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## Associating Geroprotectors

Anti-aging and Prevention of Aging-associated Diseases

EDUARDO LASALVIA-PRISCO, CARLOS DAU, JESUS VAZQUEZ, PABLO GOLDSCHMIDT, AND FELIPE GALMARINI

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# Associating Geroprotectors: Anti-aging and Prevention of Aging-associated Diseases

Eduardo Lasalvia-Prisco,<sup>1</sup> Interdoctors–Telemedical Organization, Uruguay  
Carlos Dau, Interdoctors–Telemedical Organization, Uruguay  
Jesus Vazquez, Interdoctors–Telemedical Organization, Uruguay  
Pablo Goldschmidt, Interdoctors–Telemedical Organization, France  
Felipe Galmarini, Interdoctors–Telemedical Organization, Argentina

*Abstract: Metformin and acetylsalicylic acid, two drugs that have been used in medicine for many years, are suspected to be geroprotectors, according to experimental research. Clinical observations of the drugs are compatible with the extension of geroprotective conditions to humans. In this study, we compared the variation of two parameters in blood chemistry that have been reported as markers of anti-aging activity, measured in people who had been treated for five years with one or two of these drugs. Also, we reviewed the metabolic targets of the drugs to support their effectiveness in anti-aging and the prevention of aging-associated diseases. In conclusion, the groups of forty people who were treated for five years with low doses of metformin, acetylsalicylic acid, or both, experienced significant decreases in glycosylated hemoglobin and ferritin, in comparison to a non-treated group. At the end of the five-year period, the number of living individuals in the non-treated group was minimal, higher in the groups treated with metformin or acetylsalicylic acid, and highest in the group treated with both drugs together.*

*Keywords: Survival, Geroprotection, Geroprevention, Aging-associated Diseases, Metformin, Acetylsalicylic Acid*

## Introduction

In recent decades, knowledge about the inducing agents of geroprotection and the biomarkers for measuring geroprotection has allowed scientists to explore their clinical significance and to evaluate their comparative activity.

### Agents

In animal models, research has shown that certain drugs slow aging and, therefore, increase survival (Longo et al. 2015). In recent years, in epidemiological studies, observations have demonstrated that many of these drugs have similar effects in humans (Moskalev et al. 2016). It is the time of geroprotectors (Moskalev et al. 2017). Today, there are more than 200 drugs proposed as geroprotectors, an emerging segment of preventive medicine (Moskalev et al. 2015). The medical importance of such agents is their preventive role for aging-associated diseases, such as cancer and cardiovascular, neurodegenerative, metabolic, and osteoarticular illnesses (Kumar and Lombard 2016). Preventing or delaying the onset of these diseases could explain the increase in survival and substantiate the expectation of better quality of life.

To explore medical interventions in order to prevent aging-associated diseases, we have highlighted among these drugs metformin and acetylsalicylic acid, because they have the following characteristics:

1. Reiterative demonstration of experimental geroprotective activity;
2. Observational confirmation of geroprotective activity in humans;
3. Use in medical practice with recognized acceptable safety;
4. Known targets to sustain the rationale of the geroprotective activity;
5. Biomarkers to follow the effectiveness and toxicity in clinical practice.

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<sup>1</sup> Corresponding Author: Eduardo Lasalvia-Prisco, Av. 8 de Octubre 2323, Ap. 905, R&D, Interdoctors–Telemedical, Montevideo, 11200, Uruguay. email: interdoctors@live.com, infocenter@telemedical.org

Future research to explore the association of other geroprotectors (e.g., lithium, resveratrol, rapamycin, etc.) and to optimize the chronopharmacology and safety of associated drugs will be ongoing.

### ***Biomarkers***

In addition to identifying geroprotector drugs, mechanisms of action, association protocols, and chronopharmacology, the practice of preventive medicine requires researchers to define biomarkers for these types of drugs to follow the effectiveness of the geroprotectors.

