

**write@uni**

## Annotated Research Report

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**Effect of a 19-day Mediterranean Diet on autonomic tone and reactivity in a 20 year old male: a case study**

Author's name

As this example shows, the **title** of a research report provides an overview of the research to be reported on, the participant(s), and the purpose and type of study.

Note that full sentences are not required when writing the **title** of a research report. Also, note that titles are often written in **two parts** with one phrase counterbalanced by another that gives additional information. These two phrases are joined by a colon.

The **introductory** or **topic sentence** of this first paragraph not only introduces the topic of the initial paragraph, but also the importance of the research.

Adherence to a Mediterranean diet has been associated\* with a reduction in the prevalence of **cardiovascular** disease. **Indeed**, the **PREDIMED** study found that the consumption of a Mediterranean diet reduced the relative risk of individuals suffering a major **cardiovascular** event (e.g. **stroke**, **myocardial infarction**) by 30%.<sup>1</sup> **Furthermore**, a number of trials have indicated that the Mediterranean diet is associated with a 30-70% reduction in the recurrence of **cardiovascular** events following **myocardial infarction** or **stroke**.<sup>2</sup> The underlying mechanisms mediating primary and secondary prevention of **coronary** heart disease by the Mediterranean diet, however, have been incompletely elucidated.

The first section of a research report is the **Introduction**. The main purpose of this section is to **introduce** and highlight the importance of **the research topic**, **provide background** to the research, **review** the relevant **literature**, **identify** the **gap** in the research to be addressed, provide the **rationale** for the research, and briefly describe the **methodology**.

Note the way that the writer skilfully connects one sentence to another using the **connectors** "indeed" (to introduce evidence of the significance of the Mediterranean diet) and "furthermore" (to introduce further research evidence).

Here, with the last two words of the paragraph "incompletely elucidated" the writer is providing an **initial signal** to the reader that there is a **gap** in the current research and, therefore, a need for this study.

See the extensive use of the **passive voice** in the first paragraph (apart from the second sentence) and in the introduction section. The passive is used so that the **focus** of each sentence is on the **findings** of research being reported on rather than the name of the studies or the researcher(s) carrying out the studies.

The term 'Mediterranean diet' refers to the nutritional habits that permeated Crete, Greece and Southern Italy during the early 1960s.<sup>3</sup> It is characterized by the high consumption of **monounsaturated** fat rich olive oil, omega 3 fatty acid rich fish, fruit, vegetables, brown rice and bread, the

Here, the writer gives a clear, succinct **definition** of the term "Mediterranean diet". Introducing this term early in the paper was important because understanding its meaning is central to understanding of the entire paper.

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consumption of alcohol and the low consumption of dairy products, red meat and processed foods.<sup>3</sup> This is **markedly** different from the Western diet predominant in countries such as New Zealand which is characterized by high levels of saturated fats and simple carbohydrates.<sup>4</sup>

Note the skilful use of the adverb "**markedly**" in this sentence. This adverb has a **strong meaning** and therefore strengthens the contrast between the Mediterranean and Western diet. To reduce the contrast the writer could have said, for example, "somewhat", "slightly" or "minimally".

As this paragraph illustrates, there are frequent **tense switches** in the literature review. The **present tense** is used in the first sentence ("is") to present an established fact. The **simple past** is used in the second sentence ("determined") to present the indisputable findings of a study carried out in the past. Also in the second sentence is the **simple past passive** ("was associated with"). The verb "associated with" tends to be used in the passive as it avoids the need to focus on who did the action (the agent).

Poor **autonomic function** is a well-established risk factor for **cardiovascular** disease. The **Framingham** Heart study determined that a one-standard deviation diminution in the **SDNN**, the standard deviation for all of the normal RR intervals, was associated with a 47% increase in the risk of suffering from a major **cardiovascular** event.<sup>5</sup> **Furthermore**, in patients who had already experienced a **myocardial infarction**, subnormal HRV was associated with a three- to four-fold increase in the 2.5 year mortality rate.<sup>6</sup> **Additionally**, high heart rates and **hypertension** have both been associated with increased **cardiovascular** mortality. **Therefore**, identifying mechanisms by which to improve **cardiac autonomic control** is essential.

A switch is made to the **past perfect** in the third sentence to draw attention to a specific group of patients from the study (i.e., those "who had already experienced a myocardial infarction"). Also in this sentence the **simple past passive** is used: "was associated with" (see note about previous sentence). Then the **present perfect passive** form of this verb is used in the next sentence: "have both been associated with". The difference in meaning between the **past passive** and **present perfect passive** is that the latter is thought to have more relevance to the situation now than the event discussed in the previous sentence which is situated in the past.

In the last sentence a switch is made back to the **present tense** to indicate that the writer views this as an accepted fact or truth.

In this paragraph the writer continues to **review the literature** relevant to this particular research study. It appears that more recent findings are the focus here.

Recently, **evidence** has emerged suggesting the Mediterranean diet has the capacity to improve **autonomic function**. Assessing **autonomic function** requires examining both the **tonicity** and reactivity of the **sympathetic** and **parasympathetic nervous systems**.<sup>7</sup> The **sympathetic** and **parasympathetic**

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See how the writer skilfully uses **specialised vocabulary**; e.g., "cardiovascular". According to the Oxford Advanced Learners Dictionary this is an adjective which means "connected with the heart and the blood vessels".

**branches** of the **autonomic nervous system** each have a tonic level of activity. Chronic **sympathoexcitation** has been linked with a number of **cardiovascular** conditions including **hypertension** and heart failure.<sup>8</sup> Ascertaining mechanisms by which to shift the **autonomic system** to a more **parasympathetic-dominated tone**, either by reducing **tonic sympathetic** or increasing **tonic parasympathetic** activity, has become a particularly active area of research.<sup>8</sup> Evidence **suggests** the Mediterranean diet is capable of inducing this shift. Long-term and short-term adherence to the Mediterranean diet is inversely associated with **systolic** and **diastolic** blood pressure as evidenced by results from the **PREDIMED** trial and **EPIC** study.<sup>9, 10</sup> Additionally, the SUN project demonstrated that heart rate is inversely associated with long-term adherence to the Mediterranean diet.<sup>11</sup>

Note the way in which the writer uses the verb "suggests" to **hedge** or make a **tentative claim**. The writer may do this because the evidence is still inconclusive.

See the careful attention the writer gives to **defining key terms**; in this case "autonomic reactivity". Comprehending the meaning of this term is essential to comprehending the meaning of the report. It is especially important for writers to explain what they mean when they use a particular term when there are variations in meaning.

Long-term adherence to the Mediterranean diet has also been associated with improved autonomic reactivity. Autonomic reactivity refers to the extent to which an individual responds to different stimuli such as a fall in blood pressure.<sup>7</sup> Results from the Twin Hearts Study showed a significant positive association between Mediterranean diet consumption and **heart rate variability (HRV)**.<sup>12</sup> **Perhaps** most notable was the difference in the pNN50, with scores of 1.73% and 2.18% in those with low and high adherence to the Mediterranean diet respectively.<sup>12</sup>

Note the **strong link** that is made between these two paragraphs with the last phrase of the earlier paragraph "long-term adherence to the Mediterranean diet" used to introduce the next paragraph. As in this case, **repetition** is **sometimes a very effective linker** to ensure that there is no ambiguity or confusion in meaning. Often it is possible, however, to create a link another way by, for example, using a reworded phrase or a pronoun.

