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# FEATURES OF INTERPRETATION OF THE RESULTS OF HOLTER MONITORING IN THE AGE CATEGORY OF THE POPULATION

**Abstract.** The research topic is designated as the features of interpretation of the results of Holter monitoring of the age category of patients and attention to these aspects for decision-making. The aim of the study is to identify image indicators in the parameters of Holter monitoring in patients in the space with a general age population. The article considers the conditions for updating Holter monitoring in screening for the risk of developing cardiovascular diseases for the age category of patients both in early prediction and in the current state of the cardiovascular system. An information search was conducted in two specialized information resources: PubMed and TripDataBase. The search was carried out using the PICOS methodology with a comparative assessment using the PRISMA methodology. Six studies were provided for analysis, including 4 RCTs and 2 cohort studies. The degree of separation of the basic indicators of the Holter Diptych in low- and high-frequency modes is noted. Age features are noted in assessing heart rate variability. Differences in age-related changes in Holter monitoring indicators in circadian rhythm are also noted. All this provides information for practicing specialists on the appointment of Holter monitoring for age-related patients.

**Key words:** Holter monitoring, cardiovascular disorders, age-related health, diagnostics, geriatrics, review.

## Introduction

According to UN forecasts, in 2050, life expectancy will be 79.2 years for women and 71.6 years for men. For comparison, according to the UN, in the world from 2010 to 2021, life expectancy increased from 72.7 to 73.8 years for women and from 67.6 to 68.4 years for men. By 2050, according to the forecasts of the UAPF and the UN, almost every fifth Kazakhstani will be aged 60 or older [1]. The changes taking place in Kazakhstan suggest the need to take into account the problem of population ageing in the development of national policies and the inclusion of appropriate mechanisms to support the elderly population in all social and economic programs [2, 3]. In order to improve the quality of life of the elderly population, it is important to monitor the physiological characteristics of the health of the elderly population. Early diagnosis of functional disorders of the body makes it possible to prevent a severe course and adverse outcomes in the elderly population, which affects the social ecosphere of the community and the burden of the health care system. One of these prospects is Holter ECG monitoring in the screening mode. Holter ECG monitoring is performed to record ECG changes, detect heart rhythm disorders, painless myocardial ischemia, vasospastic angina, as well as to monitor the effectiveness of antianginal therapy [4]. Currently, classical methods for assessing heart rate variability (HRV) are carried out in the modes of time or statistical (time domain) and frequency or spectral (frequence domain) analysis [5, 6, 7]. Temporal analysis refers to a group of HRV estimation methods based on the application of statistical programs to the calculation of the values of a sample of RR intervals, followed by physiological and clinical evaluation of the data obtained. Indicators of time domain analysis of HRV in Holter monitoring:

- Mean (ms) – mean value of all RR intervals (value inverse of the mean heart rate);
- SDNN (ms) – standard deviation of all analyzed RR intervals;
- SDNN-i (ms) – 5-minute standard deviation mean;
- SDANN-i (ms) – standard deviation of 5-minute averaged values of RR intervals;
- rMSSD (ms) – square root of the sum of the differences of successive RR intervals;
- pNN50 (%) – percentage representation of sequence RR interval difference episodes greater than 50 ms;
- SDSD – standard deviation of difference between adjacent RR intervals;

• Counts (or NN50 counts) – Total number of 24-hour differences in adjacent intervals differing by more than 50 ms [8].