In the study of more than 200 drugs proposed as geroprotectors, different biomarkers have been used. Some of the biomarkers were studies of anatomical structures, functionality, prevalence of diseases, or molecular components of organs, and in some cases, markers belonging to the biochemistry of plasma (Moskalev et al. 2015). Obviously, in order to explore geroprotection during a person's lifetime and to control the results of interventions with the drugs, respecting the safety and comfort of the individuals, we prefer to initiate these developments using plasmatic markers (Moskalev et al. 2016). We have used glycosylated hemoglobin and ferritin.

Glycosylated hemoglobin is a known marker of long-term glycemic control in diabetic patients that predicts risks for the development and progression of diabetic complications. However, after studying the available research, we have determined that the significance of glycosylated hemoglobin is wider, in that it is also associated with aging (Pani et al. 2008). Glycosylated hemoglobin increases with advanced age, independent of glycemia. It is also clearly associated with premature aging and increased mortality and can be used as an anti-aging evaluation tool (Ahmed Dar et al. 2015).

Ferritin levels decrease with iron deficiency and increase with inflammation as an acute-phase reacting protein. In the case of inflammation, ferritin levels may not decrease even if the patient has an iron deficiency. Inflammation is regarded as one of the mechanisms of aging, and the subclinical, chronic, asymptomatic, systemic inflammatory state is known as "inflammaging." Reported studies in geriatric medicine, excluding clinical conditions that could alter acute-phase reactants, suggest that ferritin levels increase with aging as part of inflammaging (Cankurtaran et al. 2012).

In this study, we used the serum ferritin level in older adults—discarding iron deficiency—as a longitudinal biomarker of aging-associated inflammation. Briefly, the aim of this study was to show if the association between metformin and acetylsalicylic acid improves the geroprotective effect of each drug, using the biomarkers reported as useful, to follow their activity upon their targets: oxidative stress, inflammaging, and regeneration.

### **Patients and Methods**

We evaluated the clinical records of 160 individuals and then selected test subjects to meet the inclusion/exclusion criteria for four groups.

#### ***Inclusion Criteria***

We selected records of fifty- to sixty-year-old individuals, available from 2000–2003, that complied with the following criteria:

- Forty males, treated daily with an oral dose of 850 mg of metformin for at least five years for type 2 diabetes mellitus and not requiring other pharmacological treatment during the period in question.
- Forty males, treated daily with an oral dose of 100 mg of acetylsalicylic acid for at least five years as a cardio-protector and not requiring other pharmacological treatment during the period in question.
- Forty males, treated daily with oral doses of 850 mg of metformin and 100 mg of acetylsalicylic acid for at least five years, for type 2 diabetes mellitus and cardiovascular protection and not requiring other pharmacological treatment during the period in question.
- Forty males, without treatments during the five years in question.

### ***Exclusion Criteria***

We discarded records that featured the following exclusion criteria:

- Any discontinuation of the tested treatments for more than one month, or three discontinuations of any duration.
- Unavailability of blood tests for glycosylated hemoglobin and ferritin, at least at the beginning and end of the five-year period.
- We registered only deaths caused by aging-associated diseases.

This study was approved by the appropriate institutional review board.

### ***Assessments***

- We registered assessments at the beginning and end of the five-year period in question.
- We evaluated survival by the number of living individuals, estimated following the Kaplan-Meier method, and compared using the log-rank test (Bland et al. 2004).
- We measured glycosylated hemoglobin levels using high-performance liquid chromatography (HPLC), standardized to DCCCT values by the National Glycohemoglobin Standardization, and expressed in absolute values of mg/dL (Little 2003).
- We expressed ferritin levels in ng/ml (Kalantar-Zadeh et al. 2001).
- In our statistical analysis we tested the differences between the groups with an unpaired t-test. Values < 0.05 were statistically significant. For the data analysis we used Statistical Package for Social Sciences version 17.0 for Windows.