See how the writer introduces the **acronym** "HRV". First the term is **written in full** ("heart rate variability") and then the **first letter** of each word is capitalised and placed in brackets. From this point onwards only the acronym will need to be written. Be careful not to have too many acronyms because the reader may find it difficult to remember them all.

See how the writer uses the adverb "perhaps" to **hedge** or indicate uncertainty about his interpretation of the HRV study.

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Note here the first example of a **reduced relative clause**. If this clause was written in full it would say, "Obtaining an understanding of the time [that is] required for a ...". Using such clauses helps the writer achieve brevity.

In this sentence, the writer expands on the **purpose of the research** and what it seeks to discover.

Here, in the final sentence of the introduction, the writer provides a **summary of what the study sought to accomplish**. In addition, the writer gives a **brief description** of the **methodology** used.

The **purpose of the Methods section** is to provide details about each of the methods used to collect and analyse data.

Whilst a number of studies have examined the impact of long term adherence to the Mediterranean diet on **autonomic function**, there is a **paucity** of data with respect to the immediate consequences of such a dietary intervention. Obtaining an understanding of the time required for a Mediterranean diet to begin to induce **cardioprotective** changes in **autonomic function** will provide us with an insight into the mechanisms by which it mediates the **forementioned** changes. **Additionally**, many of the recent trials examining the impact of the Mediterranean diet on cardiovascular health have taken place in countries where the baseline adherence to the Mediterranean diet is high. **Additionally**, it is important to ascertain the effect of Mediterranean mediated dietary intervention in countries with a Western diet. Our study sought to assess the impact of a 19-day Mediterranean diet on both **autonomic tonicity** and **reactivity** on a 20 year old male who primarily consumes a Western diet.

## Methods

### *Mediterranean Diet*

Our subject was a healthy 20 year old male. The subject obtained nutritional information made available through the **PREDIMED** trial website to assist with dietary manipulation. Adherence to the Mediterranean diet was assessed using

In this sentence the writer skilfully signals that there is a **gap in the current research** and therefore a need for this study. The writer **creates a research space** by providing an overview of the focus of studies done to date, and then contrasting this with the 'paucity' or 'lack' of studies in the proposed research area; i.e., the immediate consequences of the Mediterranean diet on autonomic function.

Here, the writer provides **additional justification for the research** (because up to now studies have not taken place in countries where people consume a Western diet).

Note the use of the **pronoun "our"**. This pronoun is used because the study was carried out by a group of students.

As this example shows, the Methods section is written in the **past tense**, since the writer is reporting on the methods that were used to collect data.

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Note the use of the **transition signal** "Additionally" to indicate that the writer is presenting an additional reason for using a particular scoring system.

two separate scoring systems. A 14-item questionnaire used in the **PREDIMED** trial was used because it had shown a strong correlation with longer, more time consuming questionnaires traditionally used. <sup>13</sup> **Additionally**, the modified Mediterranean diet scoring system was used because this scoring system was deliberately constructed to assess the transition from a more Westernized diet to a Mediterranean diet.<sup>14</sup>

As this sentence illustrates, the Methods section is primarily written in the **past passive**. This enables the writer to focus on the **result of the action** rather than on who did it. If this sentence was written in the **active** voice the focus would be on **who** did the action and would begin as follows: "Additionally, the researchers used the modified Mediterranean diet scoring system ..."

### Assessment of **Autonomic Tone**

Resting heart rate (RHR) values were measured using an ECG whilst the subject sat stationary for 10 minutes. Calculation of the pNN50% and pNN40% was performed using data obtained during this phase of the experiment. Resting blood pressure values were recorded using a **sphygmomanometer**. **Systolic** blood pressure (SBP), **diastolic** blood pressure (DBP) and mean blood pressure (MBP) were all recorded.

One distinct feature of scientific research reports is the multiple use of **reduced relative clauses**. If the second part of this sentence was written as a full relative clause, it would say, "using data that was obtained during this phase ...". The use of such clauses helps make the writing concise. Reduced relative clauses are in the **passive voice** and should not be confused with the past tense.

Note the **detailed**, but **concise language** the writer uses to **describe each of the assessments** undertaken by the subject. The description of this assessment, for example, begins with a clearly defined heading, followed by a sub-heading with a clear explanation of each stage of the assessment, the time required, and the data recorded.

### Assessment of *Autonomic Reactivity*

*Mental Stress* – Heart Rate was recorded for 1 minute prior to the onset of the mental stress challenge. The subject was then subjected to a series of difficult mathematical questions for 5 minutes. The difference between the average heart rate recorded during the 5 minute mental stress period and the baseline heart rate was recorded.



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**Respiratory Sinus Arrhythmia** – The subject was asked to inhale and exhale in 10 second cycles. The **RSA amplitude** was determined by examining the difference between the peak heart rate during inhalation and the lowest heart rate following exhalation.

**Postural Change** – The change in heart rate during a movement from supine to standing position was assessed in our subject. The **Peak:Baseline** ratio was calculated by dividing the highest heart rate recorded during the **postural** change by the average heart recorded in the 30 seconds preceding **postural** change. The 30:15 ratio was calculated by dividing the value of the longest R-R interval at heart beat 30 following standing by the shortest R-R interval at beat 15 following standing.<sup>15</sup>

**Valsalva Manoeuvre** – The subject was asked to blow against a closed glottis through a mouthpiece with an **expiratory** pressure of 5kPa (37.5mmHg) for 15 seconds. The **Valsalva** ratio was calculated by dividing the longest R-R interval obtained during Phase IV by the shortest R-R interval obtained during Phase II or III.<sup>16</sup> The **tachycardia** ratio was calculated by dividing the shortest R-

R interval obtained during expiration by the longest R-R interval measured in the 30 seconds prior to expiration.<sup>16</sup> The Phase IV overshoot was obtained by finding the difference between the peak systolic pressure prior to Phase I and the peak systolic pressure during Phase IV. **Additionally**, the change in heart rate from the beginning to end of both Phase II and Phase IV were assessed.

**Dive Reflex** – The subject underwent facial immersion in cold water with a temperature of 15°C for 30 seconds. Heart Rate was recorded for the 30 seconds prior to immersion and during the recovery. Average heart rate values were determined for 30 seconds pre-dive, 0-15 seconds during the dive, 15-30 seconds during the dive, and the 30 seconds post-dive. These values were then compared to assess the magnitude and speed of the response.

### *Comparison of data*

Several trials for each variable were conducted pre-diet and post-diet to enable an assessment of the effect of the 19-day Mediterranean diet on autonomic reactivity.

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The **purpose** of the **Results** section is to describe what was found or observed in the study. Key findings are presented pictorially in Tables and Figures and are described by the researcher in explanations within the text.

As this example shows, the writer **introduces each table** to follow: "A summary is given in Table 1." Results are then quantified and displayed in clearly labelled tables. Note the use of shading to distinguish one line from another.

Note the **switches in tense** in this paragraph. First, the **simple past** ("saw") is used to report on the findings. Then, the **simple present** ("is") is used to direct the reader to the Table. After this a switch is made back to the **simple past** ("was" and "did not change") for the writer to report further findings.

