

THE USE OF FORMAL CONCEPT ANALYSIS IN EVALUATION OF THE RELATIONSHIP BETWEEN THE ENVIRONMENT AND PHYSICAL ACTIVITY OF THE RESIDENTS IN CZECH REGIONAL CITIES

**Erik Sigmund, Josef Mitáš, Dagmar Sigmundová, Karel Frömel, Svatopluk Horák,
Jiří Zaccpal¹, Jiří Nykodým², Zdeněk Šebrle³, Emil Řepka³, Dana Feltlová⁴,
Aleš Suchomel⁵, Oldřich Mičan⁶, Tomáš Klobouk⁷, Marie Lukavská⁷, Ladislav Bláha⁸**

Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic

¹*Faculty of Science, Palacký University, Olomouc, Czech Republic*

²*Faculty of Sports Studies, Masaryk University, Brno, Czech Republic*

³*Pedagogical Faculty, University of South Bohemia, České Budějovice, Czech Republic*

⁴*Pedagogical Faculty, University of Hradec Králové, Hradec Králové, Czech Republic*

⁵*Pedagogical Faculty, Technical University of Liberec, Liberec, Czech Republic*

⁶*Pedagogical Faculty, University of Ostrava, Ostrava, Czech Republic*

⁷*Pedagogical Faculty, University of West Bohemia, Plzeň, Czech Republic*

⁸*Pedagogical Faculty, University of J. E. Purkyně, Ústí nad Labem, Czech Republic*

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Current trends in research promote an interdisciplinary approach to the description of real conditions in the most precise way, which means a variety of variables enter into analysis. Therefore, accurate statistical analysis must be carried out. The aim of the study was to identify variables that indicate the presence of an environment conducive to physical activity in neighborhoods where a random sample of 15–65 year old inhabitants living in regional towns was taken (Brno, České Budějovice, Hradec Králové, Liberec, Olomouc, Ostrava, Plzeň and Ústí nad Labem) using the method of Formal Concept Analysis (FCA).

Environmental characteristics of neighborhoods and demographic data of respondents (384 females and 278 males) were obtained using the ANEWS questionnaire in Spring and Autumn of 2007. Respondents were asked to wear the pedometer Yamax SW 701 at the same time, to objectively monitor their week long physical activity (PA). Formal concept analysis is a method of exploratory data analysis that aims at the extraction of natural clusters from object attribute data tables.

An increase in the number of steps per day is significantly ($\geq 10\%$) influenced by the following neighborhood characteristics – streets highly suitable for walking, a pleasant neighborhood, access to facilities and services and participation in an organized PA (≥ 2 times a week). In males increased steps were further influenced by the number of nonsmokers in their category and the number of respondents who were not obese.

An environment conducive to physical activity in neighborhoods of the Czech regional towns (according to the number of steps per day) can be described as having accessible facilities and services, an absence of cul-de-sacs, with walkable streets that are clean and having trees along the roads.

Keywords: ANEWS questionnaire, walking, number of steps, formal concept, formal concept lattice, characteristic attribute.

INTRODUCTION

To obtain the best description of phenomena in their natural environment requires identifying the number of objective and subjective variables, both quantitative and qualitative. Among the phenomena that kinanthropology aims to describe is an environment conducive to physical activity in regional cities, the populations of which accounts for 24.5% of the Czech Republic's overall population (Český statistický úřad/Czech National

Statistics Office, 2007). Everyday walking and other types of physical activity are a proven prevention strategy against civilization diseases and are predictors of longevity and a physically active lifestyle (Miles, 2007). Therefore, when planning, constructing and reconstructing urban areas, aspects associated with walking and cycling should be considered – service accessibility, walkability of streets, the absence of cul-de-sacs, adequate width of sidewalks, barrier free pavements and paths and their safety and cleanness (Frank et al., 2005; Saelens et al.,

2003). GIS analyses provide a geographic description of the environment, identify detailed indicators of particular locations and enable us to create models for different uses of the given environment. Such models are, however, only technical and do not have to correspond with the subjective perceptions of the environment by the inhabitants (Leslie et al., 2005).