### **Results**

The percentage of surviving patients at the end of a five-year follow-up was significantly higher in the groups treated with metformin, acetylsalicylic acid, or both drugs than in the non-treated group. In addition, survival rates after five years were greater for the group treated with both drugs compared to those treated only with metformin or acetylsalicylic acid.

The results also showed a reduction in the five-year increase of glycosylated hemoglobin and ferritin in all three treated groups compared with the non-treated group, with higher significance in the group treated with metformin and acetylsalicylic acid together.

Statistically, the five-year increase of glycosylated hemoglobin in the three treated groups compared with the non-treated group showed the following characteristics: for the group treated with metformin  $p = 0.02$ ; for the group treated with acetylsalicylic acid  $p = 0.04$ ; and for the group treated with metformin and acetylsalicylic acid together  $p = 0.01$ . The five-year increase of ferritin in the three treated groups compared with the non-treated group showed the following

characteristics: for the group treated with metformin  $p = 0.05$ ; for the group treated with acetylsalicylic acid  $p = 0.03$ ; and for the group treated with metformin and acetylsalicylic acid together  $p = 0.01$ .

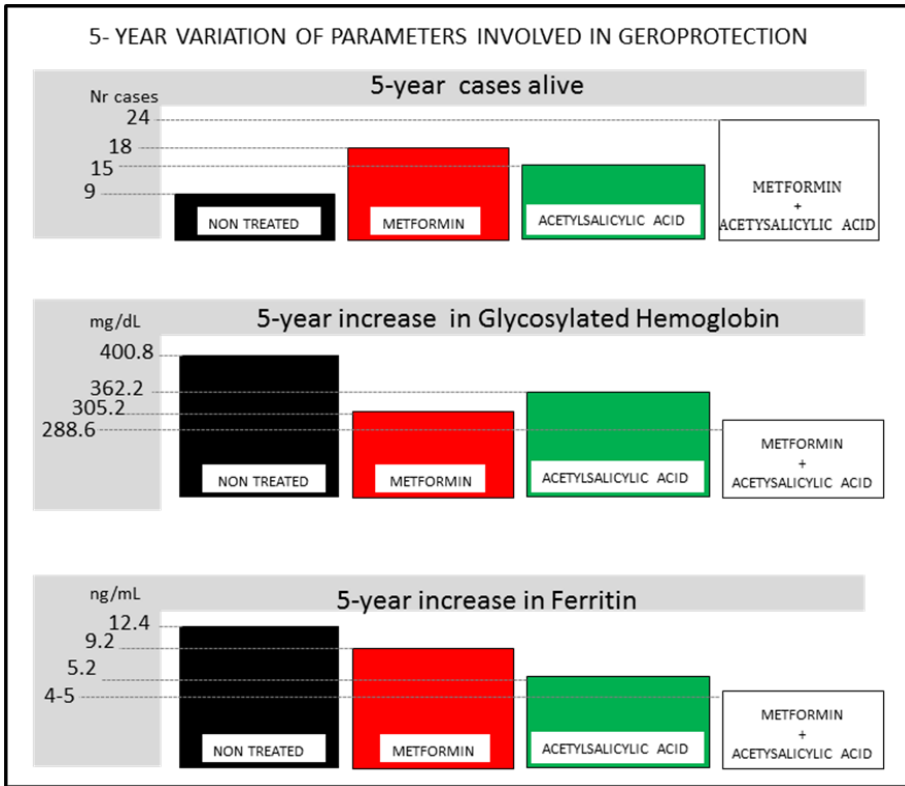


Figure 1: Five-year variation of parameters involved in geroprotection  
 Source: Lasalvia-Prisco et al.

