Title: Determination of Islamic Month Start by Moonsighting Australia (Case Study: 1 Dzulhijah 1441)

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Determination of Islamic Month Start by Moonsighting Australia
(Case Study: 1 Dzulhijjah 1441)

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Abstract
The determination of the Islamic calendar is paramount in Islam because it strongly relates to worship, like Ramadan fasting, eid-al-fitr, and zakat fitr. Many studies have examined young moon visibility criteria in many Muslim countries, such as Indonesia, Saudi Arabia, Thailand, and Singapore. However, no study on the initiation of the Islamic month has been conducted in Australia, a Muslim-minority country with middle-eastern immigrants seeking jobs. One of Australia's most trusted organizations to announce the start of Hijri month is Moonsighting Australia. Therefore, this study aimed to analyze the determination of the Islamic calendar by Moonsighting Australia organization based on factors such as method, matla, rukyat time, hilāl visibility, and resistors (1 Dzulhijjah 1441 H). A descriptive study with a qualitative approach used literature reviews, content analysis, and case studies. Primary data were taken from a decision letter from Moonsighting Australia about the start of Dzulhijjah 1441 H, interviews with the coordinator, and relevant references. The findings showed that Moonsighting Australia applies a rukyat method by the naked eye - without any optical aids and hilāl visibility criteria consideration - every 29th of Hijri month. Also, it tunes the concept of matla wilayat al hukmi, where the sighting process and result are implemented throughout Australia’s territory.

Keywords: Australia, Dzulhijjah, Hijri, Islamic Month, Moonsighting.

Introduction
In the past few years, Islamic communities worldwide have increased since being introduced and disseminated by Prophet Muhammad (SAW) The Muslim population is estimated at 1.6 M adherents, becoming the second-biggest religion. It has been distributed worldwide, especially from central to northern Africa, middle-east area, and south-east Asia. Muslim communities account for 90% of Egypt, Afghanistan, Syria, Pakistan, Turkey, and Iran. Indonesia has 231 Muslims, accounting for 13% of the community’s population worldwide. Figure 1 describes the distribution of Muslims worldwide.

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Muslim communities are united by a sentence *la ilaha illallah muhammadur Rasulullah*, meaning “The only god is Allah and Muhammad (SAW) is Allah’s prophet.” They are committed to applying Islamic laws in each aspect of their life. The basic obligations include conducting five daily prayers, paying *zakat*, fasting in the month of *Ramadan*, and performing the pilgrimage. Moreover, Muslims perform *Sunnah*, which entails *rawatib*, almsgiving, or *umrah*.

Islam obligates the only validity of worship performed with sincere intentions to Allah and according to the guidance from the Prophet Muhammad (SAW). Therefore, every worship has rules related to the procedure, time, and place of implementation. The worship is considered wrong when the procedure is correct while other aspects are inaccurate. Similarly, worship implemented on time and in the correct place is refused when it does not follow the guidance from the Prophet Muhammad (SAW).

Worship is considered valid based on the determination of the start of the Islamic month. The fasting of *Ramadan*, *eid-al-fitr*, *Arafa*, and *zakat*, *fitr* are all examples of specified time-dependent worships. Performing *Ramadan* fasting on the 30th of *Sha'ban* is not warrantable. Also, fasting on the 1st of *Shawwal* and praying *eid-al-fitr* on the 30th of *Ramadan* is not permissible. Similarly, *Zakat-al-fitr* paid outside the month of *Ramadan* or after praying *eid-al-fitr* is only considered almsgiving.

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5Abu Muhammad Mahmud bin Ahmad bin Musa Badruddin Al-Aini, *Syarah Sunan Abu Dawud (The Explanation of Sunan Abū Dāwūd)* (Riyadh: Maktubah Rasyd, n.d.); Abu Abdullah Muhammad
Studies have examined the urgency to determine the beginning of the Islamic month, which is indicated by the appearance of hilāl. In this case, hilāl is the first crescent moon that appears after the ijtima, the geometric conjunction between the earth and the moon at the same celestial longitude, viewed from the earth. Therefore, the hilāl visibility criteria have been the study object by scientists. In 1910, a preliminary study about hilāl visibility criteria was released in a reputed international journal. Subsequently, scientific publications on the same topic emerged written by Ilyas, Odeh, Sultan, Ahmed etc.