**Results**

*Degree of Dietary Intervention*

Two separate questionnaires confirmed the degree of adherence to the Mediterranean diet. A summary is given in Table 1. See Appendix 1 for details of each scoring system.

	Pre-Diet	Diet
<b>PREDIMED Diet Score</b>	3	11
<b>mMDS</b>	23	40

**Table 1:** The subject's diet during dietary intervention was considerably more Mediterranean than prior to the initiation of the diet. The PREDIMED Diet Score has a maximum score of 14. The Modified Mediterranean Diet Score (mMDS) has a maximum score of 44.

*Heart Rate, Blood Pressure and Heart Rate Variability*

Our subject saw a small drop in heart rate and an increase in heart rate variability after the dietary intervention. A summary is shown in Table 2. There was also a small drop in systolic blood pressure and mean blood pressure. Our subject's weight did not change through the 19 day intervention period.

	Pre-Diet	Post-Diet
<b>RHR (bpm)</b>	91.05	87.1
<b>pNN50%</b>	1.68	2.44
<b>pNN40%</b>	4.27	5.27
<b>SBP (mmHg)</b>	149	144
<b>DBP (mmHg)</b>	83	74
<b>MBP (mmHg)</b>	116	109
<b>Weight (kg)</b>	70.5	71

Note the reference here to the **Appendix** where details of this result in the form of raw data is given. It is usual practice to put **non-essential information**, which provides further clarification of a point, in an Appendix. Placing this information here means that unnecessary space is not used within the body of a paper (Bates College, 2011).

As can be seen here, **tables are numbered** and the name of each (e.g., "**Table 1**") is given with a detailed explanation of its contents immediately underneath each one.



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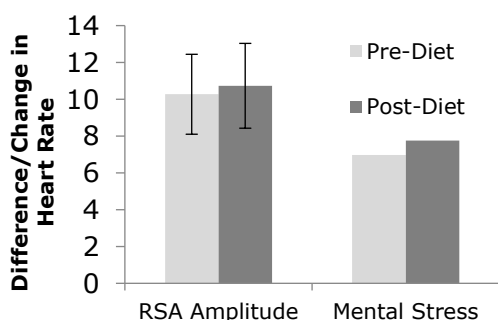
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**Table 2:** Summary illustrating changes in heart rate, heart rate variability, blood pressure and weight following dietary intervention.

*Mental Stress*

The average increase in heart rate in response to the 5 minute mental stress challenge was not notably different following dietary intervention as is illustrated in Figure 1. There was a 6.98bpm and a 7.75bpm increase in heart rate pre-diet and post-diet respectively.



**Figure 1:** RSA amplitude and the increase in heart rate in response to mental stress did not change during dietary intervention. Data represents mean ± standard deviation.

*Respiratory Sinus Arrhythmia*

The amplitude of respiratory sinus arrhythmia (RSA) did not change with dietary intervention. Indeed, the values were near-identical with amplitudes of 10.27bpm and 10.73bpm recorded pre-diet and post-diet respectively.

*Baroreflex Activity*

**Baroreflex** mediated changes in heart rate in response to changes in blood pressure were assessed in a range of different tests. The sympathetic response

to low blood pressure was examined using two separate tests with conflicting results. The increase in heart rate as a subject moved from the supine position to standing was less after dietary intervention. The ratio of peak heart rate to baseline heart rate was higher pre-diet than post-diet with ratios of 1.34 and 1.27 respectively.

However, there was a larger increase in heart rate in response to low blood pressure during phase II of the **Valsalva** manoeuvre after dietary intervention as illustrated in Table 4. However, the tachycardia ratio was identical pre-diet and post-diet. The discrepancy between these two results

	Pre-Diet	Diet
<b>30:15 ratio</b>	1.10 ± 0.04	1.10 ± 0.02
<b>Peak:Baseline ratio</b>	1.34 ± 0.02	1.27 ± 0.04

**Table 3:** Table summarizing heart rate changes during postural change. Data represents mean ± standard deviation.

likely reflects differences in the phase I drop in heart rate which was highly variable both pre-diet and post-diet. Additionally, the phase IV overshoot pre-diet and post-diet were very similar. Thus, the impact of dietary intervention on the response to low blood pressure is unclear.

The response to increased blood pressure was also assessed. The 30:15 ratio assessed during postural change was identical pre-diet and post-diet as illustrated in Table 3.

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	Pre-Diet	Post-Diet
<b>Valsalva Ratio</b>	1.71 ± 0.05	2 ± 0.20
<b>Tachycardia Ratio</b>	0.75 ± 0.02	0.75 ± 0.04
<b>Phase IV Overshoot (mmHg)</b>	43.07 ± 2.72	43.91 ± 10.96
<b>ΔHR Phase IV (bpm)</b>	-42.91 ± 2.18	-51.03 ± 6.46
<b>ΔHR Phase II (bpm)</b>	24.53 ± 2.91	30.16 ± 4.57

**Table 4:** Changes in the primary variables assessed during the Valsalva manoeuvre following dietary intervention. Data represents mean ± standard deviation.

The **Valsalva** ratio and decline in heart rate during phase IV of the **Valsalva** manoeuvre were **substantially** larger following dietary intervention. It **should also be noted** that the variation in the primary Valsalva measurements was **considerably** larger post-diet.

Here the writer uses the **modal phrase** "should also be noted" to draw the reader's attention to this particular result because there was a considerable change.

Note the writer's skilful use of the **adverbs** "substantially", "considerably" and "markedly" here to indicate that these particular results are worthy of note because there has been a **considerable change** as a result of the dietary intervention.

*Dive Reflex*

There was a **markedly** larger decrease in heart rate during the first 15 seconds of the dive phase after dietary intervention as illustrated in Table 5. **However**, there was **substantial** overlap in the heart rate recorded during the second 15 seconds between the pre-diet and post-diet trials.

Note how with the use of the **transition signal** "However", the writer skilfully signals the introduction of a contrasting result.

	Time (s)	Pre-Diet	Post-Diet
<b>ΔHR from baseline (bpm)</b>	0-15	2.36 ± 8.91	-8.77 ± 6.46
	15-30	-8.95 ± 4.35	-13.72 ± 2.52

**Table 5:** Difference between the average pre-dive heart rate and the average heart rate measured during the first and second 15 seconds of the dive period. Data represents mean ± standard deviation.

Interestingly, the average pre-dive and post-dive heart rate was similar in both the pre-diet and post-diet recordings as illustrated in Figure 2. The return to pre-dive heart rate was also faster post-diet.

See how the writer uses the adverb "Interestingly" at the beginning of the sentence. By adding this word, which has a **subjective meaning**, the writer is **making an observation** about this result, and is perhaps indicating that this result was not quite what was expected.

Note the use of the **reduced relative clause** to keep the description of the table short "Difference between the average heart rate [that was] measured ...".