Mean, SDNN, SDNNi and SDANN reflect the analysis of consecutive (consecutive) RR intervals. The essence of the rMSSD score is to estimate the degree of difference between two adjacent RR intervals. The greater the difference between adjacent RR intervals (i.e., the higher the sinus arrhythmia), the higher the rMSSD values will be. The pNN50 value also reflects the degree of difference between adjacent RR intervals, but the main criterion for estimating is the difference between two adjacent intervals by more than 50 ms. This can be with sudden pauses or acceleration of the rhythm. The main vector for assessing HRV lies in two polar directions: an increase in the parameters of the HRV temporal analysis is associated with an increase in parasympathetic influences, and their decrease is associated with the activation of sympathetic tone. This terminology is often used: "decrease" (LF) or "increase" (HF) variability. According to the classical physiological interpretation, for short sections of stationary recording (small 5-minute samples), the high frequence (HF) component of the spectrum reflects, first of all, the level of respiratory arrhythmia and parasympathetic influences on heart rate. The low frequence (LF) component is mainly sympathetic influences, but parasympathetic tone also affects its formation. The ratio of low frequencies to high-frequency components (LF/HF) is also calculated, which reflects the level of vago-sympathetic balance [9, 10, 11]:

• high frequence (HF) – waves from 0.15 to 0.40 Hz;

• low frequence (LF) – waves from 0.04 to 0.15 Hz;

• very low waves (very low frequence) – waves of 0.0033–0.04 Hz,

• ultra low frequence – waves up to 0.0033 Hz.

Spectral analysis is, first of all, a mathematical transformation, and not a method specific to medical and biological research, so the main problem of its use in the clinic is the assessment of the physiological and clinical value of the parameters obtained. According to the classical interpretation, with increased sympathetic influences (stress test) or parasympathetic blockade (administration of atropine), the high-frequency component of the spectrum (HF) is leveled. In sympathetic blockade, on the contrary, low-frequency waves (LF) are reduced [11, 12, 13]. The greatest prognostic value in Holter monitoring has time parameters (SDNN, RRNN and, possibly, pNN 50%), spectral analysis indicators (LF/HF, ULF).

## Methodology

Objective: To assess the effectiveness of the physiological consistency of heart rate in the elderly population for the early detection of chronic heart failure by Holter monitoring.

To satisfy the search questions, a hypothesis and search criteria were formed according to the PICO methodology. Based on the criteria, a strategy for searching information sources was developed, which included the selection of verified databases, keywords and the formation of a strip-line search. Based on the search, a qualitative analysis of the information obtained was carried out on the correspondence of the title of the article with the subsequent analysis of the abstract. The content of the selected information on the content of the text was evaluated using the PRISMA method.

## Results

After defining the criteria, a search strategy was developed. Studied sources to search for relevant peer-reviewed (scientific) literature.

These databases were searched by domain/aspect of the review objective. The search terms are presented in Table 1.

**Table 1** – Search terms

| Search cases | Population/patient | Intervention | Comparative | Result | Study design |
|---|---|---|---|---|---|
| 1 | CHF, age population, elderly patients, BCP/VHR | Heart rate, circadian rate, heart rate, cardiac monitoring, Holter monitoring, early diagnosis | Laboratory diagnostics, survey | Eff* | Review |
| | | | | Saf* | RCT |
| | | | | | Cohort Study |

Subsequently, individual studies were selected based on the title and abstract. At this stage, we examined the titles and abstracts/abstracts of the identified literature to assess their relevance to our review.

Subsequently, a critical assessment of the evidence was carried out using the PRISMA methodology. Thus, 6 sources of information were selected to assess the effectiveness of Holter monitoring in the age group of the population for early diagnosis of CHF signs.

**Results of evidence-based analysis**

A search of the database yielded 89 citations published up to June 01, 2024 (with the removal of duplicates). Articles were excluded based on the information in the title and abstracts. For further evaluation, the full texts of potentially relevant articles were received. 6 studies (4 RCTs, 2 cohort studies) met the inclusion criteria.

For each included study, the study design was identified and summarized in Table 2, which is a modified version of the Goodman study design hierarchy.

**Characteristics of the included studies**

Six studies were included in the evidence-based analysis. Studies were conducted in 4 different countries (Japan 3, Belgium 1, Germany 1, Italy 1) and included populations of interest (age population, elderly patients). Study specimen sizes ranged from 62 to 276 patients (Table 3).