The determination and implementation of the start of the Islamic month's uses different methods and criteria. The decisions of Muslim-majority countries such as Saudi Arabia, Turkey, and Indonesia are officially managed by the government. In contrast, minority countries are established by local Islamic organizations such as Thailand and Singapore.

Australia is one of the countries with a significant number of Muslims, reaching 604,200 or 2.6% of its population. Although it seems as a minority, Islam is the second biggest religion in Australia after Christianity. The outset of contact with Islam occurred around 1750 when fishers from


South Sulawesi, Indonesia, interacted with Australian residents in the North. This was followed by the appearance of Afghanistan immigrants that settled in Australia.\textsuperscript{15}

Hundreds of thousands of Muslims living in Australia are bounded by \textit{sharī‘ah} obligations, such as the urgency of determining the beginning of Islamic month in the worship practice. However, there is no study on the \textit{hijri} month determination. Therefore, the close distance between Australia and Muslim-majority Countries (Indonesia, Malaysia, and Brunei), as well as the Middle-East immigrants' existence, makes it a more vital and appealing topic.

As a Muslim minority country, determining the beginning of the Islamic month is not facilitated by Australia. However, it is announced by the local Islamic organizations. A previous study found that the two Islamic organizations trusted to determine the Islamic month start are \textit{Moonsighting Australia} and \textit{Australian National Imam Council}.\textsuperscript{16} This study only focused on the \textit{Moonsighting Australia} organization. It aimed to analyze the determination of the Islamic calendar by \textit{Moonsighting Australia} organization based on the method, \textit{matla\textunderscore rukyat}, \textit{hilal} visibility, and resistors (1 Dzulhijjah 1441 H).

\section{Methodology}

This descriptive study represented the phenomena and characterization\textsuperscript{17} using a quantitative approach to library research, content analysis, and case studies. The library research used literature resources to obtain data,\textsuperscript{18} while the content analysis involved a systematic explanation of quantitative data.\textsuperscript{19} Furthermore, the case study was used to develop a hypothesis for further exploration.\textsuperscript{20}

Primary data were obtained from a decree determining 1 Dzulhijjah 1441 H issued by \textit{Moonsighting Australia}\textsuperscript{21} and interviews with the \textit{Moonsighting Australia} organization coordinator. The study also collected some \textit{hilāl} and computed them using software based on accurate times.\textsuperscript{22} Moreover, secondary data were obtained from national and international books, websites, and previous works through documentation and analysis of relevant questions to theory. The data collected were analyzed by a comparative approach.\textsuperscript{23}

\textsuperscript{15}Riaz Hassan, \textit{Australian Muslims: The Challenge of Islamophobia and Social Distance} (International Centre for Muslim and non-Muslim Understanding, University of South Australia, 2018).
\textsuperscript{19}Margrit Schreier, \textit{Qualitative Content Analysis in Practice} (Sage publications, 2012).
\textsuperscript{20}Robert K Yin, \textit{Applications of Case Study Research} (Sage, 2011).
\textsuperscript{21}Moonsigthing Australia, “Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020,” Moonsigthing Australia, 2020, https://moonsightingaustralia.info/2020/07/.
\textsuperscript{23}Patrick A. Mello, \textit{Qualitative Comparative Analysis: An Introduction to Research Design and Application} (Georgetown University Press, 2021).
3. The Moonsighting Australia

The official website of Moonsighting Australia indicates that this organization’s establishment was driven by a worry about the irregular practice of the Islamic calendar and society’s misperceptions regarding astronomical calculations. The beginning of the hijri month was determined before the conjunction, impacting Eid-al-Fitr and Eid-al-Adha.