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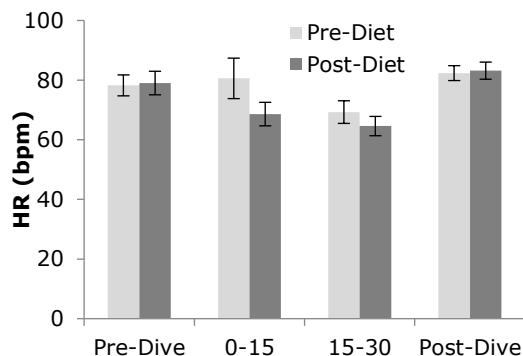
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The **Discussion** section is perhaps the most challenging section to write because the writer needs to **interpret his/her results** in relation to what has already been found in previous studies. This section closely **links to the Introduction** because it **answers the question or responds to the hypothesis** that was raised (see the last paragraph of the Introduction to find the research gap and purpose of this study). This section also explains how the research has moved understanding about the research area forward (cf. Bates College, 2011).



**Figure 2:** Average heart rate recorded during each phase of the dive reflex. Data represents mean  $\pm$  standard deviation.

### Discussion

#### Autonomic Tone – Blood Pressure

The Mediterranean diet resulted in a shift to a more **parasympathetic-dominated autonomic tone** in our subject. This was evidenced by the 4bpm drop in resting heart rate and the 5mmHg drop in systolic blood pressure observed in our subject after dietary intervention. Both of these measures, **however**, are static indices which solely provide an indication as to the net autonomic impact on the cardiovascular system.<sup>7</sup> It is **therefore** not clear whether this shift was mediated by a diminution in sympathetic nerve activity or by an augmentation of parasympathetic activity.

Our drop in systolic blood pressure is more pronounced than expected although not entirely without precedent. Results from the PREDIMED trial revealed that one year following dietary intervention, the average systolic blood pressure of participants on average dropped by 1-3mmHg.<sup>9</sup> **Whilst** our subject's drop was larger than this, this

The **Discussion** begins with the writer responding to the specified **purpose** of the study (see last sentence of the Introduction) by broadly stating the impact of the "Mediterranean diet ... on autonomic tone". Importantly, in the following sentence, the writer provides **evidence** from the study for the claim he has made.

See how the writer skilfully uses **parallelism** in the second half of this sentence where a comparison is made. In other words, the **same grammatical pattern of words** is used. Using parallelism makes it easier for the reader to follow the argument.

Note the use of the **pronoun "our"** here where the writer refers to the results of **his group's research**: "Our drop in systolic blood pressure ..."

Here, the writer **interprets the results** from his group's research in light of other research (the PREDIMED trial) that was introduced in the Introduction.

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Here the writer continues to **compare results** from previous research (the PREDIMED trial) and the writer's own study. The writer highlights **similarities** ("was similar to") and **differences** ("approximately 6 points higher" and "representing a 2.2 to 2.8 increase") between the two studies.

Note that the **active voice** is used much more in the Discussion Section than the **passive**. When the active voice is used, the subject of the sentence is the *doer* or *performer* of the action, and the object is the *receiver* of the action. The active voice is used in this sentence because it is important for the writer to specify who the **subject** is in the two studies being compared.

is not surprising. The majority of participants in the PREDIMED trial, however, had a baseline diet that was similar to the Mediterranean diet used in the study.<sup>9</sup> Indeed, the baseline adherence level on average was 8.6 to 8.8 out of 14, approximately 6 points higher than our subject's baseline diet.<sup>9</sup> The level of dietary adherence was approximately 10.6 following dietary intervention, representing a 2.2 to 2.8 increase in Mediterranean diet adherence.<sup>9</sup> The Mediterranean diet adherence score was similar to our subject's during the trial. Thus, the more pronounced drop in systolic blood pressure observed in our experiment likely reflects the higher degree of dietary modification our subject experienced. An additional reason for the difference might reflect the average age of the participants. Participants in the PREDIMED trial had an average age of 67 whereas our subject was a 20 year old male.<sup>9</sup> The younger age might also have facilitated the greater responsiveness. One noteworthy feature of our results was the time-frame under which they were achieved. The dramatic change in diet our subject underwent was capable of influencing blood pressure and heart rate in the short-term.

The precise mechanisms by which the Mediterranean diet mediates a fall in blood pressure remain unclarified. Whilst a number of the individual components

As can be seen here, frequent reference to the literature is made in the Discussion. A particular journal **referencing style** is used, which requires the citation to be represented by a superscript number and the full reference to be placed in the references section at the end of the paper.

Note the frequent use of **hedging** or **tentative language** in this section, where the writer is **interpreting the difference in results** from his group's study with previous research. By using the adverb "likely" and the modal verb "might", the writer indicates that these are **possible**, but by no means definite, **reasons for the differences** in the results.

In contrast to the previous three sentences, the writer takes a **confident stance** here by using **adjectives** with a **strong meaning** ("noteworthy" and "dramatic") to indicate the significance of these results.

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of the Mediterranean diet have been shown to reduce blood pressure, the specific biochemical pathways involved are still being elucidated. For example, the preferential consumption of foods with a low glycemic index (brown rice, brown bread, no sweet deserts) is associated with reduced systolic blood pressure.<sup>17</sup> High blood glucose levels are associated with enhanced O-linked N-acetylglucosaminylation of endothelial nitric oxide synthase (eNOS) leading to a reduction in nitric oxide (NO) production and hence heightened sensitivity to vasoconstrictive stimuli such as norepinephrine.<sup>18</sup> It is thus feasible that the reduced consumption of glucose and other simple carbohydrates by our subject facilitated heightened NO production in the vasculature and hence a reduced blood pressure. Furthermore, the increased consumption of olive oil, monounsaturated fatty acids, omega-3 fatty acids and fruit and vegetables and the reduced consumption of red meat have all been shown to independently reduce systolic blood pressure.<sup>19-23</sup>

Interestingly, heightened levels of docosahexaenoic acid (DHA) have been shown to significantly reduce the response of the forearm vasculature to heightened sympathetic norepinephrine release.<sup>24</sup> This suggests there is some commonality in terms of the location of the hypotensive inducing effect of various components of the Mediterranean diet, even if the precise signalling pathways are distinct. The changes in

blood pressure induced by each component of the diet individually are usually small and in the vicinity of a 1-2mmHg reduction.<sup>19-23</sup> Thus, it is clear that multiple components of the Mediterranean diet interact, probably synergistically, to lower blood pressure. It is also important to note that our subject did not experience a change in weight. This is significant because a drop in weight is often associated with a reduction in blood pressure.<sup>25</sup>

### *Autonomic Tone – Heart Rate*

The drop in blood pressure in our subject was likely partially mediated by the drop in heart rate. Only one study has been published investigating the relationship between heart rate and the Mediterranean diet. The SUN project found that individuals with a high adherence to the Mediterranean Diet (a score of 7-9 out of 9 on their scoring system) had on average a 2.2bpm lower heart rate than individuals with a low adherence (0-2).<sup>11</sup> Whilst our drop in heart rate might seem large when this study is considered, there are two important factors to keep in mind. The SUN project did not examine the impact of a change in diet and only compared heart rate with an individual's existing diet.<sup>11</sup> It would not be surprising if the impact of a change in diet was more pronounced than 2.2bpm given the potential role of psychological factors and the placebo effect. It is difficult to

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determine the impact that a subject's perception of the health value of their diet has on the final results. Our subject did note that he felt like he had a "greater sense of overall wellbeing" as a result of consuming the diet. Additionally, there was substantial overlap in the range of heart rates recorded during the SUN project. Individuals with a low adherence to the Mediterranean diet had an average heart rate of  $69.1 \pm 10.4$  bpm whereas those with a high adherence had an average heart rate of  $66.9 \pm 10$  bpm.<sup>11</sup> Given this degree of overlap, a 4 bpm drop in resting HR is not infeasible.