## Discussion

Three blocks of metabolic events have been identified as generators of aging, and therefore, of aging-associated diseases. The first block is the hormetic effect of Reactive Oxygen Species (ROS). The generation of mitochondrial energy is regulated by the relationship AMP/ATP and creates ROS. The effect of ROS upon the cell follows a biphasic curve (hormesis): a low increase of ROS induces a mitochondrial adaptive beneficial response, but a high increase of ROS produces cellular damage (senescence) and aging. This means that high, or accumulative, ROS is a mechanism of aging and aging-associated diseases, through the damage of functional molecules and cellular organoids (Ristow and Schmeisser 2014). As previously reported, drugs that have been described as geroprotectors inhibit ROS production. Metformin impacts this block by reducing the oxidative damage through AMPK-TOR and also through another mechanism independent of AMPK (Anisimov 2013). The oxidative damage is also inhibited by acetylsalicylic acid (Ayyadevara et al. 2013). Our results are compatible with these reports. In our model, individuals treated with metformin, compared with non-treated individuals and according to a t-test (significance  $< 0.05$ ), show a reduction in the five-year increase of glycosylated hemoglobin (a biomarker of aging) and an increase of survival.

The second block is the modulation of autophagy, whose role is to clean the cell (housekeeper). Therefore, autophagy retrieves cells from senescence and from the functional deficit produced by intracellular accumulation of molecular detritus which promote aging and

aging-associated diseases, mainly through inflammaging (Glick, Barth, and Macleod 2010; Franceschi and Campisi 2014). Autosomes and lysosomes configure the autophagosome to clean cells, avoiding cell senescence and inflammaging (Gewirtz 2013). It was previously reported that metformin improves autophagy and acetylsalicylic acid decreases inflammaging (Vigili de Kreutzenberg et al. 2015; Din et al. 2012). In other words, they act as geroprotectors. Our results are compatible with these reports. In our model, compared with non-treated individuals, individuals treated with metformin or acetylsalicylic acid show a reduction in the five-year increase in glycosylated hemoglobin (biomarker of aging), a reduction in the five-year increase in ferritin (biomarker of inflammaging), and an increase in survival, all three differences with significance in the t-test ( $< 0.05$ ).

The third block includes phenomena linked to DNA, such as structural modifications mediated by the translocation of DNA sectors, known as transposons (Lopez-Panades et al. 2015; Wood et al. 2016), and gene activation through the Wnt/Catenin mechanism (Nusse 2005). Both phenomena induce differentiation and reproduction in precursor and stem cells, which are basic for regenerative activity in order to recover functional structures and counteract cell loss that results from aging (Conboy and Rando 2005). It was previously reported that metformin and acetylsalicylic acid enhance regenerative function, meaning that they are geroprotectors (Menendez et al. 2012; Cao et al. 2015). Our results are compatible with these reports. In our model, compared with non-treated individuals, individuals treated with metformin and/or acetylsalicylic acid show a reduction in the five-year increase in glycosylated hemoglobin (a biomarker of aging), a reduction in the five-year increase in ferritin (biomarker of inflammaging), and an increase in survival (t-test  $< 0.05$ ).

Figure 2 shows the three blocks mentioned above and the targets of the geroprotective agents explored in this study: metformin and acetylsalicylic acid.