The subjective descriptions are mediated, e.g., by surveys. An example of a comprehensive survey assessing the environment of cities is the "Neighborhood Environment Walkability Scale" involving a wide scope of questions: D) types of residence in your neighborhood, E) stores and other facilities in your neighborhood, F) access to services, G) streets in my neighborhood, H) places for walking and cycling, I) neighborhood surroundings and J) neighborhood safety. The answers to the questions in the clusters F)–J) are scored as follows: 1 – strongly disagree, 2 – somewhat disagree, 3 – somewhat agree, 4 – strongly agree. In order to obtain the total score for the clusters of questions F) to J), it is recommended to calculate the arithmetic mean of points for individual questions – factor scoring for the Neighborhood Environment Walkability Scale (NEWS), Scoring for the Neighborhood Environment Walkability Scale – Abbreviated (ANEWS), which we do not consider to be appropriate. For example, the arithmetic mean in the interval 2.3 to 2.7 expresses "something between" somewhat disagree and somewhat agree. Moreover, some questions in some clusters are mutually conditioned: H1) there are sidewalks on most of the streets in my neighborhood and H2) sidewalks are separated from the road/traffic in my neighborhood by parked cars. The answer "completely disagree" to question H1) automatically implies the answer "completely disagree" to question H2. Here the condition of the logically correct use of the arithmetic mean is broken. Therefore, we aimed at finding a different way of how to calculate and express the total scores for the particular clusters of questions of the ANEWS questionnaire.

Formal conceptual analysis (FCA) seems a possible means by which to analyze data. FCA is a mathematical method to identify interesting clusters of objects from a matrix of data having the characteristics of the analyzed objects. The matrix of data is called formal context.

The formal context (X, Y, I) involves two sets X and Y and a relation I between the X and Y sets. The element of the X set is called an object and the element of the Y set is called an attribute. xIy or $(x, y) \in I$ is interpreted as "the object x has the attribute (characteristic) y ". For the set of objects $A \subseteq X$ we define:

$A^\uparrow = \{y \in Y \mid xIy \text{ for all } x \in A\}$ (the set of attributes, which the objects from A have). Similarly, for the set of attributes B , we define: $B^\downarrow = \{x \in X \mid xIy \text{ for all } y \in B\}$ (the set of all objects, which have attributes from B).

On the basis of these two operations, we can define the formal concept. The formal concept from the con-

text (X, Y, I) is the pair (A, B) , where $A \subseteq X$, $B \subseteq Y$, $A^\uparrow = B$ a $B^\downarrow = A$. The set A is called the extent and the set B is called the intent of the concept (A, B) . $B(X, Y, I)$ is to denote the set of all concepts from the context (X, Y, I) . The set $B(X, Y, I)$ forms a cluster according to the basic theorem of conceptual clusters. A partial arrangement of the elements in the cluster can be used to browse the cluster.

The majority of objects in everyday life show multi value characteristics. In a person, such kinds of characteristics are, e.g. age or height. Using classical logic, these characteristics can hardly be described, because we operate with only two values – 1 and 0; expressing true or not true values. Fuzzy logic is a possible means of how to describe such characteristics.

The result is formally fuzzy conceptual analysis. We present a not empty set of objects X and a not empty set of attributes Y . We select a structure L of true values (L is in the form of a complete residual cluster). L provides a suitable scale of true values with their structure. Using L we assess the statement that "object x has the attribute y ". We consider a binary fuzzy relation I between X and Y . $I(x, y)$ is interpreted as a level of truthfulness of the fact that object $x \in X$ has the attribute $y \in Y$. Fuzzy context (or L context) is then a triple $\langle X, Y, I \rangle$. Here we also define representation $\hat{\cdot}: L^X \rightarrow L^Y$ a $\cdot^\downarrow: L^Y \rightarrow L^X$

$$A^\uparrow(y) = \bigwedge_{x \in X} A(x) \rightarrow I(x, y)$$

$$B^\downarrow(x) = \bigwedge_{y \in Y} B(y) \rightarrow I(x, y)$$

Using them we define a fuzzy concept from the context $\langle X, Y, I \rangle$ which is the pair $\langle A, B \rangle$, where $A \in L^X$ and $B \in L^Y$ are such that:

$$A^\uparrow = B \text{ a } B^\downarrow = A.$$

We denote $B(X, Y, I)$ a set of all fuzzy concepts from the context (X, Y, I) . The set $B(X, Y, I)$ forms a cluster according to the theorem of conceptual clusters.

In Kinanthropology, the method of Formal Conceptual Analysis was first applied in processing the data of physical activity levels in the population of the Czech Republic obtained using the IPAQ questionnaire (Sigmund et al., 2007; 2008).

AIM

The main aim of the study was to identify variables pointing out the physical activity friendliness of the environment and to what extent it was stimulating to activity in a random sample of 15–65 year old inhabitants of the cities of Brno, České Budějovice, Hradec Králové,

Liberec, Olomouc, Ostrava, Plzeň and Ústí nad Labem using the method of formal conceptual analysis.

METHODS

Participants

Monitoring of the environment in the cities, demographic characteristics of the inhabitants and their weekly PA was started in the random sample of 1652 inhabitants of the cities of Brno, České Budějovice, Hradec Králové, Liberec, Olomouc, Ostrava, Plzeň and Ústí nad Labem. Out of the total number of participants, 67% ($n = 1107$) completed the ANEWS questionnaire and weekly physical activity monitoring using Yamax SW 701 pedometers. Of these questionnaires or recording sheets, 13.4% ($n = 221$) were incomplete or inaccurate. These were not included in the analysis. Out of the total of 886 of fully and correctly completed ANEWS questionnaires and recording sheets, 384 women and 278 men, according to decades of age, were randomly selected for the analysis of the environment in cities and PA levels.

