Analysis of Time Use Surveys Using CO-STATIS

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The aim of this article was to study 23 time use activities measured in the two latest Colombian National Time Use Surveys, taken in 2013 (with 119,899 participants over the age of 10) and in 2017 (with a sample of 122,620 participants), to identify similarities and differences between the years of the survey by gender, age group, and socioeconomic level. The study's results were obtained using the CO-STATIS multiway multivariate data analysis technique, which is comprised of two X-STATIS analyses and co-inertia analysis. The results confirm the existence of gender issues related to time use in Colombia, which are associated with gender stereotypes that link women to unpaid work and home care, especially in low socioeconomic levels, where women face limitations in terms of the time available to earn their own income. Additionally, differences were found by socioeconomic level, where Colombians of high socioeconomic status in all age groups are able to devote more time to leisure and recreational activities.

time use | gender inequality | multivariate analysis | CO-STATIS | X-STATIS | co-inertia

1. Time Use Analysis in Gender Studies

Time use is considered one of the key social and economic determinants of gender inequality. As in the case of the study of other gender issues, such as workforce participation by females, the feminization of poverty, or women's participation in senior level government or private company positions, the study of time use has gained prominence in recent years because it enables understanding existing gender differences and similarities in the context of the care economy and the economic empowerment of women.

The care economy is studied in order to quantify the unpaid work carried out at home in household maintenance activities and the amount of time devoted to caring for the family. Rubiano-Matulevich and Viollaz [1] argue that even though substantial progress toward gender equality has been made in the past decades, the inequalities linked to gender norms, stereotypes, and the unequal distribution of housework and childcare responsibilities persist. This implies the existence of inequalities in the use of time between women and men.

Ferrant [2] also emphasizes the importance of recognizing unpaid care work by measuring and valuing it, because it helps to redistribute unpaid care tasks more equally between men and women by transforming gender stereotypes. This author argues that this is necessary in order to support the achievement of the Sustainable Development Goals in the different countries of the world, because when women have control over their time and are free to

weigh the challenges they face at home against those they face in their professional careers, they become empowered and are able to make positive contributions to a nation's economy.

For this reason, it is important for gender studies to assess the different factors that determine the way men and women use their time, differentiating between home care, work, and free time activities, because studies of this type are conducive to the search for gender equality and female empowerment.

2. Time Use Studies by Socioeconomic Status

A specific aspect that is often studied is how socioeconomic level also determines and conditions the way people distribute and use their time. Aguiar [3] claims that there are differences in the way people from different socioeconomic levels and lifestyles organize their remunerated and leisure time. Moreover, Neubert [4], in comparing the assignment of work in different occupational categories, socioeconomic levels, and educational attainment levels, found that people with higher education have advantages in terms of time use, not only in connection with the time devoted to work, but also in the organization of their leisure and everyday activities.

Specifically on the use of time by women, Kolpashnikova [5] studied the time devoted to housework in Japan, Canada, and the United States by gender, marital status, age, socioeconomic level (SEL), and the presence of children at home. She found that women with greater purchasing power and higher educational attainment are able to hire assistance to carry out domestic work, enabling them to remain more committed to remunerated work activities.

In terms of studies in the Latin American context, Candia [6] carried out a study disaggregated by socioeconomic variables (gender, age, income, and geographic location of their home) on the use of time by Chilean workers. She found that women have a greater overall workload than men because of unpaid work. This author also found that individuals of higher socioeconomic status devote more time to leisure and free time activities than to unpaid housework.

3. Time Use Studies with a Life Cycle Approach

Time use is studied not only with a gender approach, but also in public health studies, with the purpose of analyzing variables of this type that determine differences in the quality of life of people, especially taking into consideration their life cycle stage or age.

For example, in recent literature we can cite the work of Chong et al. [7], Samonova et al. [8], and Blaurock et al. [9] in connection with time use studies with children. These authors support the idea that in this age group, the patterns of time use are associated with a family's resources (i.e., level of education) and the age of the children. On the other hand, Vernon [10] and Kim et al. [11] are among the authors that assess time use by adolescents and youth. These authors argue that in this life stage, it is important to consider the patterns of time use, including

traditional activities (i.e., paid work, homework, television, physical activity, leisure activities, sleeping, etc.) and technological activities (gaming, social networking, Internet).