There are a range of factors that could have contributed to the drop in heart rate in our subject. Increased DHA consumption as a result of the increased fish intake could have contributed. Kang et al. have demonstrated that incorporation of DHA into the membranes of cardiomyocytes results in a reduction in excitability and automaticity.<sup>26</sup> A recent cross-sectional study demonstrated that heart rate is approximately 1.6 bpm lower in moderate alcohol drinkers than in individuals who [do not] drink or drink heavily.<sup>27</sup> This is notable as one of the starkest changes in diet for our subject was the transition from not drinking wine to having one glass a day. However, it is not possible to isolate the specific dietary components that mediated the shift in autonomic tone. It is interesting to note, however, that our

subject's vegetable and nut consumption did not increase during the diet. Both of these are traditionally seen as key components of the Mediterranean diet and have been shown to enhance a shift to a more parasympathetic favourable autonomic tone. Our results suggest that, at least in our subject, neither is absolutely required to mediate the drop in blood pressure or heart rate. It is also worthy of note that whilst the subject's fruit consumption increased, this was not picked up by either of our scoring systems because the threshold fruit consumption was met pre-diet and post-diet.

### *Autonomic Reactivity - HRV*

The results regarding the influence of the Mediterranean diet on our subject's autonomic reactivity were inconclusive and in some cases conflicting. The HRV as measured by the pNN50 and pNN40 increased. Our decision to measure the pNN40 as well as the pNN50 reflected recent evidence indicating that lower values of x in pNNx tests were better at discriminating the autonomic function between two separate groups.<sup>28</sup> Our subject's results for the pNN50 and pNN40 increased following dietary intervention indicating our subject had an increase in HRV. Higher values of HRV are generally considered to reflect heightened parasympathetic modulation of autonomic tone.<sup>7, 29</sup> This reflects the reality that parasympathetic nervous system can regulate heart rate on a beat



by beat basis due to the rapid activity of **acetylcholinesterase** which is present at the synaptic cleft in high concentrations.<sup>30</sup> **Sympathetic** activity, **however**, mediates changes over a slightly longer time period.<sup>30</sup> Our results were consistent with the findings of the Twin Hearts Study. They found that individuals with a low adherence to the Mediterranean diet (score of 0-3 out of 9 in their scoring system) had a pNN50 of 1.73% **whereas** individuals with a high adherence to the Mediterranean diet (score of 6-9) had a pNN50 of 2.18%.<sup>12</sup> Our subject saw their pNN50 increase from 1.68% to 2.44% post-diet. **However**, this comes with the obvious caveat that our HRV was only measured over a 10 minute resting stationary period. **Whilst** Fei et al. have demonstrated that short term (5 minute) measures of HRV are significantly correlated with 24 hour assessments of HRV, this correlation was weak ( $r = 0.51$ ).<sup>31</sup> Longer term measures of HRV have been shown to have a stronger capability to predict cardiovascular outcomes than short term measures and **therefore** the vast majority of trials assess HRV by performing a 24 hour Holter **ambulatory ECG recording**.<sup>12, 31</sup> **HRV** during our 10 minute recording **could** be susceptible to differential external stimuli and breathing patterns that **might** impact the results.

### *Autonomic Reactivity – Baroreflex*

Intriguingly, the shift in our subject's autonomic reactivity following dietary intervention appeared to be stimulus dependent. This was most evident in our assessment of the subject's **autonomic baroreflex control**. Our subject's response to a stimulus of low blood pressure was either reduced or unchanged post-diet depending on the test performed. Our subject's heart rate response following a change in posture from supine to standing was diminished **whereas** the **tachycardia ratio** and **Phase IV overshoot** observed during the Valsalva manoeuvre was unchanged post-diet. Both of these measures assess the cardiac response to transient low blood pressure. **Taken in concert**, these results suggest that the response to low blood pressure stimuli, which reflects a combination of **sympathetic activation** and **vagal withdrawal**, was slightly diminished post-diet.

A similarly conflicting pattern of results were observed with regards to our subject's response to high blood pressure. **Whilst** the 30:15 ratio assessed during postural change was unchanged, the **Valsalva** ratio and absolute change in heart rate during Phase IV of the **Valsalva** manoeuvre were increased. The lack of a difference in the results for the 30:15 ratio **might** reflect the difficulty in precisely locating the 15th and 30th heart beat post-standing. **Taken together**, these results

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suggest that the autonomic response to high blood pressure stimuli, which reflects a combination of **parasympathetic activation** and **sympathetic withdrawal**, was slightly enhanced post-diet.<sup>8</sup> Whilst this is admittedly speculative, the coupling of a heightened response to high blood pressure with a diminished response to low blood pressure, is perhaps indicative of a shift in the **baroreflex stimulus-response** curve to the left. This would be consistent with the drop in **systolic** and **diastolic** blood pressure observed in our subject post-diet. Whilst dietary changes in salt intake have been shown to be capable of inducing a shift in the **baroreflex** curve, there is a **paucity** of research examining the link between other dietary modifications and the **mentioned shift**.<sup>32</sup> It should be noted that our subject's salt intake was not deliberately altered during the experiment. However, the reality that several of the variables measuring the autonomic response to the **baroreflex** did not change post-diet hinders our capacity to draw a firm conclusion.

### *Autonomic Reactivity – Mental Stress and RSA*

The **autonomic response** to mental stress and RSA did not change dramatically following dietary intervention. Whilst the **RSA amplitude** and increase in heart rate associated with mental stress were slightly increased post-diet, the differences were small and likely reflect natural variation.

The heart rate response to mental stress is thought to result from a range of stimuli, most notably cognitive input from the **cerebral cortex** to the **cardiovascular control centre** in the brainstem.<sup>16</sup> Whilst our subject's response to the mental stress did not change, it should be noted that the reliability of this test as an index of **sympathetic** activity is limited by the need to provide stimuli that should induce a consistent level of mental stress. Whilst the degree of difficulty of the mathematical questions asked of our subject did not change, the number of individuals present and observing the study was higher during the pre-diet assessment than the post-diet assessment. This might have artificially inflated the heart rate response to mental stress observed pre-diet.

**RSA** is mediated by input from the central respiratory centre to the **nucleus ambiguus** and the inhibition of **efferent cardiac vagal nerve** activity following lung inflation.<sup>33</sup> In our subject the **RSA amplitude** was unchanged post-diet, perhaps suggesting that the degree of parasympathetic withdrawal during inhalation was not affected by the Mediterranean diet.

### *Autonomic Reactivity – Dive Reflex*

The dive reflex is a common tool used to assess autonomic function. It is often used to assess trigeminal-brainstem-vagal activity. The drop in heart rate observed in our subject during the first 15

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seconds post-diet might simply reflect the subject becoming increasingly accustomed to the facial immersion. Interestingly, there was substantial overlap occurring between the average heart rates recorded during the second fifteen seconds of the dive pre-diet and post-diet suggesting that the diet had a limited impact on the overall magnitude of the parasympathetic response to the dive reflex.

