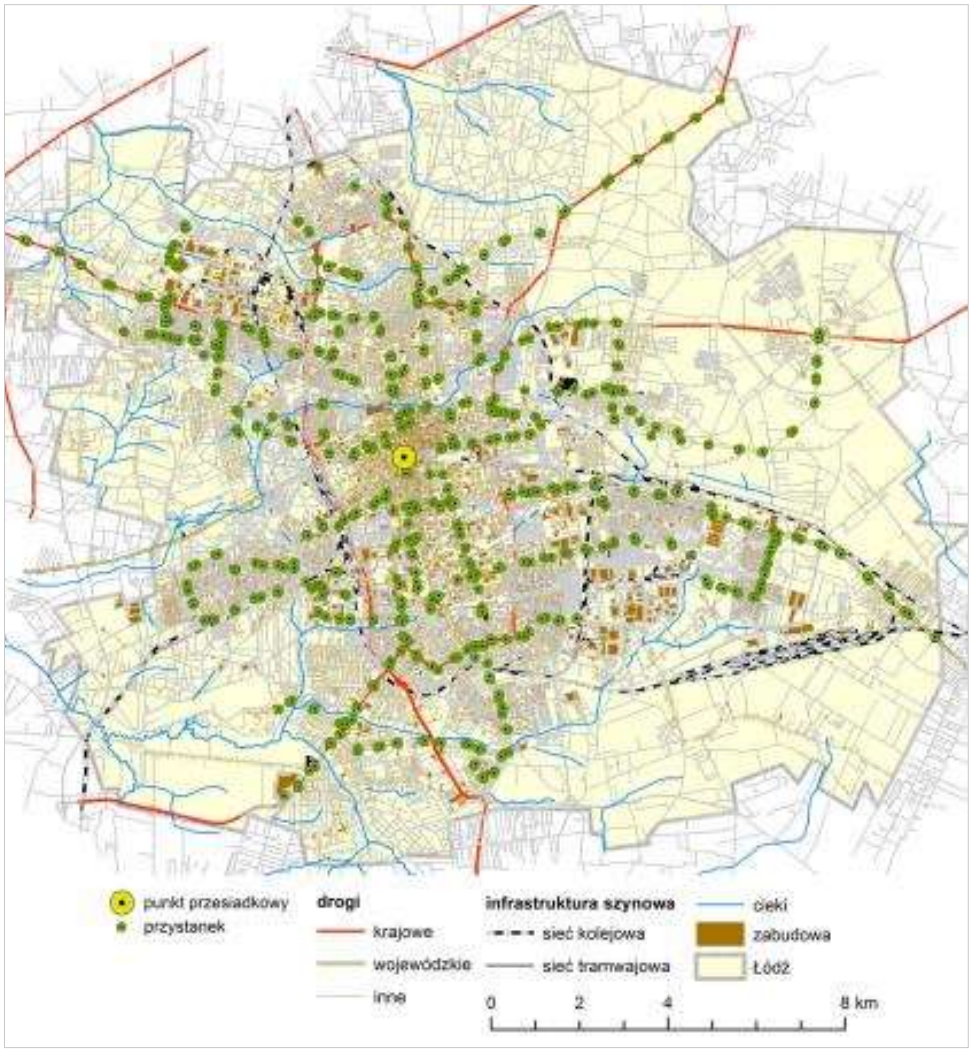
Abstract: Article focuses on analyzing the functioning of the night public transport in Łodź. The study included data on the distribution of the stops of the local carrier, which are operated by night lines, data on vehicle journeys within the individual lines as well as data on the location and age structure of the inhabitants of Łodź. Use of the said information and the application of research methods related to the accessibility of analyzes allowed to determine its spatial differentiation in relation to the point elements of night public transport system of the city, the main hub and the number and age structure of the inhabitants of the city enjoying the night-bus connections.