In 1996, the first congress among representative clerics from Australian states was held in Rooty Hill Mosque, Sydney. After a long discussion, a Moonsighting Australia organization was formed, chaired by Dr Shabbir Ahmad. More than 50 clerics from various states and territories of Australia joined the organization a year after. In 2018, over 100 clerics from the entire territories of Australia joined the organization.

Moonsighting Australia is supported by the members of the Australian Ulema Council, such as Maulana Ridwan Rafi, Maulana Shamim, Mufti Naem Ali, Sheikh Abdul Moez Nafti, Sheikh Fadi Baba, Mufti Amjad Iqbal, and Maulana Mohammed Amin. Other members are Maulana Dr. Abdul Karim, Sheikh Tariq, Maulana Hafiz Gulam Ali, Mufti Muneeb, Maulana Imran Hussain, Maulana Shahzad Khan, Maulana Uzair Akbar, and Sheikh Burhan. Furthermore, the organization is supported by Australian National Imams Council (ANIC), and some became members. The organization is the most trustworthy resource for information about Rukyatul Hilāl in Australia. It comprises more than 100 imams, mosques, and Islamic Centers in Australia.

4. Analysis of Determining the start of Dzulhijjah 1442 H by Moonsighting Australia

4.1 Analysis Method

The beginning of the Islamic month could be determined through observation (rukyat) and calculation (hisāb). The rukyat method involves observing the crescent directly on the 29th day (30th night) of the Hijri month. When the hilāl is visible, it means the next month has started, but it is summed up to 30 days when the hilāl fails to appear, and a new month starts on the next night. The hisāb method determines certain astronomical criteria to stipulate the beginning of a hijri month without observing the hilāl. The night is declared the start of the next month when the astronomical criteria are fulfilled by the 29th day (30th night). The failure to meet the criteria means the next month is declared to start on the next night, and a month is summed up to 30 days.

The rukyat method also entails observing a new moon or hilāl at the end of Shaban and Ramadan month by testimony and report of two righteous people to the judge. This definition covers three aspects. First, the visible hilāl after the sunset of the 29th of Sha’ban and Ramadan is used to determine the beginning of Ramadan and Shawwal. Second, one or two righteous people must witness the hilāl. Third, they must report their observation to the judge. Rohmah stated that the rukyatul hilāl is performed in conjunction with the moon, earth, and sunset.

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24 Australia, “Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020.”
28 Nihayatur Rohmah, “Ijtimak Sebagai Prasarat Pergantian Bulan Baru Dalam Kalender Hijriyah: Studi Analisis Ijtimak Awal Bulan Syawwal 1441 H) (Ijtima’ as a Prerequisite for the New
Verse 185 in Qur’ān, Al-Baqarah is the basis of the *rukyatul hilāl* application, where a person must fast the following day after observing the *hilāl*. Due to the existence of the word “shahida,” which means “witness,” Ibn Kathīr concluded this verse to command the *rukyatul hilāl* application for determining the beginning of *hijri* month. Moreover, *hadīth* from Prophet (SAW) give directions on this method application on determining the beginning of Ramadan and Shawwal. The Prophet Muhammad (SAW) said,

لا تصوموا حتی ترُوَّوا البَلَّانَ ولا تَطْرِبوا حتی ترُوَّوا فإنُّ غم عليكم فَأَكْمِلوا العدَّة ثلاثين

Means: “Do not fast until you see the new moon. Do not break your fast until you see the new moon. If the new moon is covered by a cloud, then complete the month to thirty days.”

These *hadīths* direct young moon observation for deciding the first of Ramadan and Shawwal. They were applied by Imam Shafi’i to command righteous people to apply *rukyatul hilāl* and determine the beginning of Ramadan and Zulhiijjah.

*Hisāb* is another method for establishing the start of an Islamic month. Abu Sabda transcribed *hisāb* linguistically as a method of calculating the visibility of *the hilāl*. When the *hisab* criteria are fulfilled on the 29th day, that night is the first of the new Islamic month. However, the current month is summed up to 30 days and the next month begins on the next night when the criteria are not met.