### Metabolic targets of Metformin and Acetylsalicylic acid in Geroprotection

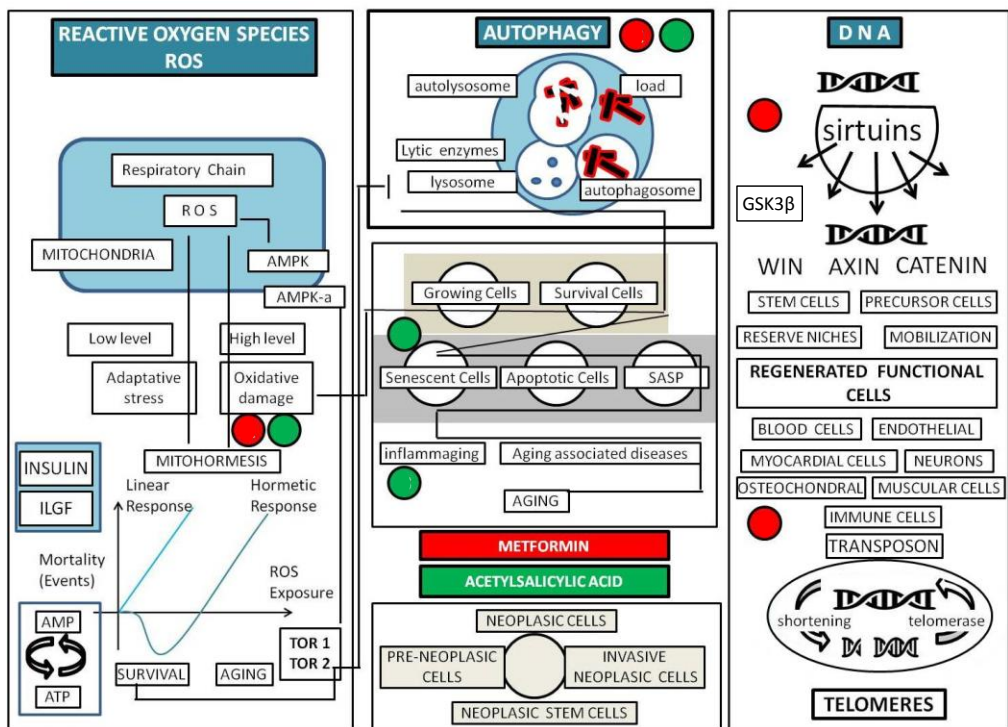


Figure 2: Metabolic targets of metformin and acetylsalicylic acid in geroprotection

Source: Lasalvia-Prisco et al.

The discussion of the biomarkers glycosylated hemoglobin and ferritin acquires special validation in the results, since their mechanical interpretation, in the form of the three biochemical blocks identified above, is compatible with the survival data recorded in the four groups in the study. The total number of living test subjects at the end of the evaluation period was the study's metric for geroprotection. Furthermore, our results suggest that administering metformin and acetylsalicylic acid together increases their effectiveness, based on the patients' biomarker levels and survival rates.

The significance of the results is rooted in the fact that aging is a multidimensional process that represents the accumulation of changes in an individual over time. Aging is among the largest-known risk factors for most human diseases. Roughly 100,000 individuals worldwide die every day of age-related causes (de Grey 2007). Therefore, developing geroprotective protocols, with demonstrated metabolic goals and biomarkers of effectiveness and safety, is a primary duty of preventive medicine in fighting against common aging-associated diseases. Metformin and acetylsalicylic acid, in association, fulfill this objective. These results are required for a first stage in the development of a geroprotective protocol.

Our results show a significant decrease (t-test) in serum levels of glycosylated hemoglobin and ferritin after five years in the population treated with metformin, acetylsalicylic acid, or both drugs. Glycosylated hemoglobin and ferritin have been identified as markers of aging by pointing out the level of glycosylation and inflammation associated with aging, when other causes of their variations are ruled out as provided in our sample (anemias and chronic systemic inflammatory conditions discarded). The decrease in these two markers may correspond to a decrease in the aging gradient in the population treated with metformin (Anisimov 2013) and/or acetylsalicylic acid (Ayyadevara et al. 2013), which could be compatible with the geroprotective activity attributed to these two drugs at a pre-clinical and clinical level. Aging-associated diseases represent the most significant cause of death in the age group represented in our sample; therefore, the decrease in mortality detected in the group treated with metformin and acetylsalicylic acid is a sign to be highlighted for the planning of future investigations.

## Conclusions

Over the course of five years we compared three groups of forty individuals each, respectively treated with metformin, acetylsalicylic acid, or both drugs together, with a fourth, non-treated group. At the end of the five-year period, there were few living individuals in the non-treated group, more living in the groups treated with metformin or acetylsalicylic acid, and the greatest number of survivors in the group treated with both drugs. There was an increase in glycosylated hemoglobin and ferritin in the groups treated with metformin and acetylsalicylic acid, but there was a more significant increase in the group treated with both drugs together.