ANEWS questionnaire

The ANEWS questionnaire (Neighborhood Environment Walkability Scale – Abbreviated <http://www.ipen-project.org/surveyanews.htm>) includes 54 questions on the environment of neighborhoods, which are divided into several categories: D) types of residences in your neighborhood, E) stores, facilities, and other things in your neighborhood, F) access to services, G) streets in my neighborhood, H) places for walking and cycling, I) neighborhood surroundings and J) neighborhood safety. The answers to individual questions in category D) are scored as: 1 – none, 2 – a few, 3 – some, 4 – most, 5 – all. All 23 questions in the E) category can be answered as: 1 – 1–5 min., 2 – 6–10 min., 3 – 11–20 min., 4 – 20–30 min., 5 – ≥ 30 min. and the possibility, “I don’t know”. Categories F) to J) are scored as follows: 1 – strongly disagree, 2 – somewhat disagree, 3 – somewhat agree, 4 – strongly agree.

Pedometer Yamax SW 701

Along with the ANEWS questionnaire, each participant received a Yamax SW 701 pedometer and a recording sheet to record their individual characteristics (weight, height, age and sex) and daily number of steps. The Yamax Digiwalker SW 200 (Yamax Corporation, Japan) is a light (20 g) and small commercial electronic pedometer that measures vertical oscillations. (Schneider, Crouter, & Bassett, 2004). Yamax uses a spring suspended lever that moves in response to the hip’s vertical

oscillations. The movement opens and closes an electrical circuit, and each vertical oscillation detected above a critical threshold (0.35 g) is registered as a step taken (Tudor-Locke et al., 2002). Total numbers of counted steps are displayed on a small screen.

In general, pedometers are most accurate in counting steps, less accurate in calculating distance, and least accurate at estimating energy expenditure (Crouter et al., 2003). Because steps are the most direct expression of what the pedometer actually measures, Tudor-Locke and Myers (2001) recommend reporting pedometer data as STEPS.

Formal Conceptual Analysis

From the perspective of FCA the group of respondents can be understood as a set of objects and individual questions as attributes. The respondents answers then, create a binary relation between the set of objects and the attributes. The answers do not have to be necessarily bivalent (yes–no). Multiple value types of answers (age, number of steps,) can appear here. Due to this, a suitable scale needs to be applied to transfer the multiple value type of answers into bivalent forms. The result of this process is a context $\langle X, Y, I \rangle$, where X is the set of objects – respondents, Y is the set of attributes – adjusted answers from the questionnaire and I is the binary relation between X and Y , where $\langle x, y \rangle \in I$ means that respondent x answered yes to question y .

Another adjustment of the questionnaire is based on the idea that some questions are closely related. We consider it more useful to group attributes which resulted from the scaling of the questions into one attribute. Thus we would obtain a more comprehensive view of the questionnaire. This idea made us create so called “aggregate attributes”.

Firstly, an expert needs to decide which questions can be grouped into an “aggregate attribute”. Then, we replace all the attributes which were formed through scaling with “aggregate attributes” using the following procedure. We calculate the weighted mean of individual attributes and we scale this mean. Formally there is number n of questions in the questionnaire which we want to cluster into the “aggregate attributes”. Through scaling of these questions, $\sum_{i=1}^n m_i$ of attributes was created, where m_i is the number of attributes which was formed through scaling of the i question. The weighted mean for the object x , is calculated according to the formula:

$$v(x) = \sum_{i=1}^n \sigma_i \sum_{j=1}^{m_i} \omega_{ij} I(x, a_{ij}) .$$

σ_i is the weight of question i , ω_{ij} is the weight of attribute j which was formed through the scaling of question i , a_{ij} is an attribute which was formed through the scal-

ing of question $i, j \in m_i$, value $v(x) \in \langle 0, 1 \rangle$. We create 5 aggregate attributes according to these rules:

- $\langle x, \text{very low} \rangle \in I_1$ iff $a(x) \in \langle 0; 0.2 \rangle$,
- $\langle x, \text{low} \rangle \in I_1$ iff $a(x) \in (0.2; 0.4 \rangle$,
- $\langle x, \text{moderate} \rangle \in I_1$ iff $a(x) \in (0.4; 0.6 \rangle$,
- $\langle x, \text{high} \rangle \in I_1$ iff $a(x) \in (0.6; 0.8 \rangle$,
- $\langle x, \text{very high} \rangle \in I_1$ iff $a(x) \in (0.8; 1 \rangle$.