**Table 2** – Group of evidence considered in accordance with the study design

| Study design | Quantity |
|---|---|
| **RCT** | |
| Systematic review of RCTs | |
| Large RCT | 3 |
| Small RCT | 1 |
| **Observational Studies** | |
| Systematic review of non-RCTs with simultaneous control | |
| Non-RCTs with simultaneous control | 2 |
| A Systematic Review of Non-RCTs with Historical Control | |
| Non-RCTs with historical control | |
| Cross-sectional database, registry or study | |
| Series of cases | |
| Retrospective Review, Modeling | |
| Research presented at the international conference | |
| Expert opinion | |
| **Total** | 6 |

**Table 3 –** Characteristics of the analyzed sources

| Author, year | Country, site | Study design | Duration of the study | Population | Age Years | Sample size, n[b] | List of all results obtained |
|---|---|---|---|---|---|---|---|
| F. Beckers et al., 2006 | Belgium, Löven | RCT | 3 years | Adult population | 18-71 | 276 | Evidence of the involvement of the autonomic nervous system in the generation of nonlinear fluctuations in healthy people has been found. Wandering paths have played a dominant role in shaping this complex dynamic. This was expressed in higher non-linear behavior at night, when the wandering effect is greatest (higher HF power). Nonlinear heart rate fluctuations also decrease with age. |
| H. Bonnemeyer et al., 2003 | Germany, Heidelberg | RCT | 3 years | Adult population | 20-70 | 166 | Normal aging is associated with a permanent decrease in modulation of the cardiac vagus nerve due to a significant decrease in cardiac parasympathetic activity, which occurs predominantly at night. It is possible that a better understanding of the circadian relationship between autonomic modulation of the heart and HRV will provide more predictive information than a single measurement of HRV over time. |

*Continuation of the table*

| Author, year | Country, site | Study design | Duration of the study | Population | Age Years | Sample size, n[b] | List of all results obtained |
|---|---|---|---|---|---|---|---|
| M. Matteucci et al., 2003 | Italy, Milan | Cohort study | 3 года | Adult population | 20-76 | 63 | Evaluation of the effectiveness of HRV as a predictor of age may lead to the identification of a novel biomarker of aging and thus may be useful for screening purposes and for identifying cardiovascular differences between healthy young and adult subjects and healthy centenarians |
| S. Sakata et al., 1999 | Japan, Nagoya | RCT | 3 years | Adult population | 21-79 | 62 | It was found that the simple assumption of the power law makes not only the method of spectral analysis, but also the analyzed frequency band, both of which could affect the resulting spectral exponent. The non-harmonic components of HRV observed in different frequency domains can differ from each other not only in mathematical properties, but also in physiological origin. |
| H. Tasaki et al., 2006 | Japan, Nagasaki | RCT | 15 years (interval) | Adult population | 14-87 | 164 | In healthy older adults, we showed a paradoxical dissociation between 24-hour mean and hourly heart rate (or mean UA) and HRV (or HRV) with aging. Moreover, with regard to the circadian rhythms of HR/UA and HRV in healthy elderly patients, a strong correlation between hourly HR/UA and HRV/HRV persisted not only in the first period, but also 15 years later, regardless of the common concept of waning trends throughout HRV with age. In addition, the amplitude of HRV increased in the morning hours with age, when the HRV/HRV balance leaned toward sympathetic neural activity in the circadian rhythm.<br>These features of age-related changes in HR/UA and HRV/HRV may be characteristic of the elderly and are associated with their susceptibility to cardiovascular events in the morning. |
| Yo. Yamasaki et al., | Japan, Osaka | Cohort Study | 3 years | Adult population | 20-78 | 105 | The present study clearly shows that sympathetic function is expressed in young, healthy males and that sympathetic function declines more linearly with age than parasympathetic function. In addition, parasympathetic function is relatively preserved in older females compared to older males. These results provide basic information for assessing the impairment of the autonomic function of the heart and its modulation due to aging and sex differences. A daily assessment of the heart's sympathetic and parasympathetic function using frequency area analysis of a 24-hour ECG recording can be a useful tool for assessing autonomic nerve dysfunction in a variety of diseases. |
| TOTAL | 4 (Japan – 3, Belgium – 1, Germany – 1, Italy – 1) | 2 (RCT – 4, Cohort Study – 2) | | | 18-87 | 62-276 | |

