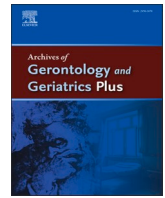




Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics Plus

journal homepage: www.sciencedirect.com/journal/archives-of-gerontology-and-geriatrics-plus

Leveraging human-AI collaboration to visualize age-related diabetes features using dataset

ARTICLE INFO

Keywords

Generative AI tools
ChatGPT
Bing.com with ChatGPT-4
Gemini

ABSTRACT

This paper explores the synergy between humans and generative AI in the context of diabetes and biochemical analysis for endocrinologists. It underscores the necessity for human intervention to supplement the information that the AI has not yet learned, using search engines as a tool. The paper is crafted to be user-friendly, catering to both novices and those without a programming background. It covers human-centric for code verification, while the generative AI is tasked with creating Python code for data visualization automatically. The paper introduces a succinct set of guidelines for interacting with these AI tools, with the aim of minimizing unnecessary interactions. It guides readers on how to harness the power of the latest generative AI to assist and expedite research, using various search operators or options. While acknowledging the limitations of these generative AI tools, the paper emphasizes their potential in streamlining scientific research by reducing time and cost. It provides tangible examples, such as the visualization of graphs for the HbA1c dataset. In conclusion, despite their limitations, the paper champions the use of generative AI tools to propel advancements in science and technology. It highlights their significant potential in reducing time and cost, thereby catalyzing the pace of research.

Dear Editor,

Humans play a crucial role in guiding generative AI (Parviainen & Rantala, 2022), not only by gathering the latest information over the Internet but also by formulating precise queries for desired outcomes. This collaboration enhances the AI's relevance and effectiveness, particularly in data visualization. The use of generative AI, which can create new content through dialogue, has become vital in fields like endocrinology. It aids in research and biochemical analysis, such as HbA1c, by learning from existing data and generating new examples. Knowledge of guiding techniques enhances the efficient use of AI, marking a shift from traditional AI's focus on pattern identification and decision-making.

This paper uses generative AI to visualize HbA1c biomarkers from a public dataset, examining diabetes trends by age. Despite the dataset's complexity, the AI simplifies the task, enabling beginners to generate code and visualize the data effectively. Human intervention is crucial in guiding AI systems in data and information search over the Internet (Stokel-Walker, 2023). The following table provides a summary of Google Search operators.

Operator	What its function is.	Example
()	group multiple search	(diabetes AND (data OR dataset))
AND	Search for information associated with X and Y	(diabetes AND dataset)
OR	Search for information associated with X or Y	(data OR dataset))
“ “	Search for results including a word or phrase.	“diabetes dataset”
-	Search for results excluding a word or phrase.	-Japan
filetype:	Search for specific file category	filetype:pdf
site:	Search for results from a website	site.nih.gov

(continued on next column)

(continued)

allintitle:	Search for pages with multiple words in the URL	allintitle:diabetes dataset
allintext:	Search for pages with multiple words in their content.	allintext:diabetes dataset
before:	Search for information prior to a specific date.	before:2020
after:	Search for information a specific date.	After:2011-03-11
define:	Search for the definition of a word or phrase	define:"macular edema"

The human intervention generated by Google Search are the product of executing specific operational commands. It's important to note that generative AI may not possess the necessary capabilities to identify appropriate datasets or to find new information over the Internet.

Dialog generative AI systems, such as online interactive dialog AI and terminal command AI (GitHub, 2023), have different access methods and settings. This paper highlights the interactive use of Google's Gemini (Microsoft Bing Blogs, 2023) instead of Bing.com's ChatGPT-4 (OpenAI, 2023) via the Edge browser (King, 2023), an advanced system by OpenAI.

This paper provides a guide for researchers to use AI effectively in generating Python code for diabetes research.

The dataset, which was compiled and analyzed for lifestyle habits and HbA1c levels, encompasses data from 2012 to 2014 pertaining to middle-aged and elderly individuals in Japan (Maw & Haga, 2018). The dataset in focus contains 6156 records, each characterized by 68 attributes, including "Age" and "HbA1c". The "Age" attribute varies from 40 to 74 years, while the "HbA1c" attribute ranges from 3.5 to 12.9. The Python code is designed to calculate the mean "HbA1c" value for each of the seven age brackets, specifically 40–45, 45–50, 50–55, 55–60, 60–65, 65–70, and 70–75 years.

Essential keywords and key phrases are highlighted and emphasized in the query which is fed to Gemini:

<https://doi.org/10.1016/j.aggp.2024.100025>

Received 1 April 2024; Received in revised form 9 April 2024; Accepted 9 April 2024

Available online 15 April 2024

2950-3078/© 2024 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Query: make a code in Python with `data.csv` to show and save the graph. use pandas library to read `data.csv` with `shift_jis` encoding and matplotlib library for plotting the graph. Use two determinants such as "Age" for x-axis and "HbA1c" for y-axis, divide the range of all possible values in "Age" to multiple age groups, calculate the average of each age groups on "HbA1c" within age range, and show the graph with x-axis as age groups and y-axis as the average of "HbA1c" in each age group. Calculate the number of members in each age group and reflect them on the plotted graph with scatter. Values of "Age" is from 40 to 74. Values of "HbA1c" is from 3.5 to 12.9.