There are several well-known calculation methods, such as Úrfi *hisāb*, hakiki *hisāb*, and contemporary *hisāb* methods. Sabda redefined Úrfi *hisāb* as the calculation of the beginning of the month based on its age or habit basis. This method involves taking the average time of the moon to revolve around the earth. The Contemporary *hisab* is the calculation of the sky objects based on the actual motion. In its application, some people used the actual calculation while others calculated the average motion. Hakiki *hisāb* is the calculation of the positions of the sky objects depending on their actual motion and thousands of correction terms for a more accurate result.

Some scholars supported the application of *hisāb* due to its higher accuracy in determining the start of the Islamic month. It is based on Qur’ān chapter Yusuf verse 5 about *manzilahs* that Allah has created and chapter Ar-Rahman verse 5 about calculating the moon and the sun's cycle. *Hisāb* is also based on *hadīth*, where the Prophet (SAW) discussed the *ummi*, referring to people that could not read or write. The Prophet Muhammad (SAW) said,

إِنَّا أَمِينَةٌ، لَا نَكُلْبُ وَلَا نَخَسْبُ، الشَّهْرُ هكذا هكذا

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Moon in the Hijri Calendar: Ijtima’ Analysis Study at the Beginning of Shawwal 1441 H),” *AL-MIKRAJ: Jurnal Studi Islam Dan Humaniora* (E-ISSN: 2745-4584) 1, no. 1 (2020): 78-87.


31 *Ṣaḥīḥ al-Buḵhārī*, 2/674: 1807.


33 A. Sabda, *Ilmu Falak, Rumusan Syar’i Dan Astronomi* [Astronomy, Shar’i Formulation], 2nd ed. (Bandung: Persis Pers, 2019).

34 Arifin, “Fiqih Hisab Rukyah Di Indonesia: Telaah Sistem Penetapan Awal Bulan Qamariyyah,” [Fiqih Hisab Rukyah in Indonesia: Study the System of Determining the Beginning of the Qamariyyah Month].


36 Ibid.
Means: “Indeed, we are the ummiyah people. We do not know the kitābah (writing) nor do we know reckoning (hisāb). The month is like this (he signifies with the number 29) and like this (he signifies with the number 30).”

Consequently, some hadiths scholars supported the calculation method and adopted rukyatul hilāl due to society’s inability to calculate the celestial motion. The decree for determining the 1st of Dzulhijjah 1441 H by the Moonsighting Australia organization states that on July 21st, 2020, hilāl was not visible in Australia. Therefore, following the guidance of the Prophet Muhammad (SAW), the 1st of Dzulhijjah would start on July 23rd, 2020, and Eid-al-Adha would fall on August 1st, 2020.

Moonsighting Australia, the rukyatul hilāl method in determining 1st of Dzulhijjah is based on the visibility of the first crescent. This decision was taken because of the unseen hilal, meaning Zulkaedah was completed in 30 days, and the 1st of Dzulhijjah fell on the next night on July 23rd, 2020.

4.2 Matla Analysis

Analysis of Moonsighting Australia's decree on determining the 1st of Dzulhijjah illustrates the matla concept believed by the organization. Maṭlā’ hilāl is placed in certain areas to observe the visibility of hilal on the horizon after sunset to start the beginning of the Islamic month. This concept is the basis of the availability of Islamic month determination.

Matla’s scope is the observer’s eastern area determined from the calculation of the earth’s rotational speed, the moon’s evolution around the earth, and the sun’s apparent speed around the earth per year. The higher the crescent moon, the farther the matla boundary is to the east of the observer. According to Fiqh, Matla’s scope has four perspectives, including the difference of 1) 88,704-kilometers distance; 2) climate; 3) matla hilal; 4) wilayat al hukmi, implying rukyatul hilal based on the country’s territory.