Previously, a growing number of drugs had demonstrated geroprotective activity in experimental models in which they were tested individually. The development of an intervention protocol in clinical practice for the prevention of aging-associated diseases had its first steps when geroprotection in humans began to be verified. In an attempt to progress in this development, the present study explored the possible benefit of associating at least two geroprotectors. We proposed that researchers explore the usage of these or other biomarkers of metabolic pathways associated with aging in order to develop geroprotectors within the framework of preventive medicine.

The results are compatible with this benefit, evaluated through markers of aging and, mainly, of survival. (Non-survival in this context means death associated with aging.) Thus, it is necessary to continue the development of geroprevention protocols for clinical practice, trying new associations and identifying the chronopharmacology of each incorporated drug. If these developments optimize protocols that delay aging-associated diseases and, consequently, prolong life expectancy, society must accommodate its aging population for the years that have been added to their lives, with comfort, participation, companionship, and a good quality of life.



Briefly, we conclude that the association of both drugs can improve the geroprotective activity of metformin and acetylsalicylic acid. However, future study is necessary.

## REFERENCES

- Ahmed Dar, Bashir, Manzoor Ahmed Dar, Sheeba Bashir, Saima Nazir, Shania Bashir, and Yawer Bashir. 2015. "Glycosylated Hemoglobin (HbA<sub>1c</sub>): A Biomarker Of Anti Aging." *International Journal of Biological and Medical Research* 6 (3): 5084–86.
- Anisimov, Vladimir N. 2013. "Metformin: Do We Finally Have an Anti-Aging Drug?" *Cell Cycle* 12 (22): 3483–89. <http://doi.org/10.4161/cc.26928>.
- Arkkelin, Daniel. 2014. *Using SPSS to Understand Research and Data Analysis*. Book 1. Valparaiso: Valparaiso University. [http://scholar.valpo.edu/psych\\_oer/1](http://scholar.valpo.edu/psych_oer/1).
- Ayyadevara, Srinivas, Puneet Bharill, Abhijit Dandapat, Changping Hu, Magomed Khaidakov, Sona Mitra, Robert J. Shmookler Reis, and Jawahar L. Mehta. 2013. "Aspirin Inhibits Oxidant Stress, Reduces Age-Associated Functional Declines, and Extends Lifespan of *Caenorhabditis Elegans*." *Antioxidants & Redox Signaling* 18 (5): 481–90. <http://doi.org/10.1089/ars.2011.4151>.
- Bland, J. Martin, and Douglas G. Altman. 2004. "The Logrank Test." *BMJ* 328 (7447): 1073. <http://doi.org/10.1136/bmj.328.7447.1073>.
- Cankurtaran, M., B. B. Yavuz, M. Halil, Z. Ulger, I. C. Haznedaroglu, and S. Ariogul. 2012. "Increased Ferritin Levels Could Reflect Ongoing Aging-associated Inflammation and May Obscure Underlying Iron Deficiency in the Geriatric Population." *European Geriatric Medicine* 3 (5): 277–80. <http://doi.org/10.1016/j.eurger.2012.06.005>.
- Cao, Yu, Jimin Xiong, Shenghui Mei, Fu Wang, Zhigang Zhao, Songlin Wang, and Yi Liu. 2015. "Aspirin Promotes Bone Marrow Mesenchymal Stem Cell-based Calvarial Bone Regeneration in Mini Swine." *Stem Cell Research & Therapy* 6 (1): 210. <http://doi.org/10.1186/s13287-015-0200-4>.
- Conboy, Irina M., and Thomas A. Rando. 2005. "Aging, Stem Cells and Tissue Regeneration: Lessons from Muscle." *Cell Cycle* 4 (3): 407–10. <http://doi.org/10.4161/cc.4.3.1518>.
- de Grey, Aubrey D. N. J. 2007. "Life Span Extension Research and Public Debate: Societal Considerations." *Studies in Ethics, Law, and Technology* 1 (1): <http://www.sens.org/files/pdf/ENHANCE-PP.pdf>.
- Din, Farhat V. N., Asta Valanciute, Vanessa P. Houde, Dania Zibrova, Kevin A. Green, Kei Sakamoto, Dario R. Alessi, and Malcolm G. Dunlop. 2012. "Aspirin Inhibits MTOR Signaling, Activates AMP-activated Protein Kinase, and Induces Autophagy in Colorectal Cancer Cells." *Gastroenterology* 142 (7): 1504–15. <http://doi.org/10.1053/j.gastro.2012.02.050>.
- Franceschi, Claudio, and Judith Campisi. 2014. "Chronic Inflammation (Inflammaging) and Its Potential Contribution to Age-Associated Diseases." *Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 69: S4–S9. <http://doi.org/10.1093/gerona/glu057>.
- Gewirtz, David A. 2013. "Autophagy and Senescence: A Partnership in Search of Definition." *Autophagy* 9 (5): 808–12. <http://doi.org/10.4161/auto.23922>.
- Glick, Danielle, Sandra Barth, and Kay F. Macleod. 2010. "Autophagy: Cellular and Molecular Mechanisms." *Journal of Pathology* 221 (1): 3–12. <http://doi.org/10.1002/path.2697>.
- Kalantar-Zadeh, K., B. R. Don, R. A. Rodriguez, and M. H. Humphreys. 2001. "Serum Ferritin Is a Marker of Morbidity and Mortality in Hemodialysis Patients." *American Journal of Kidney Diseases: The Official Journal of the National Kidney Foundation* 37 (3): 564–72.