Keywords: Public transport; Accessibility; Population; Łódź

Introduction

Night transport in Łodź operates basing on seven bus lines (N1-N7). Three of them (N1, N4, N6) provide access beyond the city limits, to Andrespol, Aleksandrów Łódzki, Pabianice and Imielnik Nowy. All night lines "meet" at one point of Łodź, in which it is possible to change. In workdays "meeting" takes place every hour, and on weekends every 30 minutes. Carrier providing nightly merger is the Municipal Transport Company (MPK) - Łodź Sp. z.o.o. In space of the city is located 578 stops serviced by night public transport (Fig. 1).

The studies on the operation of urban public transport are often undertaken research issues in both the national literature [2], [3], [10], [14], [12] and international [1], [9], [5]. This article focuses on determining the effectiveness of the night public transport in Łodź in light of the availability of walking to bus stops for potential passengers and the availability of time the individual stops to the point of interchange. The study refers only to the area of population and public transport network within the city limits and is up to date on 01.02.2016.



1. Distribution of night stops of public transport in Łódź, *Source: own work*

Source materials and research methods

For attainment the purpose of the research necessary was to gather the source materials relating to the distribution of the stops serviced by the night bus lines, data with schedule of each of the seven lines and information on the location and the age structure of the population of the inhabitants of Łodź. The location of each of the 578 stops were taken from the databases Road and Transport Administration (ZDiT) in Łodź. Information about the time of journeys buses between stops obtained from the website of urban transport [13]. Data with potential demographic town (population registered for permanent and temporary residence) was obtained however from the Office City Strategy Municipal Office of Łódź.

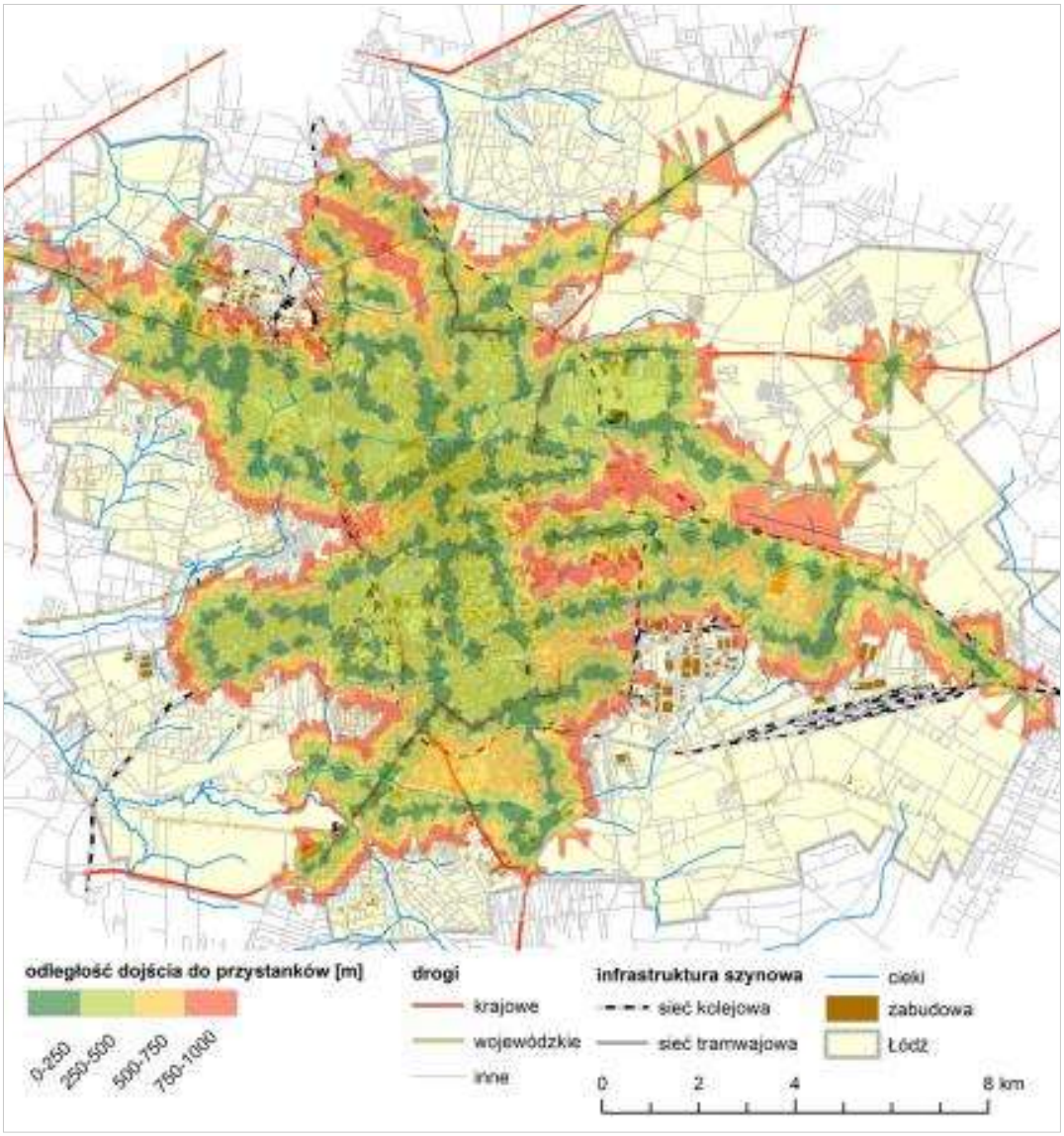
In research methods resorted to commonly used in the analyzes devoted to public transport with analysis of availability - the availability of cumulative and availability of measured distances. The first one is also called isochronic availability. The availability of this type is measured by estimating a set of destinations available at a given time at a given cost effort travel [11]. In this study, were taken into account the inhabitants of Łodź, whose actual physical distance arrive at individual stops transport of the night did not exceed 1 km in 250 m intervals. After drawing arrive equidistant at individual stations within Łódź combined mileage of isolines of the same, the lowest possible values. This made it possible to determine the spatial diversity available within the city limits. For each building (address) within the city