The Matla’s scope used by Moonsighting Australia organization is the fourth in Fiqh perspective of wilayat al hukmi. The process and result of rukyatul hilāl are only used in Australian territory. Although Indonesia, which is only 488 km from outer Christmas Island in Australia, views the hilāl, the result cannot be applied to determine the beginning of Dzulhijjah in Australia. Hilāl's rising location is different between Perth and Sydney. At a distance of 3,290.45 km, Perth successfully sights the hilal, but the result legitimizes Sydney and Australia to start fasting in Ramadhan.

Akhyar stated that rukyat has global and local methods. The Global method determined the start of the Islamic month based on sighted hilal in a certain place and applied worldwide. The local
rukyat is based on moon visibility in a certain place and only applied on that territory (the Matla’s scope).\textsuperscript{43}

The Moonsighting Australia organization’s determination is based only on the sighted hilāl in Australia. It does not consider sighted hilāl in other countries such as Indonesia through https://www.instagram.com/p/CC5tj8hMa8p/. Therefore, Moonsighting Australia organization applies the local rukyat.\textsuperscript{44}

4.3 Rukyat Time Analysis

The Prophet (SAW) stated that a month has 29 or 30 days. When hilāl is seen on the 29th day, the next month starts on that night, or otherwise summed up to 30 days.\textsuperscript{45} Therefore, rukyatul hilāl is always conducted on the 29th day of the hijri month. Based on the decree, rukyatul hilāl was conducted on Monday, July 21st 2020, because the Moonsighting Australia organization believed that day was Zulqada 29th, 1441H. The accurate times software showed that the conjunction occurred at 03:31 Australian time (Sydney) on that day.

Assuming Zulqada 29th 1441H was on July 21st 2020, then the Zulqaada 1st 1441H determined by the Moonsighting Australia organization fell on June 23rd 2020. This was consistent with the decree by the organization about Zulqaada 1st 1441H determination written on its website.\textsuperscript{46} Its observation on June 22nd 2020, for determining the beginning of Zulqaada 1441H could be assumed to be Shawwal 29th 1441H. This was consistent with the determination of Shawwal 1st 1441H, which fell on May 23rd 2020.\textsuperscript{47}

The accurate times software application showed that the conjunction happened on June 21st 2020, at 16.41 Australian time for the month of Zulqaada. This means conjunction was not a benchmark for applying rukyatul hilāl because the observation was done one day later. The finding confirms Moonsighting Australia’s choice of the rukyatul hilāl method.

It is important to investigate whether rukyatul hilāl implementation timing is practised every month. Islamic organizations apply different methods to determine the beginning of the hijri months. For instance, the government of Brunei Darussalam only implemented rukyatul hilāl.\textsuperscript{48} Others use the hisab technique as implemented by the Islamic Society of North America (ISNA).\textsuperscript{49} Moreover, some organizations combine both methods, such as those implemented by Indonesia. The start of

Based on the Position of the Sun and Moon Using the Meeus Algorithm)” (Universitas Gadjah Mada, 2015).

\textsuperscript{43}Ibid.

\textsuperscript{44}Lapan Kupang, “Pengamatian Hilal Awal Dzulhijjah 1441 H/21 Juli 2020 (Early Hilal Observation Dzulhijjah 1441 H/21 July 2020),” 2020, https://www.instagram.com/p/CC5tj8hMa8p/.


\textsuperscript{46}Australia, “Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020.”


\textsuperscript{48}Hanapi and Hassan, “Basis for Using the Rukyah Method for Determining the Arrival of Ramadan and Syawal in Brunei Darussalam.”

months regarding eminent worship of Muslims, including Ramadan, Shawwal, and Zulhijjah, is determined by rukyatul hilāl. Other months are established by hisab through MABIMS criteria.