Note that the writer begins this section with the **most pertinent limitations** of the study and **signals** to the reader the order in which these will be addressed. The first, "the participation of only one subject" is addressed in this paragraph, and the second, "the lack of a placebo group" is addressed in the next.

### *Limitations*

The most pertinent limitation in our experiment is the participation of only one subject and the lack of a placebo-control group. It is not possible to extrapolate data obtained from one individual and apply it to the population at large. Our subject was a healthy 20 year old, normal weight, non-smoking male. The response to the Mediterranean diet is likely to be substantially affected by age, gender, the original baseline diet, the presence of co-morbidities, weight, the use of anti-hypertensive drugs, smoking, waist circumference, exercise frequency and a range of additional factors.<sup>12</sup> None of these factors can be controlled for in a study involving one individual.

As shown in this example, it is very important to include the **limitations** of a study. Reference to these can also be made in the Methods and Results. Identifying the limitations of a study shows that you are able to evaluate your research and see its shortcomings. Reference to limitations (particularly in the Discussion) also opens up possible avenues for future research (Glassman-Deal, 2010).

Our study also lacked a placebo group. Whilst the high level of consistency observed pre-diet and post-diet across several measured autonomic tests adds weight to the idea that changes in the Valsalva ratio and suchlike were potentially mediated by the dietary

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changes, the presence of a placebo group would have provided an indication as to whether the changes in the **autonomic** test scores obtained by our subject were the result of natural variation.

Another limitation was that a number of the tests we were using to assess autonomic activity, whilst are commonly used in the clinic to assess a range of conditions, have not previously been used to assess the impact of the Mediterranean diet on **autonomic** function. Therefore, it was difficult and in some cases impossible to assess whether our data was consistent with what had been observed elsewhere.

See how the writer skilfully switches between the **active and passive voice** in this paragraph: the active is used when the writer wants to specify the **agent** or **doer** of the action (e.g., "our data was"), whereas the passive is used when the writer does not want to specify this (e.g., "have not previously been used").

Note the way in which the writer skilfully develops a **coherent and logical argument** in this paragraph. Each sentence is clearly connected to the one that precedes it. The writer achieves coherence by:

- (1) **elaborating on a claim**; e.g., The writer's claim in the first sentence about the "limitation of dietary intervention as a therapeutic tool" is elaborated on in the next with the statement "An individual's preference for specific food groups has a major impact on ..."
- (2) **using transition signals** at the beginning of sentences (i.e., For example, Thus, and Ideally).

Our study also illustrates the most significant limitation of dietary intervention as a therapeutic tool. An individual's preference for specific food groups has a major impact on the capacity to adhere to a Mediterranean diet. For example, our subject did not consume nuts or increase his consumption of vegetables such as tomatoes during the diet. Thus, our subject only managed to achieve a dietary adherence score of 11 out of 14. Ideally, our subject would have achieved a score of 14.

The first sentence of the **concluding paragraph** of the Discussion **sums up the limitations** by clearly stating that "no firm conclusions can be drawn". Then, importantly, the writer highlights **the general possibilities for future research**.

Here the writer **restates the gap** in the current research, which prompted the need for this study and highlights the need for future studies.

Thus, no firm conclusions can be drawn from our study with respect to the potential benefits of the Mediterranean diet on the rest of the population. It does, however, as many case study reports do, provide insight into potential areas for future research. Much, but not all, of the literature in recent years has been focussed on studies (e.g. the SUN

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Here, the writer highlights **specific possibilities for future research** in light of findings from the current study and from previous studies.

project, **PREDIMED** trial and the EPIC study) in which the base population lived in Europe where adherence to the Mediterranean Diet is high. <sup>9-11</sup> Our study **therefore** acts as a reminder that more data, similar to that acquired during the Lyon Heart Study, is required to ascertain the impact of the transition from a Western to a Mediterranean diet on **autonomic function** and cardiovascular control.<sup>2</sup> This is **imperative** given the high prevalence of cardiovascular disease in societies with a Western diet.<sup>2</sup>

Note the way in which the writer makes a **strong argument** for further research into the impact of the Mediterranean diet in Western societies by beginning the final sentence with the words "This is imperative ...".

### Conclusions

Consumption of a Mediterranean diet for 19 days by our subject resulted in a shift to a more **parasympathetic-dominated autonomic tone**. However, the impact on **autonomic reactivity** was inconclusive with a range of conflicting results. Results from our study highlight the need for more Mediterranean diet-based studies to be performed in populations with a baseline Western diet.

The **Conclusions** is the briefest section of the research report. This section gives the writer the opportunity to sum up the main findings and highlight the possibility of **future research**.

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The **referencing style** used in this paper lists each reference sequentially according to the order it was first mentioned in the body of the paper.

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**Appendix 1: Adherence to Mediterranean Diet**

Shown below is the 14-item Mediterranean Diet Assessment tool used to assess our subject’s degree of dietary adherence. More detailed information regarding the scoring system and specific serving portions has been published previously.<sup>33</sup>

Our subject had a score of 3 prior to commencement of the diet and 11 during the diet.

It is usual practice to put **non-essential information**, which provides further clarification of a point in an Appendix. Placing this information here means that unnecessary space is not used within the body of a paper (Bates College, 2011). This **Appendix** provides details of the results in the form of raw data.

**Table 1: Adherence to the Mediterranean Diet: A 14-item Validated Assessment Model**

Questions	Criteria for 1 point	Pre-Diet	During Diet
Do you use olive oil as the main culinary fat?	Yes		X
How much olive oil do you consume per day?	≥4 tbsp		X
How many vegetable servings do you consume per day (1 serving: 200g)?	≥2		
How many fruit units do you consume per day?	≥3	X	X
How many servings of red meat, hamburger or other meat products do you consume per day?	<1		X
How many servings of butter, margarine, or cream do you consume per day (1 serving: 12g)?	<1		X
How many sweet or carbonated beverages do you consume per week?	<1		X
How many servings of fish or shellfish do you consume per week (1 serving:100-150g)?	≥3		X
How many times per week do you consume commercial sweets or pastries?	<3		X
How much wine do you drink per week?	≥7		X
How many servings of nuts do you consume per week (1 serving: 30g)?	≥3		
Do you preferentially consume chicken, turkey or rabbit meat instead of veal, pork, hamburger or sausage?	Yes	X	X
How many times per week do you eat dishes seasoned with sofrito?	≥2		
How many servings of legumes do you consume per week (1 serving: 30g)?	≥3	X	X

X = achieved.

**Annotation key**

Tentative claims

Strong Claims

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Our subject's adherence to the Mediterranean diet was also confirmed using the Modified Mediterranean diet score. More detailed information regarding the scoring system and specific serving portions has been published previously.<sup>34</sup>

A summary of our subject's score is illustrated below. A score is given for each category depending on the degree of adherence to the Mediterranean diet achieved. For example, if your primary wheat consumption is of brown bread/rice you receive a score of 4, if you primarily consume white bread, you receive a score of 0.