In the studies, criterion indicators were of particular importance, which reveal the significance of the results obtained and the trend in the practical application of the conclusions of the study (see Table 4).

**Table 4 –** Spectrum of analyzed indicators in the study

| Author | Theme | Purpose | Criterion | Indicator |
|---|---|---|---|---|
| F. Beckers et al., 2006 | Aging and Nonlinear Heart Rate Control in a Healthy Population | 1 – to study the influence of gender and age on nonlinear indices; 2 – to study the changes of day and night in nonlinear indices; 3 – correlate traditional time and frequency domain HRV measurements with methods derived from nonlinear dynamics to obtain physiological correlates; 4 – to determine the physiological range of these nonlinear indicators in a healthy population | Heart rate variability during daily Holter monitoring | 1 – scaling slope 1/f (where f is the frequency), 2 – fractal dimension of short-term correlations, 3 – fractal dimension of long-term correlations of trendless fluctuation analysis (DFA1 and DFA2, respectively), 4 – correlation dimension (CD), 5 – Lyapunov index (LE), 6 – approximate entropy (ApEn) |
| H. Bonnemeyer et al., 2003 | Circadian Profile of Cardiac Autonomic Nerve Modulation in Healthy Individuals: Different Effects of Age and Sex on Heart Rate Variability (HRV) | 1 – determination of the influence of normal aging on physiological circadian fluctuations of HRV by decades; 2 – assessment of the effect of sex on the daily HRV profile in different age decades in a large number of healthy subjects | Heart rate variability during daily Holter monitoring | 1 is the mean RR of the interval, 2 is the square root of the mean of the sum of the squared differences between adjacent NN intervals (rMSSD), 3 is the standard deviation of the NN intervals (SDNN), 4 is the mean standard deviation of the NN intervals for all 5-minute segments (SDNNi), 5 is the standard deviation of the NN interval values for all 5-minute segments (SDANN), 6 is the absolute count of adjacent consecutive NN intervals, differing by >50 ms per hour (sNN50), 7 is the geometric triangular index (TI). |
| M. Matteucci et al., 2003 | Heart rate variability analysis to predict the age of patients in a healthy population | To assess the age of healthy individuals by HRV parameters and to assess the potential of HRV indices as a biomarker of age | Heart rate variability during daily Holter monitoring | 1 – RR interval, 2 – time mean parameter (M), 3 – standard deviation (SD) of all normal RR indices (NN intervals), 4 – SD mean value of NN (SDANN) calculated over 5-minute periods, 5 – mean value of 5-minute standard deviations NN (SDNNi), 6 – square root of standard differences of successive RR intervals (rMSSD), 7 – percentage of interval differences of successive RR intervals greater than 50 ms (pNN50) |
| S. Sakata et al., 1999 | Aging and Spectral Characteristics of the Nonharmonic Component of Daily Heart Rate Variability | Is the fundamental shape of the logarithmically scalable power spectrum of 24-hour HRV always straightforward, regardless of age and total power? | Heart rate variability during daily Holter monitoring | 1 – Power Spectrum Density (PSD), 2 – Ultra Low Frequency Range (LF), 3 – Ultra Low Frequency Range (VLF), 4 – Low Frequency Range (LF), 5 – High Frequency Range (HF), 6 – Power Spectrum Slope (b Tilt) |