- Kumar, Surinder, and David B. Lombard. 2016. "Finding Ponce de Leon's Pill: Challenges in Screening for Anti-Aging Molecules." *F1000Research* 5: 406. <http://doi.org/10.12688/f1000research.7821.1>
- Little, Randie R. 2003. "Glycated Hemoglobin Standardization—National Glycohemoglobin Standardization Program (NGSP) Perspective." *Clinical Chemistry and Laboratory Medicine* 41 (9): 1191–98. <http://doi.org/10.1515/CCLM.2003.183>.
- Longo, Valter D., Adam Antebi, Andrzej Bartke, NirBarzilai, Holly M. Brown-Borg, Calogero Caruso, Tyler J. Curiel, et al. 2015. "Interventions to Slow Aging in Humans: Are We Ready?" *Aging Cell* 14 (4): 497–510. <http://doi.org/10.1111/accel.12338>.
- Lopez-Panades, Elisenda, Elizabeth R. Gavis, and Elena Casacuberta. 2015. "Specific Localization of the Drosophila Telomere Transposon Proteins and RNAs, Give Insight in Their Behavior, Control and Telomere Biology in This Organism." *PLOS ONE* 10 (6): e0128573. <http://doi.org/10.1371/journal.pone.0128573>.
- Menendez, Javier, and Alejandro Vazquez-Martin. 2012. "Rejuvenating Regeneration: Metformin Activates Endogenous Adult Stem Cells." *Cell Cycle* 11 (19): 3521–22. <http://doi.org/10.4161/cc.21878>.
- Moskalev Alexey, Elizaveta Chernyagina, Anna Kudryavtseval, and Mikhail Shaposhnikov. 2017. "Geroprotectors: A Unified Concept and Screening." *Aging and Disease* 8 (3): 354–63. <http://doi.org/10.14336/AD.2016.1022>.
- Moskalev, Alexey, Elizaveta Chernyagina, João Pedro de Magalhães, Diogo Barardo, Hari Krishnan Thoppil, Mikhail Shaposhnikov, Arie Budovsky, et al. 2015. "Geroprotectors.org: A New, Structured and Curated Database of Current Therapeutic Interventions in Aging and Age-Related Disease." *Aging* 7 (9): 616–28. <http://doi.org/10.18632/aging.100799>.
- Moskalev, Alexey, Elizaveta Chernyagina, Vasily Tsvetkov, Alexander Fedintsev, Mikhail Shaposhnikov, Vyacheslav Krut'ko, Alex Zhavoronkov, and Brian K. Kennedy. 2016. "Developing Criteria for Evaluation of Geroprotectors as a Key Stage toward Translation to the Clinic." *Aging Cell* 15 (3): 407–15. <http://doi.org/10.1111/accel.12463>.
- Nusse, Roel. 2005. "Wnt Signaling and Stem Cell Control." *Cell Research* 18 (5): 523–27. <http://doi.org/10.1038/cr.2008.47>.
- Pani, L. N., L. Korenda, J. B. Meigs, C. Driver, S. Chamany, C. S. Fox, L. Sullivan, R. B. D'Agostino, and D. M. Nathan. 2008. "Effect of Aging on A1C Levels in Individuals without Diabetes: Evidence from the Framingham Offspring Study and the National Health and Nutrition Examination Survey 2001–2004." *Diabetes Care* 31 (10): 1991–96. <http://doi.org/10.2337/dc08-0577>.
- Ristow, Michael, and Kathrin Schmeisser. 2014. "Mitohormesis: Promoting Health and Lifespan by Increased Levels of Reactive Oxygen Species (ROS)." *Dose-Response* 12 (2): 288–341. <http://doi.org/10.2203/dose-response.13-035.Ristow>.
- Vigili de Kreutzenberg, S., G. Ceolotto, A. Cattelan, E. Pagnin, M. Mazzucato, P. Garagnani, V. Borelli, et al. 2015. "Metformin Improves Putative Longevity Effectors in Peripheral Mononuclear Cells from Subjects with Prediabetes. A Randomized Controlled Trial." *Nutrition, Metabolism and Cardiovascular Diseases* 25 (7): 686–93. <http://doi.org/10.1016/j.numecd.2015.03.007>.
- Wood, Jason G., Brian C. Jones, Nan Jiang, Chengyi Chang, Suzanne Hosier, Priyan Wickremesinghe, Meyrolin Garcia, et al. 2016. "Chromatin-Modifying Genetic Interventions Suppress Age-Associated Transposable Element Activation and Extend Life Span in Drosophila." *Proceedings of the National Academy of Sciences* 113 (40): 11277–82. <http://doi.org/10.1073/pnas.1604621113>.