limits was generated focal point and assigned him to count the inhabitants according to the Office of the City of Łodź to-date on 01/01/2016. In Poland customarily assumed that the affected area of public transport covers an area with a radius of 500 m 1 km away. This means that residents can reach the bus stop on foot at the time of 6 to 12 minutes, assuming that the average speed of their movement is 5 km / h [7]. Of course, such a model does not reflect the ability to generate the stop demand for public transport, even if it would be carried out in all directions and at maximum frequency. This is due to the fact that each of the residents may have a different distance limit, with which abandons the use of stop. In addition, a hypothetical user of public transport count next to distance the possible facilities to help you reach a stop or barriers to its achievement. The impact of these factors is different for every inhabitant and is strongly determined by the individual characteristics of each user, such as their age, health, sex, place of residence, etc. [4]. Substantially in the literature are encountered methodological problems associated with the distance limit for different types of transportation. In the UK the maximum distance to come to the bus stop in the city assumed equidistant 640 m, while the regional rail or underground 960 m [7]. German planners, in turn, consider the maximum way to come to the bus stop distance of 300 m, tram 400 m, while the regional rail 500 meters [6]. Differences in determining the distance of the center of boundary transport result of several key issues. Greater distance from the tram stop in relation to the bus reduces the capital expenditures incurred for the construction of new tram lines, while the assumption that people are able to continue to walk to the bus stop, where they can more quickly and comfortably get to your destination. In the present study therefore we adopt several variants of the border gap which is forced to overcome a potential passenger on foot to reach the bus stop. When determining the distance adopted metric Manhattan. Unless the correct application in the study of the distance of 250 - 500 m find their justification in the literature, the introduction of larger distances may seem controversial. In this study, it was decided to introduce the baseline values of 750 and 1000 meters due to the night of the operations. It should be assumed that potential customers are willing to overcome the greater distance to the nearest bus stop, the first in the absence of alternatives in other means of transport, and secondly in connection with the organization of night transport which, thanks to point with stops allows at one change access to any place covered by the night transport. The third argument, which may be a reason to increase the area of research is the sense of security when moving around the city at night. It must be assumed that the bus trip gives the feeling more comfortable ride than to defeat the walking distance. Thus, it was assumed that residents would be willing to use public transport than to walk the stretch, even if the day would be inclined to do. It is extremely important in this regard the deployment of the night stops of public transport and the main generators of night traffic.