**Table 2: Modified Mediterranean Diet Score**

Category	Pre-Diet	During Diet	Maximum Score
<b>Fast-food consumption</b>	4	4	4
<b>Fruit and Vegetables</b>	8	8	8
<b>Sweet Deserts</b>	1	4	4
<b>Primary Fat</b>	0	4	4
<b>Secondary Fat</b>	2	0	2
<b>Fried Food consumption</b>	3	3	4
<b>Bread consumption</b>	0	4	4
<b>Fish consumption</b>	1	3	4
<b>Alcohol Consumption</b>	0	6	6
<b>Fluid with meals</b>	4	4	4
<b>Total</b>	23	40	44

## MEDSCI Research Reports

### Background to this research report

The above research report was written by a student for a laboratory group assignment for a MEDSCI course. There were four members in this student's group who designed the research project and collected the data together before each of them individually wrote up and submitted their own reports. The student who wrote this report was the sole subject of the trial.

### Sections of research report

As this example illustrates, scientific research reports based on experimental work follow a very specific format and often include the following sections: Introduction, Methods, Results, Discussion, Conclusions, and References. Each section is written in a distinct way with variations, for example, in tense usage, hedging devices (through which tentative claims are made), and active and passive voice.

Because there are so many variations in the content of research reports, it is vital that you follow the course guidelines about expectations of the sections to be included, referencing style, formatting and length of each section. You will see that in this example, the first three sections (Introduction, Methods and Results) are of a similar length, whereas the Discussion section is much longer and the Conclusions is very short. Below is a brief overview of each section:

#### *Introduction*

The main purpose of the Introduction is to introduce and highlight the importance of the research topic, provide background to the research, review the relevant literature, identify the gap in the research to be addressed, provide the rationale for the research, and briefly describe the methodology. In addition, Glasman-Deal (2010) observes that at the very end of the Introduction, the writer can announce the findings (p. 23).

#### *Methods*

The Methods section describes and provides details of the procedures that were followed in the study to collect and analyse data.

#### *Results*

The Results section describes what was found or observed in the study. Results are often presented visually in tables or figures and accompanied by explanatory text.

#### *Discussion*

The Discussion is perhaps the most challenging section to write because the writer needs to interpret his/her results in relation to what has already been found in previous studies. This section closely links to the Introduction because it answers the question or responds to the hypothesis that was raised (see the last paragraph of the Introduction to find the research gap and purpose of this study). The Discussion also explains how the research has moved understanding about the research area forward (cf. Bates College, 2011).

#### *Limitations*

As this example shows, the Discussion can also include reference to the limitations of a study, which Glassman-Deal (2010) observes opens up possible avenues for future research. Reference to the limitations of a study can be made in the Methods, Results and Discussion. Identifying the limitations of a study shows that you are able to evaluate your research and see its shortcomings (Glassman-Deal, 2010).

#### *Conclusions*

The Conclusions is the briefest section of the research report. This section gives the writer the opportunity to sum up the main findings and highlight the possibilities of future research.

## Annotation key

Tentative claims

Strong Claims

Transition signals

Specialised vocabulary

### References

The References section follows the Conclusions and comprises a list of all references referred to in the research paper.

### Appendices

It is usual practice to put non-essential information, which provides further clarification of a point, in an Appendix. Placing this information here means that unnecessary space is not used within the body of a paper (Bates College, 2011).

## Distinctive language features of research reports

Research reports have a number of distinctive language features, which are outlined below:

### Pronoun usage

One distinctive feature of research reports is related to the use of pronouns. You will see that in this report the pronoun “our” is used to refer to the subject of the study. The plural pronoun is used in this research report because the study was carried out by a group of students, who each reported on it individually; e.g.,

Our subject was a healthy 20 year old male. (First mention in Methods).

### Parallelism

A further language feature is the use of parallelism, which means that the same grammatical pattern is used in lists or comparisons. The writer skilfully uses parallelism in this report, which makes it easier for the reader to follow the argument; e.g.,

It is therefore not clear whether this shift was mediated by a diminution in sympathetic nerve activity or by an augmentation of parasympathetic activity.

<b>preposition</b>	<b>noun phrase</b>	<b>preposition</b>	<b>noun phrase</b>
by	a diminution	in	sympathetic nerve activity
by	an augmentation	of	parasympathetic activity

## Expressing an opinion or the author’s “voice”

As you can see in the above report, it is possible for the writer to position themselves and express their opinion through their choice of language. Writers can make tentative claims by using “hedging” devices (e.g., perhaps, suggest) or strong claims (e.g., markedly) when they are certain about the point they are making. Further, writers can comment on something interesting (e.g., interestingly, intriguingly) by using adverbs.

### Tentative claims

Tentative claims or “hedging” are made most frequently in the Discussion section of this research report. Frequent use of hedging is made here because the writer needs to interpret the results of his study in light of previous research and he may not be certain of the claim he is making. The writer either uses adverbs (likely, slightly), verbs with a weak meaning (suggest, seem), or modal verbs (could, might, can) or a combination of these to express uncertainty:

An additional reason for the difference might reflect the average age of the participants.

Whilst our drop in heart rate might seem large when this study is considered, there are two important factors to keep in mind.



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Hedging is used less frequently in the other sections of this research report. Indeed, in this paper, there are just two examples of hedging in the Introduction where the writer is interpreting the results of previous studies:

Evidence suggests the Mediterranean diet is capable of inducing this shift.

Perhaps most notable was the difference in the pNN50, with scores of 1.73% and 2.18% in those with low and high adherence to the Mediterranean diet respectively.

There are no examples of hedging in the Methods where the writer is just explaining what they did and one in the Results where the writer is interpreting the findings:

The discrepancy between these two results likely reflects differences in the phase I drop in heart rate which was highly variable both pre-diet and post-diet.

### *Strong claims*

The writer expresses strong opinions or makes strong claims by using adverbs and nouns with a strong meaning. The author does this for a variety of reasons. First, to express contrast:

This is markedly different from the Western diet predominant in countries such as New Zealand which is characterized by high levels of saturated fats and simple carbohydrates.

Second to express the gap in the research (in the Introduction):

Whilst a number of studies have examined the impact of long term adherence to the Mediterranean diet on autonomic function, there is a paucity of data with respect to the immediate consequences of such a dietary intervention.

### *Another way to express the writer's voice*

It is possible for writers to make subjective comments when describing the results by using words (e.g., obvious[ly], surprising[ly]) and phrases (e.g., in particular, in principle). In this report, the writer skilfully uses adverbs to make subjective comments in the Discussion:

Interestingly, heightened levels of docosahexaenoic acid (DHA) have been shown to significantly reduce the response of the forearm vasculature to heightened sympathetic norepinephrine release.

Intriguingly, the shift in our subject's autonomic reactivity following dietary intervention appeared to be stimulus dependent.