## ABOUT THE AUTHORS

***Dr. Eduardo Lasalvia-Prisco:*** Academic Director, R&D, Interdoctors–Telemedical Organization, Montevideo, Uruguay; Former Professor of Medicine, School of Medicine, University of the Republic of Uruguay, Montevideo, Uruguay

***Dr. Carlos Dau:*** Director, R&D, Interdoctors–Telemedical Organization, Montevideo, Uruguay

***Jesus Vazquez:*** Director, R&D, Interdoctors–Telemedical Organization, Montevideo, Uruguay

***Dr. Pablo Goldschmidt:*** Director, R&D, Interdoctors–Telemedical Organization, Paris, France

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*Author(s):* Eduardo Lasalvia-Prisco, Carlos Dau, Jesus Vazquez, Pablo Goldschmidt, Felipe Galmarini

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## Abstract

Metformin and acetylsalicylic acid, two drugs that have been used in medicine for many years, are suspected to be geroprotectors, according to experimental research. Clinical observations of the drugs are compatible with the extension of geroprotective conditions to humans. In this study, we compared the variation of two parameters in blood chemistry that have been reported as markers of anti-aging activity, measured in people who had been treated for five years with one or two of these drugs. Also, we reviewed the metabolic targets of the drugs to support their effectiveness in anti-aging and the prevention of aging-associated diseases. In conclusion, the groups of forty people who were treated for five years with low doses of metformin, acetylsalicylic acid, or both, experienced significant decreases in glycosylated hemoglobin and ferritin, in comparison to a non-treated group. At the end of the five-year period, the number of living individuals in the non-treated group was minimal, higher in the groups treated with metformin or acetylsalicylic acid, and highest in the group treated with both drugs together.