In terms of the availability of temporary residents of the city to the point of interchange through the night adopted local public transport travel times of buses between the stops according to the timetable of the carrier. Then, as shown by prior methodology counted potential passengers, who reside in the equidistant from the bus stop assigned time directions to interchange.

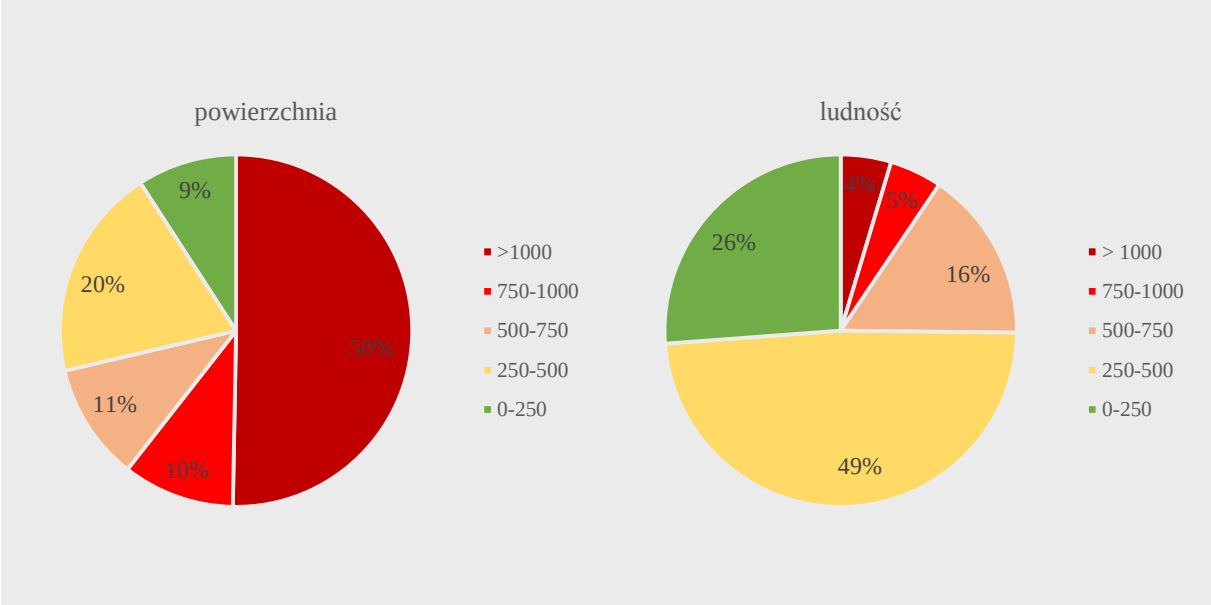
Results and discussion

Application of submitted conduct research made it possible to determine the spatial diversity pedestrian accessibility to night public transport stops (Fig. 2). A rough analysis of the considered arrangement makes stops of night transport as highly satisfactory, since the area bounded with equidistants covers half of the area around the city.