The ending of Zulhijjah’s decree announced by the Moonsighting Australia organization has information about the beginning of other hijri months on its official website https://Moonsighting australia.info. This site provides a list of openings of hijri month’s determination since June 2016 and is updated every month. As a result, Moonsighting Australia continuously implemented rukyatul hilāl on the determination of every hijri month. This matter is also strengthened in the book of Policy and Procedures: Hilāl Sighting and Decisions, that the start of every Islamic month must be determined by rukyatul hilāl, not only on Ramadan, Shawwal, and Dzulhijjah.

4.4 Hilāl Visibility Analysis

The following parameters could be used as hilal visibility criteria according to Odeh: Furthermore, ARV-ARCL-DAZ geometry is depicted in Figure 2.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moon age (age)</td>
<td>The time interval between conjunction and observation</td>
</tr>
<tr>
<td>lag time (Lag)</td>
<td>The time interval between the setting and rising of the sun and the moon</td>
</tr>
<tr>
<td>Altitude (Alt)</td>
<td>The angular distance between the moon and the horizon</td>
</tr>
<tr>
<td>Elongation (ARCL)</td>
<td>Arc distance between the sun and the moon</td>
</tr>
<tr>
<td>Arc of vision (ARCV)</td>
<td>Relative altitude between the sun and the moon</td>
</tr>
<tr>
<td>Relative azimuth (DAZ)</td>
<td>Relative azimuth difference between the sun and the moon</td>
</tr>
<tr>
<td>width (W)</td>
<td>Width of the lighted area along the moon’s diameter</td>
</tr>
</tbody>
</table>

Figure 2. Fundamental geometry variable to predict hilal visibility

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50 Wahidi et al., “Implementation of the Mabims Criteria in Determining the Beginning of Islamic Month in Indonesia and Brunei Darussalam.”


52 Odeh, “New Criterion for Lunar Crescent Visibility.”
Odeh has collected around 737 hilāl observations worldwide from his studies and by Schaefer, Doggett and Schaefer, and the SAAO list.\textsuperscript{53} Data were also obtained by private communication with Jim Stamm, Mohsen Mirsaeed, and Alireza Mehrani. Based on those results, hilāl visibility was formulated based on the topocentric altitude difference between the sun and moon (ARCV) and the topocentric hilāl width (W). The best time calculation was considered to implement rukyatul hilāl ($T_b$), where $T_b$ is the function for the setting time of the sun ($T_s$) and moon lag time (lag)\textsuperscript{54}:

$$T_b = T_s + \frac{4}{9} \text{Lag (1)}$$

Hilāl’s observable areas are divided into three zones.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Comparison</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$ARCV \geq ARCV3$</td>
<td>visible by naked eyes</td>
</tr>
<tr>
<td>B</td>
<td>$ARCV \geq ARCV2$</td>
<td>visible by naked eyes/optical aid</td>
</tr>
<tr>
<td>C</td>
<td>$ARCV \geq ARCV1$</td>
<td>visible by optic aid</td>
</tr>
</tbody>
</table>

The parameters are illustrated in Table 3.

Table 2. Classification of Hilal Visibility Zones by Odeh \textsuperscript{55}

<table>
<thead>
<tr>
<th>Zone</th>
<th>Comparison</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>C</td>
<td>$ARCV \geq ARCV1$</td>
<td>visible by optic aid</td>
</tr>
</tbody>
</table>

This study applied accurate times software to calculate the astronomical data of the sun and moon in Australia on the observation day. Five geographic representation cities were selected, including north, south, east, west, and central, as well as Sydney as the capital. Table 4 shows the Arch of vision (ARCV) and width of hilal compared with Odeh’s visibility criterion.