*Continuation of the table*

| Author | Theme | Purpose | Criterion | Indicator |
|---|---|---|---|---|
| H. Tasaki et al., 2006 | Remote follow-up of circadian heart rate and heart rate variability in healthy elderly patients | To elucidate the change in HRV and its circadian rhythm with aging in the elderly, to perform Holter monitoring twice at 15-year intervals in healthy elderly patients and to assess longitudinal age-related changes in HR/U, HRV, and their circadian rhythms | Heart rate variability during daily Holter monitoring | 1 – mean sine RR interval (mean NN; seconds), 2 – high-frequency (HF) component (HF: 0.148-0.398 Hz; ms2), 3 – low-frequency (LF) component (LF: 0.039-0.148 Hz; ms2), 4 – HF/LF ratio |
| Yo. Yamasaki et al., | Daily heart rate variability in healthy people: the effects of aging and gender differences | To find out the daily profile of cardiac nerve function and how it is affected by aging and sex differences | Heart rate variability during daily Holter monitoring | 1 – mean sine RR interval (mean NN; seconds), 2 – high frequency (HF) component, 3 – low frequency (LF) component, 4 – general frequency (TF) component, 5 – percentage of low frequency component (%LF) |

In a study by F. Beckers et al., 2006, the study of day-night variation revealed the following: the value of CD increased slightly during the night (3.97/0.72 to 4.37/1.30 in men regardless of age; P 0.05; 4.15/0.75 to 4.41/1.29 in women regardless of age; P NS). Overnight, the percentage of CD values of surrogate data files that differed from the CD value of the original data increased in both populations (P 0.001). FD and DFA1 values increased significantly during the daytime. DFA2, ApEn, LE increased at night; The gradient is 1/f less steep at night. All linear indices showed day-night change, with the exception of SD and LF power, which did not show this in either men or women. Heart rate decreased during the night (P 0.001). In general, the daily values of the linear indices were lower than the nightly ones. In both males and females, total potency and HF potency increased significantly during the night (both P 0.001). LF power showed a smaller relative contribution compared to daily values; in the study of gender differences, changes were found only in ApEn, DFA1 and LE: ApEn was higher in the female population, and LE and DFA1 were lower compared to the male population, heart rate in the female population was higher compared to the male population both day and night; in the study of age relationships, it was revealed that all nonlinear indices were significantly correlated with age (all P 0.001) in the daytime, especially in the female population. Overnight, the association with age disappeared on some measures, especially in men. Spectral powers, rMSSD, pNN50, FD, ApEn, DFA1, CD, and LE decreased with age, and the 1/f slope became steeper. Only DFA2 increased with age (r 0.45; P 0,001). Increasing age was associated with higher heart rate only in women (day: r 0.35; night: r 0.27; both: p 0.001). For nonlinear indices, the age relationship was particularly pronounced in the daytime and was more pronounced in women. FD was most strongly correlated with age (r 0.56; P 0,001). Linear indices in the male population were more strongly associated with age than in the female population. A more in-depth analysis by age category over 10 years showed a stabilization of age-related decline in FD and ApEn at age 40. DFA2 continued to increase until the age of 60. The amount of surrogate data with baseline data remained stable across all ages. The 1/f slope became steeper and the LE decreased at age 60. The change in day and night in most nonlinear indices also depended on age. The differences between day and night in ApEn and DFA1 were most pronounced in the age categories of 50 years, whereas in LE they were more pronounced in the age categories of 50 years. Also, the decrease in linear indicators stabilized in the area of the age category of 40 years. Values for the male and female populations converged at higher ages, and gender differences for ApEn, FD, LE, and linear parameters (LF, HF, and total power) disappeared at age 40 years [14].