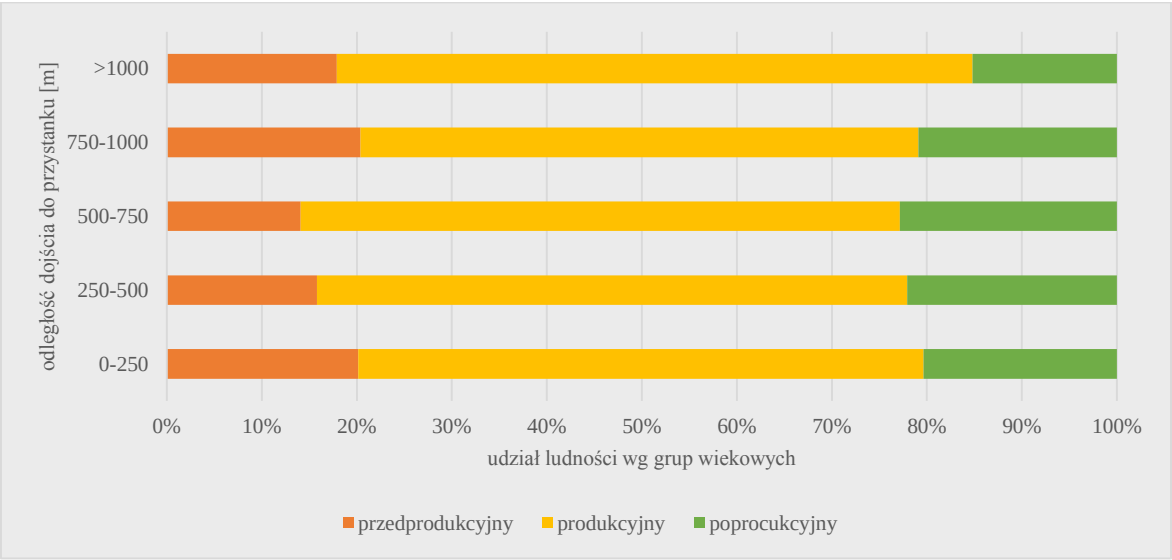
2. Pedastrian availability to bus stops of night transport in Łódź, *Source: own work*

However, almost half of the area are the areas from which prospective passengers would be forced to beat from 500 to 1000 m (Fig. 3). The efficiency of public transport should apply, however, to the distribution of the population. In this respect, the situation is even more positive. Three out of four Łodźians to use night public transport does not have to overcome on foot more than 500 m (Fig. 3). However, such considerations make sense only in the case of transport organization in which there is a transfer point, which meet all the lines and waiting time of vehicles allows you to change trains. In other cases, the availability of public transport evaluated due to the availability of the stop post is highly theoretical. It does not account for where the passenger can be reached from the bus stop and to what extent this corresponds to the needs of even the theoretical transport residents.