Using these aggregate attributes, we replace all the grouped attributes. In this way, a formal context $\langle X, Y, I_1 \rangle$ is created, where Y_1 is the original set of attributes from which we remove all the attributes which we have grouped into aggregate attributes and then we add the aggregate attributes into it: $\langle x, y \rangle \in I_1$ if y is not an aggregate attribute and for aggregate attributes the above rules are applied.

Example 1

For better understanding we provide an example. There are questions (G1–G3) in the questionnaire which concern streets in my neighborhood. The expert states the values in individual weights: $\sigma G1 = 0.4$, $\sigma G2 = 0.4$ and $\sigma G3 = 0.2$. To all questions, the respondents could choose from among these answers: 1 – strongly disagree, 2 – somewhat disagree, 3 – somewhat agree, 4 – strongly agree. The value of weights ω_{ij} is stated in TABLE 1.

They created 5 “aggregate attributes”: street – very low, street – low, street – moderate, street – high, street – very high (the classification of streets depending on their suitability for walking). If respondent x answers the questions this way: G1 – 3, G2 – 1, G3 – 2, will be $v(x) = 0.4 \times 0.75 + 0.4 \times 0.5 + 0.2 \times 0.5 = 0.6$ and then $\langle x, \text{street moderate} \rangle \in I_1$.

Typically, such a formal context contains many objects and a manageable number of attributes. The corresponding concept lattice is too large for an expert to comprehend. In addition, the expert might not be interested in the formal concepts from this concept lattice. Rather, the expert might want to consider aggregates of the individual respondents as objects in the formal context with the aggregates defined by having the same attributes on a set S of attributes specified by an expert, such as those regarding age, sex, etc., with S being a subset of the set Y of all attributes. Attributes from S will

be called characteristic attributes. The aggregates we consider are equivalence classes of individual respondents. For respondents $x_1, x_2 \in X$, we put $x_1 \equiv_S x_2$ if and only if $\{x_1\}^\uparrow \cap S = \{x_2\}^\uparrow \cap S$.

Clearly, $\equiv_S$ is an equivalence relationship of X and $x_1 \equiv_S x_2$ means that x_1 and x_2 have the same attributes from S , i.e. are indistinguishable from the attributes of S . We call the classes $[x]_{\equiv_S}$ of $\equiv_S$ aggregate objects and denote, furthermore by X_1 the set of all classes of $\equiv_S$, i.e. $X_1 = X / \equiv_S$, by Y_2 , including the set of those attributes from Y_1 not included in S , i.e. $Y_2 = Y_1 - S$. Now, for each class $[x]_{\equiv_S}$ from X_1 and each attribute $y \in Y_2$, we consider the relative frequency of objects in having attribute y and denote it by $I_2([x]_{\equiv_S}, y)$ or simply by $I_2(x, y)$. That is, we put down:

$$I_2(x, y) = \frac{|\{x_1 \in [x]_{\equiv_S} : x_1 \text{ has } y\}|}{|[x]_{\equiv_S}|}.$$

We can consider I_2 a fuzzy relation which will indeed be the case in this study. Namely, we will consider a particular concept lattice associated to $\langle X_1, Y_2, I_2 \rangle$, called a lattice of crisply generated fuzzy concepts. For technical reasons, we round up the degrees assigned by I_1 to those from the scale $(0; 0.01; \dots; 0.99; 1)$. More details on this method are described in the article (Bělohlávek et al., 2007).

For such a formal fuzzy context $\langle X_1, Y_2, I_2 \rangle$ we can calculate a fuzzy conceptual cluster. We base it on the following study Bělohlávek (2002). The conceptual cluster obtained in this way $B(X_1, Y_2, I_2)$ is already suitable for analysis.

RESULTS

The ANEWS questionnaire (Neighborhood Environment Walkability Scale – Abbreviated) includes 54 questions in total. They were answered by 662 respondents. Using the method described above, we created 8 aggregate attributes, from which we created 40 attributes using scaling (8×5) . Next to these attributes, the context involves other attributes of demographic data: sex

TABLE 1

Weights ω_{ij} from example 1

Questions	Answers			
	1	2	3	4
G1 – absence of cul-de-sac (dead end streets)	0.25	0.5	0.75	1
G2 – short distance between intersections (100 yards or less)	0.25	0.5	0.75	1
G3 – alternative routes for getting from place to place	0.25	0.5	0.75	1

(2 attributes – females, male), BMI – Body Mass Index (4 – lower body weight, normal body weight, overweight and obesity), age (5 – aged 15–29, aged 30–39, aged 40–49, aged 50–59, aged 60–65), smoking (2 – smoker, nonsmoker), driver (2 – has, does not have a driving license), participation in organized physical activity (4 – none, 1 per week, 2–3 per week, more than 3 per week), steps (TABLE 2).