## Developing a coherent argument

An important feature of a well-written research report is that it is coherent and well-structured. A variety of strategies can be used to ensure that the ideas are logically connected to one-another. One is to use "transition signals" such as indeed, furthermore, additionally, and therefore:

Additionally, high heart rates and hypertension have both been associated with increased cardiovascular mortality. Therefore, identifying mechanisms by which to improve cardiac autonomic control is essential. (Introduction)

Another is to use a pronoun such as "it", "this" or "these". If using a pronoun, however, check that the meaning is clear as in the following example where the pronoun "It" clearly represents "Mediterranean diet":

The term 'Mediterranean diet' refers to the nutritional habits that permeated Crete, Greece and Southern Italy during the early 1960s<sup>3</sup>. It is characterized by the high consumption of monounsaturated fat rich olive oil, omega 3 fatty acid rich fish, fruit, vegetables, brown rice and bread, the moderate consumption of

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alcohol and the low consumption of dairy products, red meat and processed foods. (Introduction)

Otherwise, if the meaning of the pronoun is not clear, it is preferable to repeat the noun or use a synonym or a noun phrase, as shown in this example:

Average heart rate values were determined for 30 seconds pre-dive, 0-15 seconds during the dive, 15-30 seconds during the dive, and the 30 seconds post-dive. These values were then compared to assess the magnitude and speed of the response.

A further way of ensuring that the ideas connect from one to another is to use the exact wording of a phrase from one sentence to begin the next sentence:

Long-term adherence to the Mediterranean diet has also been associated with improved autonomic reactivity. Autonomic reactivity refers to the extent to which an individual responds to different stimuli such as a fall in blood pressure.

While this can be an effective way to link ideas together, be careful not to overuse it.

## Specialised vocabulary

Another feature of well-written research reports is that specialised vocabulary is correctly used; e.g., "cardiovascular". According to the Oxford Advanced Learners Dictionary this word is an adjective which means "connected with the heart and the blood vessels". To use specialised vocabulary well, it is important to use the word's correct form and use the word in an appropriate collocation; that is, with words that frequently combine together; (e.g., 'cardiovascular disease' NOT 'cardiovascular situation' or 'cardiovascular illness'). Given the importance of correctly using specialised vocabulary, you may find it useful to build a glossary and focus on learning these words so that you are familiar with their meaning, the words they collocate with, and the various forms of the word.

## Verb usage

Research reports are characterised by frequent shifts in tense (past, present), aspect (perfect and simple and very occasionally progressive) and voice (active and passive). Detailed analysis of verb usage can be found in the annotated comments in the body of the paper. A few general comments are given here.

### Verb tenses

#### Introduction

The present tense is predominantly used in the Introduction, and the past tense is used less frequently. The present tense is used, for example, to:

- (1) define terminology:  
The term 'Mediterranean diet' refers to the nutritional habits that permeated Crete, Greece and Southern Italy during the early 1960s.
- (2) present well-established facts  
Poor autonomic function is a well-established risk factor for cardiovascular disease.
- (3) express the gap in the research:  
Whilst a number of studies have examined the impact of long term adherence to the Mediterranean diet on autonomic function, there is a paucity of data with respect to the immediate consequences of such a dietary intervention.

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In contrast, the past tense is used to report results from previous studies; e.g.,

Indeed, the PREDIMED study found that the consumption of a Mediterranean diet reduced the relative risk of individuals suffering a major cardiovascular event (e.g. stroke, myocardial infarction) by 30%.

### Methodology

The past tense is used throughout the methodology section. This tense is used to signal that something took place in the past; e.g.,

Resting blood pressure values were recorded using a sphygmomanometer.

Our subject was a healthy 20 year old male. The subject obtained nutritional information made available through the PREDIMED trial website to assist with dietary manipulation.

### Results

The past tense dominates the results section as the writer presents the results of the study; e.g.,

There was a 6.98bpm and a 7.75bpm increase in heart rate pre-diet and post-diet respectively.

The present tense is used to refer the reader to Tables and Appendices:

The average increase in heart rate in response to the 5 minute mental stress challenge was not notably different following dietary intervention as is illustrated in Figure 1.

A summary is given in Table 1.

The present tense is also used to present acknowledged facts:

The PREDIMED Diet Score has a maximum score of 14. The Modified Mediterranean Diet Score (mMDS) has a maximum score of 44.

### Discussion

There are frequent switches between the present and past tense in the Discussion. Reference to the present tense is used, for instance, in the interpretation of the results; e.g.,

Our drop in systolic blood pressure is more pronounced than expected although not entirely without present.

Reference to the past tense is made, for example, when referring to the Results of the current or past studies; e.g.,

The Mediterranean diet resulted in a shift to a more parasympathetic-dominated autonomic tone in our subject.

Results from the PREDIMED trial revealed that one year following dietary intervention, the average systolic blood pressure of participants on average dropped by 1-3mmHG.

### Conclusions

The Conclusions switches between the simple past to the simple present:

The past tense is used when describing the overall results of the study:

However, the impact on autonomic reactivity was inconclusive with a range of conflicting results.

The present tense is used when describing the possibilities for future research:

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Results from our study highlight the need for more Mediterranean diet-based studies to be performed in populations with a baseline Western diet.

### Aspect

Frequent switches from the simple to perfective aspect are made particularly in the Introduction and somewhat in the Discussion and minimally, if at all, in the other sections. The present perfect is used when the action that took place in the past is still of relevance now; e.g.,

Adherence to a Mediterranean diet has been associated with a reduction in the relevance of the cardiovascular disease. (Introduction)

The past perfect is used less frequently. Here it appears in the Methods to compare a questionnaire from a study undertaken in the past with other questionnaires used in the past:

A 14-item questionnaire used in the PREDIMED trial was used because it had shown a strong correlation with longer, more time consuming questionnaires traditionally used.

The progressive aspect is only used once in the research report to emphasise the continuous process of using tests to collect data:

Another limitation was that a number of the tests we were using to assess autonomic activity, whilst are commonly used in the clinic to assess a range of conditions, have not previously been used to assess the impact of the Mediterranean diet on autonomic function.

### Active and passive voice

A distinct feature of research reports is related to the use of active and passive voice. The passive voice is used much more in research reports than in essays. The writer chooses whether to use the active or passive voice depending on what is being said and where the focus is to be.

When the active voice is used, the subject of the sentence is the *doer* or *performer* of the action, and the object is the *receiver* of the action. The active voice is used in the following example from the Introduction because the writer wants to highlight the name of the study being referred to:

SUBJECT

VERB    OBJECT

Results from the Twin Hearts Study showed a significant positive association between Mediterranean diet consumption and heart rate variability (HRV).

In contrast, the passive voice enables the writer to focus on the *result* of the action rather than on *who* did it:

Furthermore, a number of trials have indicated that the Mediterranean diet is associated with a 30-70% reduction in the recurrence of cardiovascular events following myocardial infarction or stroke. <sup>2</sup>

You can see that the past passive is predominantly used in the Methods section because it is used to report a particular procedure that is finished and the focus is on the result of the action rather than on who carried it out:

Resting blood pressure values were recorded using a sphygmomanometer.

### Reduced relative clauses

A further feature of scientific research reports is the multiple use of reduced relative clauses especially in the Methods, Results and Discussion. Use of such clauses helps make the writing concise. Reduced relative clauses are in the passive voice and should not be confused with the simple past tense as this example illustrates:

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However, there was substantial overlap in the heart rate [that was] recorded during the second 15 seconds between the pre-diet and post-diet trials.

The verb "recorded" in the above example is a non-finite *-ed* participle.

In contrast, if this sentence had been written in the active voice, the verb "recorded" would be in the past tense:

The researchers recorded substantial overlap in the heart rate during the second 15 seconds between the pre-diet and post-diet trials.

Writing the above sentence in the active voice, however, would have placed unnecessary focus on those carrying out the action: the researchers.

## References

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