Table 4. Comparison of ARCV and W Data with Odeh’s Criteria

<table>
<thead>
<tr>
<th>City</th>
<th>Longitude</th>
<th>Description</th>
<th>Latitude</th>
<th>ARCV</th>
<th>W</th>
<th>Odeh’s Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>151:11:00</td>
<td>Capital City</td>
<td>33:57:00</td>
<td>+04°:31’:18’ (04.5°)</td>
<td>+00°:00’:08’ (0.13’)</td>
<td>ineligible</td>
</tr>
</tbody>
</table>


\textsuperscript{55}Odeh, “New Criterion for Lunar Crescent Visibility.”
<table>
<thead>
<tr>
<th>City</th>
<th>Longitude</th>
<th>Description</th>
<th>Latitude</th>
<th>ARCV</th>
<th>W</th>
<th>Odeh’s Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darwin</td>
<td>130:52:00</td>
<td>North</td>
<td>12:25:00</td>
<td>+07°:30:20”</td>
<td>+00°:00:10”</td>
<td>Zone C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(07.5°)</td>
<td>(0.16’)</td>
<td></td>
</tr>
<tr>
<td>Adelaide</td>
<td>138:32:00</td>
<td>South</td>
<td>34:57:00</td>
<td>+04°:48:19”</td>
<td>+00°:00:09”</td>
<td>ineligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(04.8°)</td>
<td>(0.15’)</td>
<td></td>
</tr>
<tr>
<td>Brisbane</td>
<td>152:59:34.9</td>
<td>East</td>
<td>27:19:29.7</td>
<td>+05°:16:28”</td>
<td>+00°:00:08”</td>
<td>ineligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(05.3°)</td>
<td>(0.13’)</td>
<td></td>
</tr>
<tr>
<td>Perth</td>
<td>115:58:00</td>
<td>West</td>
<td>31:56:00</td>
<td>+05°:58:32”</td>
<td>+00°:00:11”</td>
<td>Zone C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(06.0°)</td>
<td>(0.18’)</td>
<td></td>
</tr>
<tr>
<td>Alice</td>
<td>133:53:00</td>
<td>Central</td>
<td>23:48:00</td>
<td>+06°:20:41”</td>
<td>+00°:00:09”</td>
<td>Zone C</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
<td></td>
<td>(06.3°)</td>
<td>(0.16’)</td>
<td></td>
</tr>
</tbody>
</table>

Three of seven *hilal* counted cities qualified with Odeh’s criterion for Zone C, including Alice Spring, Perth, and Darwin. Zone C is where the height of the *hilal* is low and only visible using optic aid. Table 4 shows the moon’s altitude in three areas is between 6-7.5 degrees.

Based on Odeh’s *hilal* visibility calculation, the crescent should be seen in the north, west, and central areas, but *Moonsighting Australia* announced otherwise. Some cities represent every state and geographic area of Australia, including Alice Springs, Darwin, Adelaide, Brisbane, and Sydney. This finding reasserts *Moonsighting Australia*’s position to use the observation method regardless of crescent visibility criteria.

### 4.5 Hilal Visibility Resistor Analysis

Some factors could resist the visibility of *hilāl*, becoming a multi-discipline problem concerning astronomy, meteorology, physiology, and optic.\(^{56}\)

#### 4.5.1 Observer Physiology Analysis

Physiology is a part of biology related to the functions of life support, organism process, and its parts.\(^{57}\) Regarding *hilal* observation, observer physiology relates to their vision of *rukyatul hilāl*. Ahmed and Halim stated that the physiology variable of vision contributes to the observing result’s difference.\(^{58}\) Observer’s quality is included in subjective error because *hilāl* observing is a physical and physiological process. The beam of *hilal* illumination arriving at an observer’s eyes is transferred to the brain, which continues a perception process from the object received by the human eye depending on prior knowledge and *hilāl* experience. Therefore, observing experience, theory, and

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\(^{58}\) Ahmed and Aziz, “Young Moon Visibility Criterion Based on Crescent Illumination and Sky Brightness Contrast Model.”
perception impact hilal visibility outcomes. In this context, high observation quality is obligatory to get an effective and objective result.\textsuperscript{59}

Considering this institution's track record of observing hilal since 1996, it is impossible for the observer's physiology to cause unseen hilal. Moreover, reports on unseen hilal came from all areas in Australia and were written on the announcement declared by Moonsighting Australia.\textsuperscript{60}