TABLE 2

Scale for value steps

Attribute	Number of steps per week
Steps low	4000–6999
Steps moderate	7000–9999
Steps high	10000–12999
Steps very high	13000–15999

Thus we obtained a formal context which includes 662 objects and 65 attributes. For another adjustment of formal context, aggregate objects are applied. We used sex – male, sex – female and steps (steps – low, steps – moderate, steps – high a steps – very high) as characteristic attributes. The obtained formal fuzzy context includes 8 objects and 59 attributes. Using it, we created a corresponding fuzzy conceptual cluster.

When studying the cluster, we tried to examine what influence the environment (characterized by aggregate attributes) has on the number of steps in respondents.

We studied males and females separately. TABLE 3 shows the corresponding concepts for male and TABLE 4 for female. We state only the aggregate attributes at the levels of very high (VH) and high (H). It is also possible to compare the other levels (moderate, low and very low), but we were interested mainly in the positive influence of the environment on steps.

The levels of correspondence in TABLE 3 express a minimal number of respondents in percentage, which show the given attribute. In bold, the most apparent differences between groups of men or women with a low number of steps vs. a high number of steps are presented. Fig. 1 and 2 show variables (attributes) with more than a 10% increase in the groups of men (Fig. 1) and women (Fig. 2) categorized according to the daily number of steps. Fig. 1 and 2 also show the increase of selected individual characteristics of respondents. In both the groups of men and women, we have indentified the highest increase in the attributes F) walking accessibility of services and shops, G) types of streets, and I) neighborhood surroundings; all in the levels high and very high. Out of the individual characteristics of respondents, which are associated with the increasing number of steps per day, are participation in organized physical activity (2 and more times a week) and in the group of men, moreover normal weight and nonsmoking also play a role (Fig. 1 and 2).

The category of questions G) on types of streets in the neighborhood is related to a higher number of steps

TABLE 3

Comparison of concepts of females and males

Intent	level	Gender – male, steps				Gender – female, steps			
		{low}	{moderate}	{high}	{very high}	{low}	{moderate}	{high}	{very high}
D type of resid. apartment	VH	0	0	0	0	0	0	0	0
	H	0.23	0.22	0.20	0.18	0.10	0.19	0.16	0.19
D type of resid. house	VH	0	0.05	0.02	0.05	0	0.03	0.07	0.05
	H	0.46	0.34	0.35	0.42	0.52	0.37	0.37	0.34
E distance of stores and services	VH	0.08	0.04	0.03	0.01	0.10	0.06	0.05	0.03
	H	0.15	0.19	0.18	0.26	0.21	0.39	0.24	0.26
F access to stores and services	VH	0.40	0.52	0.54	0.53	0.42	0.48	0.51	0.57
	H	0.38	0.37	0.35	0.39	0.47	0.39	0.37	0.30
G type of streets	VH	0.38	0.39	0.53	0.57	0.36	0.34	0.51	0.48
	H	0.46	0.41	0.31	0.26	0.42	0.43	0.33	0.35
H places for walking/cycling	VH	0.15	0.23	0.15	0.24	0.26	0.29	0.26	0.21
	H	0.76	0.43	0.63	0.45	0.57	0.41	0.48	0.56
I neighborhood surroundings	VH	0.08	0.09	0.08	0.14	0.05	0.08	0.11	0.09
	H	0.23	0.28	0.32	0.28	0.10	0.31	0.26	0.33
J neighborhood safety	VH	0.53	0.38	0.49	0.53	0.52	0.44	0.55	0.47
	H	0.46	0.37	0.35	0.39	0.36	0.45	0.34	0.45

(>10000), therefore we focused more on individual questions in this category. The category G) includes the following questions: G1) – the streets in my neighborhood **do not** have many cul-de-sacs (dead end streets). G2) – the distance between intersections in my neighborhood is usually short (less than 100 meters). G3) – there are many alternative routes for getting from place to place in my neighborhood. (I don't have to go the same way every

time.) Using FCA, we have expressed in % representation of positive answers (strongly agree) to questions G1) to G3) in groups of men and women. Fig. 3 shows that mainly the absence of cul-de-sacs in the neighborhoods and the possibility to choose alternative routes in getting from place to place support daily physical activity in the inhabitants of the regional cities.