In the specific case of older adults, some studies that argue why it is important to study time use in this age group are Powers et al. [12], Foong et al. [13], Ko [14], Chai et al. [15], and Steptoe and Fancourt [16].

Specifically, the latter, in reviewing survey data from over 7000 men and women in the United Kingdom in the age range of 50 or older, found similarities and differences in their "worthwhile life ratings" by age, sex, educational attainment, and socioeconomic status. The authors claim that the differences in the life quality of older adults depend on social and economic variables, health conditions and time spent with friends, watching television, being alone, engaging in volunteer activities, and devoting time to exercising or walking.

Due to the above, time use studies are also important for comparisons between age groups, because at different life stages, daily activities are distributed differently, which implies that age can be understood as a determinant of life quality and personal satisfaction.

4. Time Use Studies by Means of Modeling Techniques

Time use studies tend to be of a socio-political type and do not always involve modeling techniques to identify multiple associations or patterns that are not obvious from the data at first sight. Studies of this type typically assess the data using descriptive techniques with one or two variables or through econometric estimation methods, where the time use variables are usually analyzed separately or descriptively. However, it is viable to conduct multivariate analysis on data of this type to arrive at results of interest for gender studies. There is no good reason to be limited to simple analyses that are usually solely for confirmation purposes. The possibility of combining the variables opens the door to obtaining results that are sometimes unexpected and beyond the obvious [17] (p. 14).

Due to the above, in order to contextualize the analysis of this study, it is also important to cite some authors who in recent studies analyze official time use data by means of statistical techniques and multivariate analyses to obtain their results.

In the European context, Rogge and Van Nijverseel [18] quantified and reviewed the quality of life of European Union countries using a multidimensional design. To this end, they used citizen satisfaction data in eight dimensions, based on which they developed a composite index, concluding that the correlations between the variables show a strong relationship between the multidimensional and one-dimensional measurements of subjective life quality.

Fraire [19] also carried out a comparative analysis between European Union countries. This author used the STATIS Dual and Multiple Factor Analysis techniques to compare time use results of surveys made near to 2000 in six European countries: Belgium, Estonia, Finland, Norway, Slovenia, and the United Kingdom. In this study, after presenting descriptive statistics by gender, employment status and marital status by age group, and presence of

children in the family, a STATIS Dual analysis was performed to compare the 12 time use activities in each country under each of the considered categories to characterize the population.

Kızılırmak and Köse [20] studied the determinants of the use of free time in Turkey by exploring associations between time used in cultural, social, sports, and other leisure activities compared to socio-demographic variables on gender, age, educational level, household income level, marital status, employment status, health conditions, and time used for childcare. To this end, they examined data from the 2014–2015 TurkStat Time Use Survey and obtained research results by means of a multiple regression model.

Yoon et al. [21] studied time use by Korean citizens over the age of 65 based on surveys taken by the Korean National Statistics Office in 2004 and 2009. The study's results were obtained using multivariate techniques: correspondence analysis and Biplot analysis, based on which they search for and describe clusters of individuals.

In the Australian context, Richardson et al. [22] conducted a longitudinal cohort study with a group of first-year university students to discover time use associations by gender and age group. The authors found statistically significant differences through hypothesis testing on comparisons between population groups. Bittman [23] also studied time use in Australia, based on data from the Australian Bureau of Statistics.

Several studies of reference in the United States of America [24][25][26][27] used modeling techniques to characterize time use in different population groups and also used the records of the American Time Use Survey (ATUS). This international survey is well known for periodically publishing annual information with disaggregation levels that enable using different analytic approaches and facilitate the use of different modeling techniques.

Due to all of the above, in this study, we conducted a multi-dimensional exploration, with no specific response variable to find and analyze underlying patterns and to compare the data from the 2013 and 2017 Colombian National Time Use Surveys (ENUT, by its acronym in Spanish: Encuesta Nacional de Uso del Tiempo) from a gender perspective. The results were obtained from data analysis using the CO-STATIS method [28]. In this technique, the co-inertia analysis [29] is used to relate two compromises obtained from two partial triadic analysis (PTA). The PTA was proposed by Jaffrenou [30] to analyze k-table data, which is also called X-STATIS according to Abdi et al. [31]. Thus, CO-STATIS seeks the relationships between two stable structures.

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