### 4.5.2 Meteorology Analysis

Meteorology is the most popular knowledge for discussing weather and climate.\textsuperscript{61} Its effect could also become one of the hilal visibility resistor factors. Consequently, the earth cycles around the sun, producing four subtropics seasons. The northern hemisphere witnesses the summer season from December to February and the fall season from March to May. Winter and spring seasons occur from June until August and September until November, respectively.\textsuperscript{62}

On 29\textsuperscript{th} July 2020, the rukyatul hilal was conducted in Australia, which coincided with the winter. Most parts of Australia were foggy, frozen, or even snowed.\textsuperscript{63} The natural conditions caused difficulties in monitoring the new moon in most parts of Australia. Therefore, one major inhibiting factor for the crescent visibility in Australia for Dzulhijjah 1441H was the climatic conditions caused by the winter season.

The only dry area in the winter season is the northern region, such as Darwin.\textsuperscript{64} July is characterized by high temperatures between 19.3 – 30.6 degrees Celsius. Humidity is also the lowest throughout the year, at 37\%, accompanied by the lowest rainfall. During the day, the average sunshine is 10.1 hours.\textsuperscript{65} These conditions are ideal for monitoring the new moon, but Darwin et al. does not report moon sightings.\textsuperscript{66}

### 4.5.3 Optic Device Analysis

The optical devices commonly utilized to observe the new moon are cameras and telescopes.\textsuperscript{67} This section analyzes the optical instruments used by Australian Moonsighting observers. The analysis started by checking the book Policy and Procedures: Hilāl Sighting and Decisions, published by Moonsighting Australia. The book confirms that a valid rukyat report is observed with the naked eye without optic aid.\textsuperscript{68} This finding supports the statement by the Moonsighting Australia


\textsuperscript{60}Australia, “Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020.”

\textsuperscript{61}Steven Ackerman, and John Knox, Meteorology (Jones and Bartlett Publishers, 2011).


\textsuperscript{64}Australia.com, “Australia’s Seasons.”


\textsuperscript{66}Australia, “Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020.”


\textsuperscript{68}Australia, “Policy and Procedures: Hilāl Sighting and Decisions.”
coordinator, Dr Shabbir, that hilal observing must be consistent with the practice done by Rasulullah (SAW) without optic aid.\textsuperscript{69} Therefore, the Moonsighting Australia observation is performed by the naked eye only. This is different from Brunei, Nigeria, and Indonesia,\textsuperscript{70} which permits the use of optic aid. However, the method used by Moonsighting Australia is in line with Thailand's application in deciding on Ramadhan and Shawwal. Rukyatul hilāl is only observed by the naked eye regardless of visibility criteria.\textsuperscript{71}

This finding requires further analysis, as the previous discussion showed that Alice Spring, Perth, and Darwin meet the Odeh criteria for hilal visibility using optical aid. It means that hilāl is invisible in Australia because Moonsighting Australia does not use optical instruments. This is confirmed by a report of hilal observation by the National Institute of Aeronautics and Space (LAPAN) in Kupang City, which used a telescope (Takahashi FSQ-106ED) and an Astronomy camera (QHY 5L-II-M). The areas are located at 123° 34.77' East and 10° 9.88' South, not too far from Darwin. These two cities were only 2-degree latitudes and 829 kilometers apart.\textsuperscript{72} Although the cities are in Zone C of Odeh criteria, they reported two opposing results.

5. Conclusion

This study analyzed the methods, matla, time, hilāl visibility and resistor factors on Zulhijjah 1441 H determination and made the following conclusions:

1. Moonsighting Australia applied the rukyat method with the naked eye without optical aid to determine the first hijrah month.

2. Moonsighting Australia convinced the matla concept of ‘wilayat al hukmi,’ only used in Australian territorial regions.

3. Rukyatul hilāl is performed every 29th of the current month without considering the conjunction time.

4. The criteria of hilal visibility cannot be referenced for consideration at the beginning of the Hijri month.

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