Answer from Gemini:

```
import pandas as pd
import matplotlib.pyplot as plt
# Read the data from the CSV file.
df = pd.read_csv("data.csv", encoding="shift_jis")
# Divide the range of all possible values in "Age" to multiple age groups.
age_groups = [40, 45, 50, 55, 60, 65, 70, 75]
# Calculate the average of each age groups on "HbA1c" within age range.
average_hbA1c = []
for age_group in age_groups:
    average_hbA1c.append(df[df["Age"] >= age_group]["HbA1c"].mean())
# Calculate the number of members in each age group.
number_of_members = []
for age_group in age_groups:
    number_of_members.append(df[df["Age"] >= age_group]["Age"].count())
# Plot the graph with x-axis as age groups and y-axis as the average of "HbA1c" in each age group.
plt.scatter(age_groups, average_hbA1c, s=number_of_members)
plt.xlabel("Age")
plt.ylabel("Average HbA1c")
plt.title("HbA1c vs. Age")
plt.savefig("hbA1c_vs_age.png")
plt.show()
```

Running the generated Python code results in the creation of a graph, as depicted in Fig. 1. In Query with Gemini for generating the Python code, we must supply the accurate determinant names of the dataset for visualizing the targeted goal on HbA1c. As much as possible, we must also eliminate noise from the dataset to visualize and accomplish the desired task. To reduce the need for multiple conversations with generative AI, users should suggest error-less or error-free libraries for use in the target Python code. Generative AI systems alone may not be sufficient to tackle complex problems. It might be necessary for users to break down the task into manageable subtasks.

Generative AI requires precise user queries to produce accurate visualizations. Novices and non-programmers might struggle to instruct the AI to visualize desired trends across seven age groups, as it takes eight thresholds to calculate the average for these groups, ranging from 40 to 74 years old. In other words, beginners might find it challenging to compute the average 'HbA1c' levels for each age group within a specified range without using the keyword 'age range' in Query. Therefore, users are required to validate the eight thresholds present in the generated Python code.

Presently, generative AI systems are grappling with issues of reproducibility, and they also pose potential ethical concerns, particularly in the realm of medical research and healthcare applications.

Funding

This research has no fund.

CRediT authorship contribution statement

Yoshiyasu Takefuji: Writing – review & editing, Writing – original

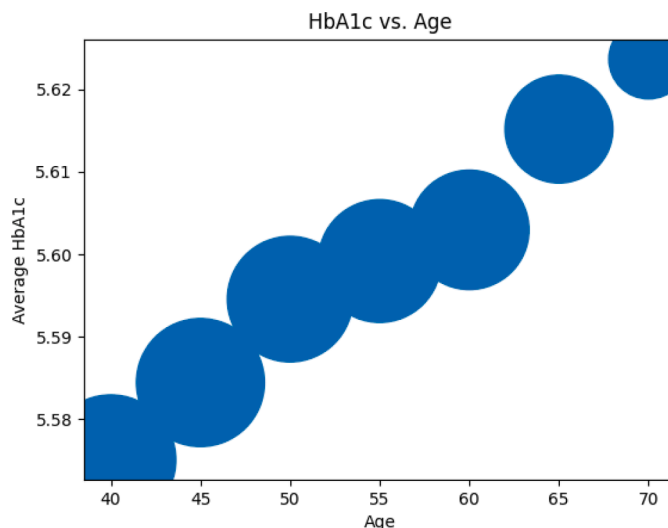


Fig. 1. Created graph by running Python code with Gemini.

draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

References

- Parviainen, J., & Rantala, J. (2022). Chatbot breakthrough in the 2020s? An ethical reflection on the trend of automated consultations in health care. *Medicine, health care, and philosophy*, 25(1), 61–71. <https://doi.org/10.1007/s11019-021-10049-w>
- Stokel-Walker, C. (2023). AI chatbots are coming to search engines - can you trust the results? *Nature*. <https://doi.org/10.1038/d41586-023-00423-4>. Advance online publication.
- GitHub. (2023). How to use generative AI systems <https://github.com/y-takefuji/openai>.
- Microsoft Bing Blogs. (Accessed on May 21, 2023). Confirmed: The new Bing runs on OpenAI's GPT-4. https://blogs.bing.com/search/march_2023/Confirmed-the-new-Bing-runs-on-OpenAI%E2%80%99s-GPT-4.
- OpenAI. (Accessed on May 21, 2023). GPT-4 is OpenAI's most advanced system, producing safer and more useful responses. <https://openai.com/product/gpt-4>.
- King, M. R. (2023). Can Gemini, Google's experimental Chatbot based on the LaMDA large language model, help to analyze the gender and racial diversity of authors in your cited scientific references? *Cellular and molecular bioengineering*, 16(2), 175–179. <https://doi.org/10.1007/s12195-023-00761-3>
- Maw, S. S., & Haga, C. (2018). Dataset for lifestyle behaviors and HbA1c status from 2012 to 2014 of Japanese middle aged and elder people. *Mendeley Data*, V1. <https://doi.org/10.17632/g7gzwd4c7h.1>. <https://data.mendeley.com/datasets/g7gzwd4c7h>

Yoshiyasu Takefuji

Faculty of Data Science, Musashino University, 3-3-3 Ariake Koto-ku,
Tokyo 135-8181, Japan

E-mail address: takefuji@keio.jp