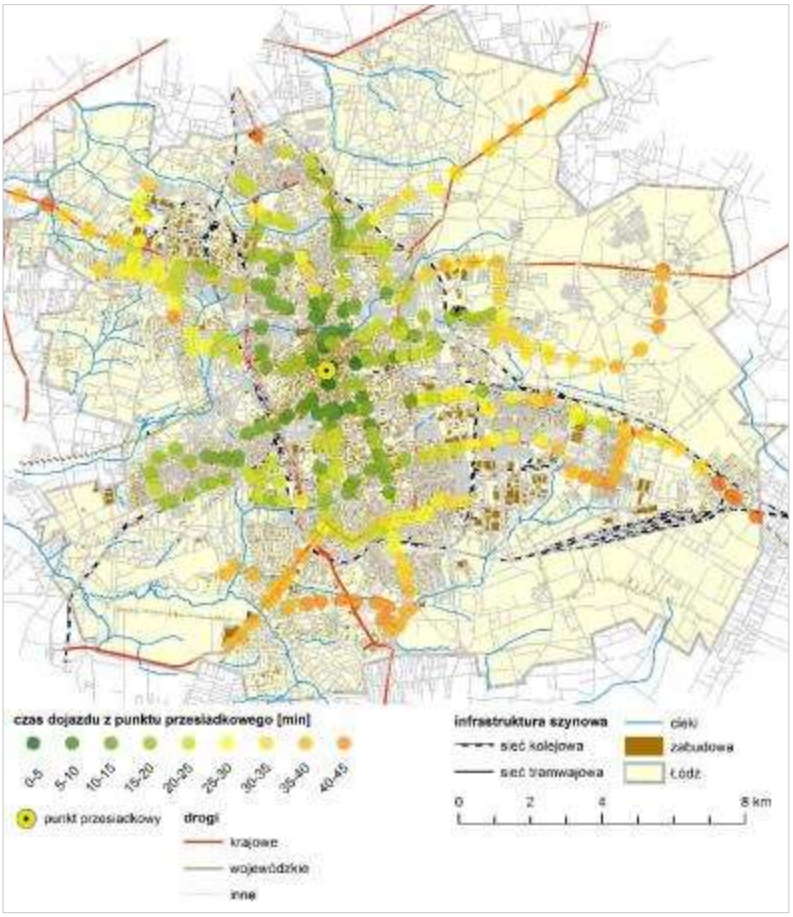
3. Share of area and Łódź population in each equidistant pedestrian access to stops of night public transport, *Source: own work*

The age structure of the population living in areas designated by equidistant stops reaching does not differ significantly from the structure characteristic of the entire city where the population in pre-working age is 14%, in age 64% and 22% of post-production. Assuming that night rides residents of the city on weekdays are primarily associated with commuting to work and at the weekends come to them commuting to the places of entertainment social events, this age group, which far outweighs in crossings are people of working age (Fig. 4.).



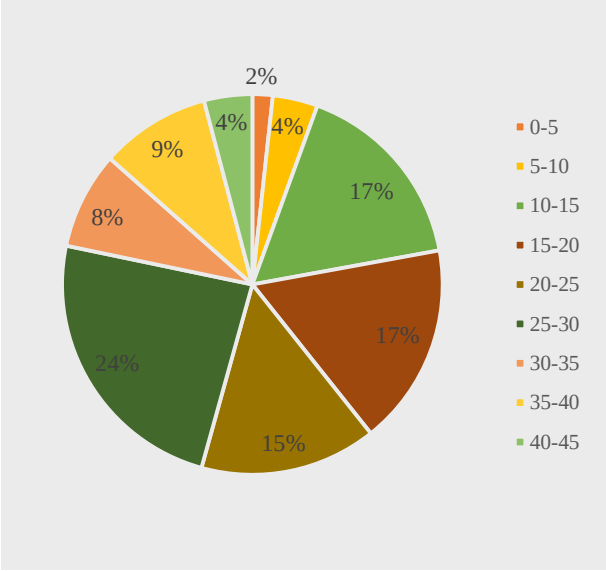
4. The share of the population of Łódź by age group in each equidistant pedestrian access to stops of night public transport, *Source: own work*

Examination of the functioning of the night transport in terms of connection speeds offered by its lines shows that the journey starting from the point of interchange passengers will not have to spend no more than 40-45 minutes to reach the most remote stops (Fig. 5.).