In a study by H. Bonnemeyer et al., 2003, all 24-hour HRV parameters decreased with age by a decade, with the most marked decrease observed between the second (30-39 years) and third (40-49 years) decades. Consistently, with increasing age, HRV decreased only gradually, reaching 13.5% (sNN50), 40.6% (rMSSD), 50.2% (SDNNi). 65.3% (TI), 66.3% (SDNN) and 67.8% (SDANN), adjusted in particular from baseline levels in the sixth (60-70 years) decade. Thus, the marked negative correlation of 24-hour HRV in the time domain with normal aging of the entire study population is mainly due to the strong age-related HRV relationship in the young

(20-29 years) decade. Among all HRV/HRV parameters, SDNNi, sNN50, and rMSSD showed the strongest correlation with aging (r 0.64, 0.63, and 0.62, respectively). The RR interval was characterized by a U-shaped path, with the lowest values in the fourth decade; there were no significant differences in HRV parameters and mean RR interval between subjects over 50 years of age who did or did not undergo a routine coronary angiogram. The circadian flow of the RR interval showed a continuous increase during sleep hours, peaking 3 hours before awakening and consistently decreasing to baseline in the morning hours. Circadian profiles of HRV parameters revealed three different characteristic patterns: 1 – rMSSD and sNN50 increased during sleep and peaked 2-3 hours before awakening; 2 – SDNN и SDNNi peaked at about the hour of awakening; 3 – TI and SDANN decreased during sleep hours and increased again at the hour of awakening. The relative decrease in the RR interval from night (9 p.m. to 6 a.m.) to daytime (7 a.m. to 8 p.m.) within a slight decrease of 18% to 14%. the hourly profiles of rMSSD and sNN50 showed a continuous decline with age, mainly characterized by a marked attenuation of the nighttime peak. Consequently, the night-to-day ratio (the percentage difference between the hourly average of the 10 p.m. to 7 a.m. and 8 a.m. to 9 p.m. time periods) continuously decreased from 27% to 4% for rMSSD and from 33% to 0% for sNN50. Similarly, a continuous decrease in mean hourly values of the circadian profile and a weakening of the morning peak with increasing age was observed for SDNN and SDNNi. However, the relative decrease from night to day was comparable for both SDNN and SDNNi, with no significant change with age. In addition, SDANN and TI showed no significant age-related change with respect to night-to-day ratio (SDANN: 9% to 15%; TI: 9% to 15%), and hourly values were higher during the day and lower at night for these parameters. For TI, there was a continuous decrease in circadian profile hourly values from decade to decade, while there were no significant differences between decades for SDANN hourly values [15].

M. Matteucci et al., 2003, showed that ApEn is negatively correlated with SDANN in PC2. The most important role in PC3 is played by the slope of the power spectrum, which is negatively correlated, and a1, the small scaling exponent of DFA, while the results of PC4 are strongly negatively correlated with the mean value of the RR intervals and with α2, the far scale exponent of DFA. As each component contributes to the In the complex phenomenon under study, the observed composition highlights the fact that nonlinear parameters provide important and complementary information independent of traditional indices [16].

S. Sakata et al. found that fB was higher in group O (old) than in group Y (young) ($P<0.001$). Interestingly, while βa was larger in group O than in group M (middle), which in turn was larger than group Y ($P<0.001$), βb was smaller in group O. The relationship between age and spectral parameters in each subject showed that fB was positively correlated with age ($r=0.51$, $P<0.001$). Although βa was positively correlated with age ($r=0.70$, $P<0.001$), βb was negatively correlated ($r=-0.39$, $P=0.001$), hence the difference between the two (βb–βa). reflecting the degree of specum bending, decreased with age ($r = -0.60$, $P<0.001$) [17].