Fig. 1

Variables with the most apparent increase ($\geq 10\%$) of representation in groups of men classified according to daily number of steps

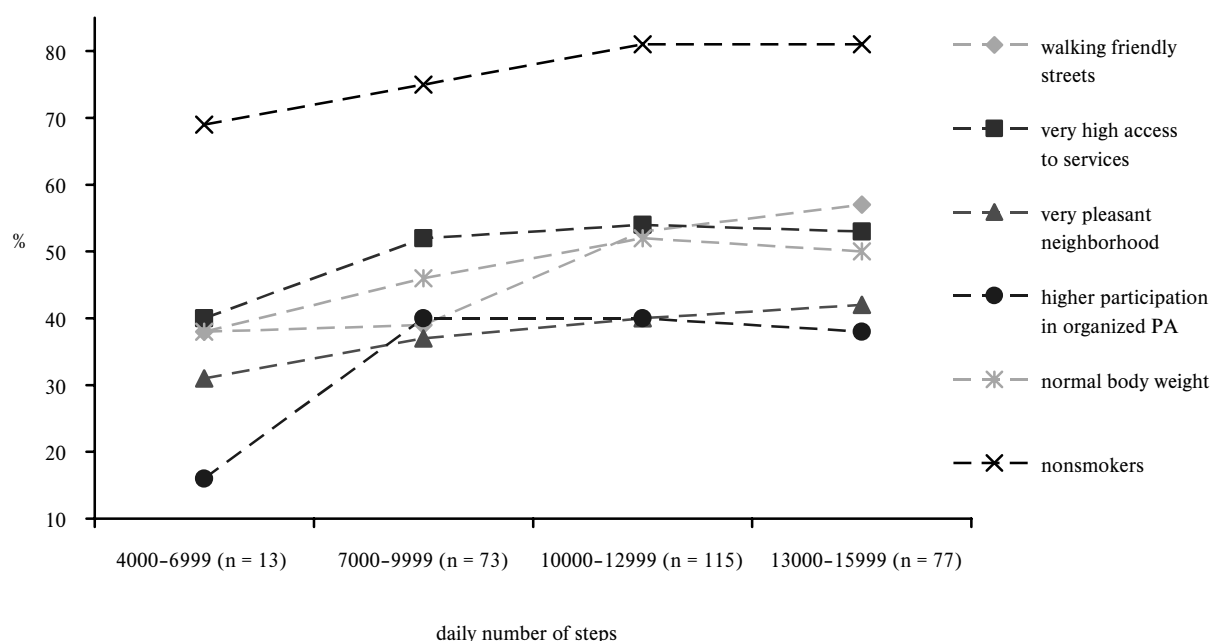


Fig. 2

Variables with the most apparent increase ($\geq 10\%$) of representation in groups of women classified according to daily number of steps

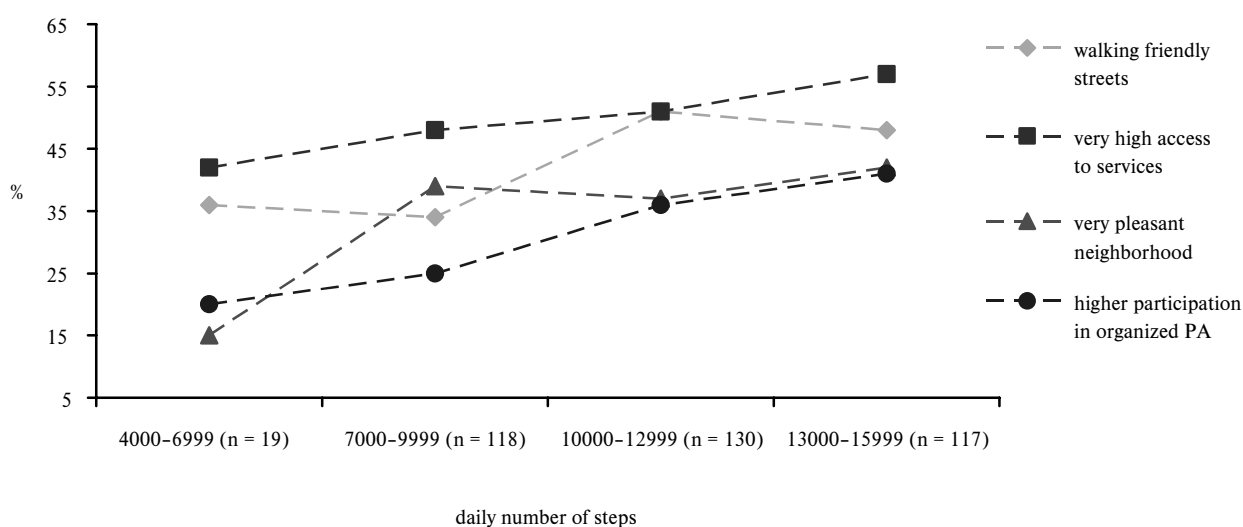
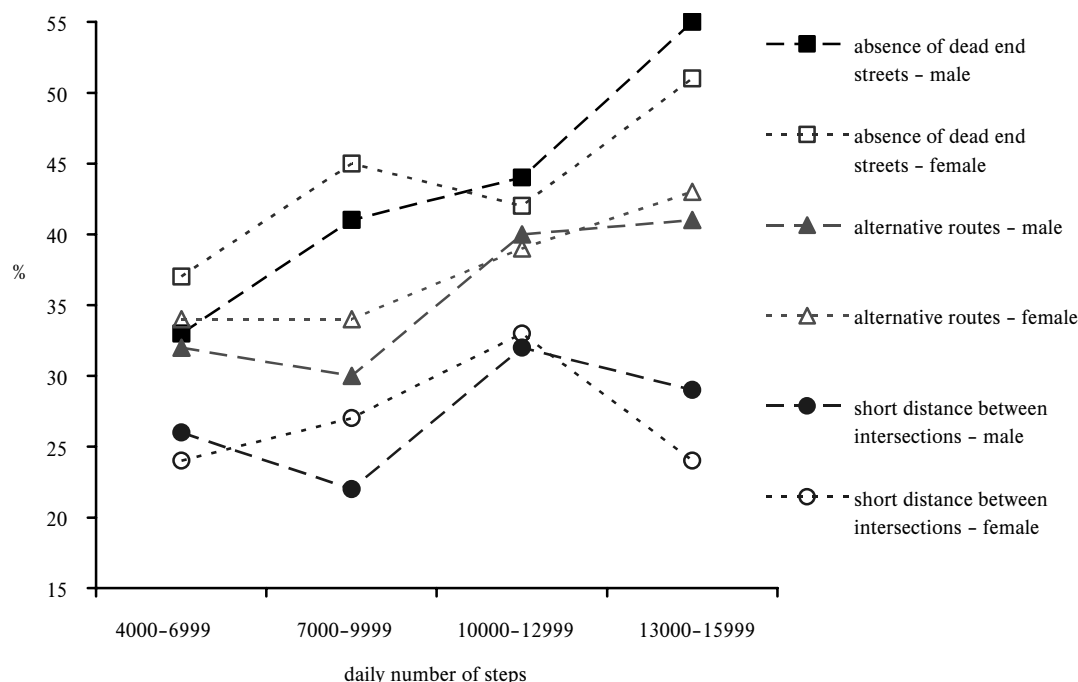