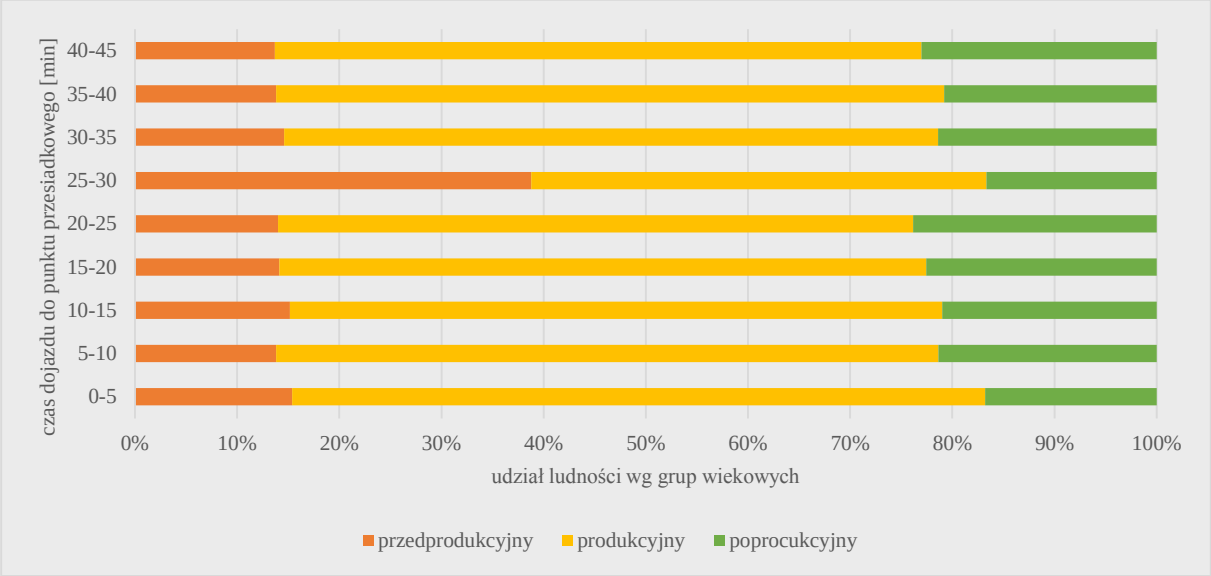
5. Time availability point of interchange of night public transport in Łódź, *Source: own work*

Assuming that a potential passenger decides to complete the journey begun at the point of transfer to the bus stop that is closest to his place of residence, that almost every fourth resident of Łodź (which stop is not more than 1 km) will travel no more than 15 minutes (Fig. 6 .). A half-hour bus ride however allows to reach the dwelling place almost 80% of the inhabitants of Lodź.



6. Share of the population of Łódź in particular access isochrone the night public transport from the point of interchange, *Source: own work*

Analysis of the age of the population covered by each directions isochrones from the point of interchange in the vast majority of directly refers to the age structure of the inhabitants of Łodź (Fig. 7). Clearly differs from this regularity, this group of the population that the trip needs to spend between 25 and 30 minutes. It is a very large group of residents because their situation should be particularly important for managers of local transport. It would be advisable to carry out detailed research on those sections of the journey of night buses.



7. Share of Łodź population duw to age group in particular access isochrone the night public transport from the point of interchange, *Source: own work*

Conlusions

Considering examined in the study characteristics of the night local urban transport, its function should be considered as effective. When exposed to seven lines and is less than 600 stops buses can handle 75% of the population of the city at generally acceptable distance to come to the bus stop (500 m). In addition, 80% of the population of the city (with the accepted distance limit to come to the bus stop) is able in one hour to drive through almost the whole city together with passing through a transfer point. It should of course be borne in mind that the results presented assume that the potential passengers would be willing to change the bus at the point of transfer. High efficiency designed so the system seems to justify the planned network of interchanges in the new model of public transport of Łodź [8]. It assumes that the individual bus and tram lines "will meet" in the interchanges with different levels of importance - from local to regional scale located in different parts of the city. Flowing from the operation of night transport applications should provide for designers daily system important guidelines, because as far as implementation of the hub has a certain universal stages and characteristics, each city in which it is to be introduced has its unique characteristics as for example: distribution of demographic potential, which transportation solutions also make unique. The research initiated in this article should be continued, taking into account the results of the in situ inspection of tickets. Currently on sale are tickets and electronic controllers and readers have to collect the information about checked tickets. These data complement and at the same time verified the results obtained in the work.

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