H. Tasaki et al., 2006, conducted a study with an interval of 15 years from the first collection of data from fixed objects and found that the average NN value per day decreased significantly compared to the first (first monitoring vs. second monitoring: 0.976±0.115 (s) vs. 0.903±0.117 (s), $p=0.0019$). Each Hourly Mean NN, with the exception of 05.00 h, also clearly decreased and about three-quarters of them decreased significantly after 15 years. The average HF value for the day of the second follow-up period showed an upward trend compared to the first (221.20±138.89 (ms2) versus 310.78±296.73 ms2), $p=0.1102$). Most of the hourly HF in the circadian rhythm also showed an increasing trend 15 years later, and the 2-hour HF during 06:00 h and 19:00 h increased significantly; the average LF/HF value per day of the second monitoring period significantly decreased compared to the first (1.681±0.731 versus 0.962±0.442, $p= 0.0022$). With each hour, LF/HF in the circadian rhythm also decreased markedly, and about three-quarters of them decreased significantly after 15 years. The mean LF value of the second monitoring period decreased significantly compared to the first (278.88±176.43 (ms2) versus 179.19±132.33 (ms2), $p = 0.0039$). Hourly LF in the circadian rhythm also decreased markedly after 15 years, and about three-quarters of them decreased significantly [18].

Yamasaki et al. performed a spectral analysis of the power of 24-hour RR variability recorded by the Hotter ECG recorder and evaluated the daytime profiles of the LF (0.03–0.15 Hz) and HF (0.15–0.4 Hz) components. The daily profiles of TF, LF, HF and %LF were estimated as averages of the 24-hour, 60-hour morning, afternoon, evening, night, and early morning periods of Oh. The LF component in the morning and afternoon periods was consistently high in men in all age groups. In women, LF was high in the afternoon and evening among all age groups. The HF component showed a plateau at night during all time periods in both males and females, regardless of age. TF in men showed two plateaus in the morning and at night, especially in the younger age groups. In contrast, the TF of women aged 20-49 showed higher values at night. Elderly men and women (50-78 years) had less pronounced daily profiles of the TF component than younger patients. The %LF, which represents the relative cardiac response to sympathetic nerve activity, was high in the morning, afternoon, and evening, but low at night. In men and women of all age groups, except for men aged 60 to 78 years and women aged 40 to 49 years, %LF was significantly higher in the afternoon than at night. Sex differences were found for LF and HF of younger subjects. Men aged 20 to 29 years and 50 to 59 years showed significantly higher LF levels in the morning and afternoon than women aged 20 to 29 years and 50 to 59 years. However, there were no differences in HF components between men and women aged 20 to 39 years. In addition, women aged 50 to 59 and 60 to 7% showed significantly higher levels of HF than men of the same age in the periods 1200-1800 and 1800-0600, respectively. Men aged 20 to 29 years and 50 to 59 years showed significantly higher TF in the morning and afternoon than women aged 20 to 29 years and 50 to 59 years. Thus, all male men, with the exception of 40-49 years of age, showed a significantly higher 24-hour LF than women of the same age. Men between the ages of 20 and 59 showed significantly higher levels of %LF between 1200 and 1800. The LF and HF components gradually decreased with age. In addition, the TF of men aged 20 to 29 and 50 to 59 years was significantly higher than that of men aged 20 to 29 years and 50 to 59 years. Despite the age relationship between the LF and HF components, in men of all age groups, the percentage of LF was consistently higher than in women. Regardless of the time period, TF and LF of both sexes showed a very significant correlation with age ($r = -0.7486$ to $-0.5423$). HF showed a relatively weak but significant correlation with age ($r = -0.5956$ to $-0.3344$). The 24-hour %LF and %LF in the afternoon and evening showed a significant correlation with age ($r = -0.5302$ to $0.3931$). However, female subjects showed a loss of correlation with the age of %LF at night and early in the morning [19].

## Conclusion

Temporal (statistical) analyses should be performed when evaluating the results of Holter monitoring, and interpretations of HF and LF should be of particular importance. The analysis should take into account the fact of a decrease in LF values and an increase in HF values with age. The differences between day and night in ApEn and DFA1 were most pronounced in the age categories of the population.

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