Fig. 3

Types of streets in neighborhoods of men and women according to the daily number of steps



DISCUSSION

The main aim of the study was to identify variables pointing out physical activity friendly and stimulating environments in a random sample of 15–65 year old inhabitants of selected cities in the Czech Republic using the method of Formal Conceptual Analysis. The answers of the respondents in the random sample of the 15–65 year old population to the questions in the ANEWS questionnaire and their physical activity levels provide a sufficient base in order to identify common attributes related to a walking and cycling friendly environment in Czech cities. The tools involved in the Formal Conceptual Analysis (“aggregate attribute”, “characteristic attribute”, “true value”, “weight of the answer”) allow more views of the data; especially, in the case of non metric data (nominal and ordinal data) that require non parametric tests. The FCA, however, emphasizes the expert evaluation, e.g. weights, when scoring individual questions in the same category or the choice of the limit values of the intervals of aggregate attributes.

FCA is a mathematical method to identify interesting clusters of objects in a matrix of data which are formed by objects and by the characteristics of the analyzed objects. The matrix of data (formal context) is formed by the objects, attributes (the characteristics of the objects) and by their relations, which state whether a given object has a given attribute. In the classical FCA approach, the relation is bivalent (the object either has

the given attribute or not) and is thus formed only from 0 or 1. Yet generally, we work with multi value or continuous characteristics (height, number of steps per day, age, etc.). “Classical logic”, operating only with 0 = not true and 1 = true values, can hardly provide sufficient description of these data. In order to describe such characteristics, we apply fuzzy logic.

The procedure of calculating a fuzzy conceptual cluster is very complex (formal context – formal fuzzy context – formal fuzzy conceptual cluster) but it should lead to the most accurate description of phenomena and their interpretation. In our study, we use 101 true values (0; 0.01; ...; 0.99; 1), which we can interpret as the minimal number of respondents in percentage who have a given attribute or a combination of attributes. Mathematical formulation in percentage is comprehensible to a non expert public, too.

Where there is at least a 10% difference in the characteristics of the environment in groups of men and women categorized according to their number of steps per day (Fig. 1–3), this is considered to be logically significant. The choice of the limits was based on the common variability of the answers ($\pm 4\%$) between equivalent forms of the Czech version of the IPAQ questionnaire and the FCA method for its evaluation (Sigmund et al., 2007). Similarly to other studies using the NEWS questionnaire (Leslie et al., 2005; Saelens et al., 2003) and GIS analysis of the environment (Frank et al., 2005), we have confirmed the hypothesis that a walking friendly environment enhances a higher (longer and more fre-

quent) level of walking and other physical activities. A walking friendly environment is represented by street connectivity, the absence of cul-de-sacs, a combination of commercial and residential areas, esthetics (clean streets, trees, etc.) and by safety. Unlike international studies, all the groups of respondents in our study perceived their neighborhood as being safe or very safe regardless of the categories of the number of steps per day. We need to, however, ask whether the perception of highly safe neighborhoods is not already changing, e.g. with the increasing number of cars and traffic which brings ever more noise and air pollution.

The novelty of this study is represented by the joint use of the "objective" measure of physical activity and the "subjective" assessment of the neighborhoods by the inhabitants. Monitoring was carried out during the "walking and cycling friendly periods" of Spring and Autumn over a usual working week. However, the generalization of the results to all Czech cities would be more profound if other large cities such as Prague, Jihlava, Karlovy Vary, Pardubice, and Zlín had been included in the study. Not having the full range of large cities included in the study can be seen as one of the limits of the study.

CONCLUSION

On the use of the Formal Conceptual Analysis

FCA provides useful tools to describe the relationship between physical activity and the environment in neighborhoods from the kinanthropological perspective. There is a strong emphasis on the expert choice of the limit values of the intervals of aggregate attributes or weights assessment when scoring the individual questions.

On the relationship between the environment in cities and physical activity

Based on the results obtained from the ANEWS questionnaire and the number of steps per day, a physical activity friendly/stimulating environment in Czech cities can be described as having good accessibility to services, highly walkable streets (connectivity, cleanliness, the absence of cul-de-sacs) and the nice esthetics of neighborhoods. The factor of participation in regular physical activity is closely associated with the availability of services.

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POUŽITÍ FORMÁLNÍ KONCEPTUÁLNÍ ANALÝZY PŘI HODNOCENÍ VZTAHŮ MEZI PROSTŘEDÍM VYBRANÝCH METROPOLÍ ČESKÉ REPUBLIKY A POHYBOVOU AKTIVITOU JEJICH OBYVATEL (Souhrn anglického textu)

Současným trendem co nejvěrnějšího popisu reálných jevů je interdisciplinární přístup, který s sebou přináší velké množství analyzovaných proměnných. Důraz je proto kladen na přesné statistické zpracování a co nejvýstižnější interpretaci tak velkého množství různorodých dat. Cílem studie je najít proměnné poukazující na pohybově přátelské a stimulující prostředí metropolí u randomizovaného souboru 15–65letých obyvatel Brna, Českých Budějovic, Hradce Králové, Liberce, Olomouce, Ostravy, Plzně a Ústí nad Labem pomocí metody formální konceptuální analýzy (FCA).

Charakteristiky prostředí metropolí a demografické údaje jejich náhodně vybraných obyvatel (384 žen a 278 mužů) byly mapovány dotazníkem ANEWS v průběhu jara a podzimu roku 2007. Současně s aplikací ANEWS dotazníku byla pomocí pedometru Yamax SW 701 monitorována týdenní pohybová aktivita (PA) zúčastněných obyvatel. FCA je matematickou metodou hledání zajímavých shluků objektů z matice dat o vlastnostech analyzovaných objektů.

S rostoucím denním počtem kroků z Yamaxu se u žen i mužů významně zvyšují ($\geq 10\%$) následující charakteristiky prostředí – chodecky vysoce příznivé

ulice, velmi příjemné okolí bydliště a chůzí dostupné služby a faktor účasti v organizované PA (≥ 2 krát týdně). U skupiny mužů navíc i procentuální zastoupení nekuřáků a neobézních jedinců. Pohybově přátelské a stimulující prostředí našich metropolí lze, vzhledem k dennímu počtu kroků, charakterizovat blízkou dostupností služeb, absencí slepých ulic, pěší průchodností ulic, jejich čistotou a osázením stromy.

Klíčová slova: ANEWS dotazník, chůze, počet kroků, formální koncept, formální konceptuální svaz, charakteristický atribut.

Mgr. Erik Sigmund, Ph.D.



Palacký University, Olomouc
Faculty of Physical Culture
tř. Míru 115
771 11 Olomouc
Czech Republic

Education and previous work experience

Author is a research worker of Center for Kinanthropology Research at Faculty of Physical Culture of Palacký University in Olomouc. He graduated in Mathematics and Physical Education high school teacher from Palacký University, Olomouc and obtained his Mgr. in 1997. In the field of Kinanthropology he obtained Ph.D. at Faculty of Physical Culture, Palacký University, Olomouc. His scientific interests are in the areas of human movement, environment for physical activity, physical activity programmes for children, data analysis and formal concept analysis. He was a main investigator and coinvestigator of university and state grants in these fields.

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